Unit 1: Cell and Sub-Cellular Organelles

Straight MCQs

1. The basic structural and functional unit of all living organisms is the:
(A) tissue (B) **cell** (C) organ (D) organelle

2. Who first observed thin slices of cork under a simple microscope in 1665 and named the empty spaces "cells"?
(A) Schleiden (B) Schwann (C) **Robert Hooke** (D) Virchow

3. Which scientist concluded that cells are the ultimate units forming the structure of all plant tissue?
(A) Schwann (B) **Schleiden** (C) Hooke (D) Pasteur

4. Schwann studied animal cells and found that they:
(A) have a thick cellulose wall (B) have no membrane (C) **lack a cell wall and are covered by a membrane** (D) contain chloroplasts

5. In 1885 Rudolf Virchow stated that:
(A) cells arise from non-living matter (B) **new cells develop by the division of pre-existing cells** (C) all cells have a cell wall (D) cells are formed by spontaneous generation

6. Which of the following is NOT one of the three tenets of the cell theory?
(A) The cell is the fundamental unit of structure and function in living things (B) All organisms are composed of one or more cells (C) Cells arise from pre-existing cells through cell division (D) **All cells contain a nucleus and mitochondria**

7. Which pair of scientists demonstrated that cells cannot grow in sealed and sterile conditions?
(A) Hooke and Schleiden (B) **Francesco Redi and Louis Pasteur** (C) Schwann and Virchow (D) Svedberg and Golgi

8. Viruses are an exception to the cell theory because they:
(A) have a cell wall but no membrane (B) **are acellular and have no cell machinery** (C) always contain a nucleus (D) divide by mitosis

9. Which cells lack a nucleus and cannot divide to form new cells?
(A) Xylem vessels and neurons (B) Hepatocytes and sieve tube cells (C) **Red blood cells and sieve tube cells** (D) Muscle fibres and guard cells

10. The coenocytic hyphae of Rhizopus and the cells of the alga Vaucheria are exceptions to the cell theory because they are:
(A) anucleate (B) **multinucleate** (C) prokaryotic (D) diploid only

11. The total magnification of a light microscope is calculated by:
(A) adding objective and ocular lens values (B) dividing objective by ocular lens value (C) **multiplying objective lens value by ocular lens value** (D) subtracting ocular from objective lens value

12. The maximum magnification of a light microscope is about:
(A) 150X (B) 500X (C) **1500X** (D) 15000X

13. The resolving power of a light microscope is about:
(A) 0.2 nm (B) 0.1 mm (C) **250 nm** (D) 1 nm

14. The resolving power of an electron microscope is about:
(A) 250 nm (B) **0.2 nm** (C) 0.1 mm (D) 20 nm

15. The image formed by the objective lens of a compound light microscope is:
(A) virtual, erect and magnified (B) **real, inverted and magnified** (C) real, erect and diminished (D) virtual, inverted and diminished

16. Resolution of a microscope is the ability to:
(A) enlarge an object (B) increase the brightness of an object (C) **distinguish two close points as separate** (D) colour the specimen

17. Which statement is true of an electron microscope but NOT of a light microscope?
(A) Living specimens can be observed (B) The image is usually coloured (C) **A vacuum is essential for operation** (D) Glass lenses are used

18. Specimens for an electron microscope are kept as thin sections of:
(A) 2 to 10 nm (B) **20 to 100 nm** (C) 200 to 500 nm (D) 1 to 5 mm

19. The unit of sedimentation coefficient, used in ultracentrifugation, is named after:
(A) Camillo Golgi (B) Robert Brown (C) **Theodor Svedberg** (D) Shinya Yamanaka

20. The two major types of electron microscope are:
(A) light and phase contrast (B) **TEM and SEM** (C) TEM and compound (D) SEM and dissecting

21. The cell wall of fungi is made up of:
(A) cellulose (B) peptidoglycan (C) **chitin** (D) pectin

22. The plant cell wall is chemically made up of mainly:
(A) peptidoglycan (B) chitin (C) **cellulose** (D) lipid

23. Which layer of the plant cell wall is a true wall that develops in newly growing cells and stretches plastically?
(A) Secondary wall (B) **Primary wall** (C) Middle lamella (D) Plasma membrane

24. The middle lamella is composed of:
(A) cellulose and lignin (B) **pectin and calcium and magnesium salts** (C) chitin and protein (D) hemicellulose only

25. The secondary cell wall is rigid because of the deposition of:
(A) pectin (B) suberin (C) **lignin** (D) chitin

26. The secondary cell wall is found mainly in:
(A) meristematic cells (B) **sclerenchyma cells** (C) guard cells (D) root hair cells

27. Chemically, the plasma membrane contains:
(A) lipids 60 to 80 percent and proteins 20 to 40 percent (B) **proteins 60 to 80 percent and lipids 20 to 40 percent** (C) carbohydrates 60 percent and lipids 40 percent (D) only phospholipids

28. Which model describes the membrane as a phospholipid bilayer with scattered proteins like icebergs in the sea?
(A) Sandwich model (B) **Fluid mosaic model** (C) Unit membrane model (D) Micelle model

29. In the phospholipid bilayer, the hydrophobic ends:
(A) face the cytoplasm and the outside (B) **face each other in the interior** (C) are on the outer surface (D) are attached to carbohydrates

30. Increasing the unsaturated fatty acids in membrane phospholipids makes the membrane:
(A) more rigid (B) **more fluid and flexible** (C) impermeable (D) thicker

31. In the plasma membrane cholesterol:
(A) increases fluidity at all temperatures (B) **helps stabilize the bilayer and restricts entry of polar molecules and ions** (C) acts as a receptor for hormones (D) forms the channel proteins

32. Carbohydrates attached to membrane proteins are called:
(A) glycolipids (B) **glycoproteins** (C) lipoproteins (D) nucleoproteins

33. The thickness of the plasma membrane is about:
(A) 0.7 nm (B) **7 nm** (C) 70 nm (D) 700 nm

34. Hormones bind to specific target cells because those cells have specific:
(A) channel proteins (B) **receptor proteins** (C) carrier proteins (D) cholesterol molecules

35. In cell signaling, signaling molecules are also called:
(A) receptors (B) **ligands** (C) enzymes (D) transducers

36. The correct sequence of cell signaling is:
(A) response, reception, transduction (B) transduction, reception, response (C) **reception, transduction, response** (D) reception, response, transduction

37. Peptide hormones cannot pass through the plasma membrane because they are:
(A) lipid soluble (B) **water soluble** (C) very small (D) non-polar

38. cAMP acts as a:
(A) first messenger (B) **second messenger** (C) ligand (D) steroid hormone

39. Steroid hormones can diffuse directly across the plasma membrane because they are:
(A) hydrophilic (B) proteins (C) **lipophilic** (D) charged

40. Which of the following is a steroid hormone?
(A) Insulin (B) Glucagon (C) **Estrogen** (D) Adrenaline

41. Movement of molecules from higher to lower concentration without a carrier is:
(A) osmosis (B) active transport (C) facilitated diffusion (D) **simple diffusion**

42. Which is NOT a passive transport mechanism?
(A) Simple diffusion (B) Facilitated diffusion (C) Osmosis (D) **Active transport**

43. Glucose and amino acids cross the plasma membrane by:
(A) simple diffusion (B) **facilitated diffusion** (C) exocytosis (D) phagocytosis

44. The two types of transport proteins used in facilitated diffusion are:
(A) enzymes and hormones (B) **channel proteins and carrier proteins** (C) receptors and antigens (D) porins and histones

45. Osmosis is the movement of:
(A) solute from low to high concentration (B) **water through a semipermeable membrane from low solute concentration to high solute concentration** (C) ions against a gradient (D) solute through a channel only

46. Feeling thirsty after eating salty food is an example of:
(A) diffusion (B) **osmosis** (C) active transport (D) endocytosis

47. Active transport differs from passive transport because it:
(A) goes down the concentration gradient (B) needs no membrane protein (C) **moves substances against the gradient using energy** (D) is always bidirectional

48. The sodium-potassium pump is an example of:
(A) facilitated diffusion (B) **primary active transport** (C) osmosis (D) exocytosis

49. The cytosol is the:
(A) nuclear matrix (B) **water-soluble liquid matrix of the cytoplasm surrounding the organelles** (C) matrix of the mitochondrion (D) fluid inside the vacuole

50. Cytoplasm is about:
(A) 50 percent water (B) 70 percent water (C) **90 percent water** (D) 99 percent water

51. A network of membranous tubules and sacs called cisternae describes the:
(A) Golgi complex (B) **endoplasmic reticulum** (C) mitochondrion (D) lysosome

52. Which organelle synthesizes lipids, steroids and detoxifies drugs in liver cells?
(A) Rough ER (B) **Smooth ER** (C) Golgi complex (D) Ribosome

53. Secretory proteins leave the rough ER in vesicles that bud from a region called:
(A) cisface (B) **transitional ER** (C) trans face (D) nuclear pore

54. Eukaryotic ribosomes are:
(A) 70S with 30S and 50S subunits (B) **80S with 40S and 60S subunits** (C) 80S with 30S and 50S subunits (D) 70S with 40S and 60S subunits

55. Ribosomes are formed in the:
(A) cytoplasm (B) Golgi complex (C) **nucleolus** (D) rough ER

56. Ribosomal subunits are held together by the presence of:
(A) calcium ions (B) **magnesium ions** (C) sodium ions (D) iron ions

57. A chain of many ribosomes attached to one mRNA is called a:
(A) ribosome cluster (B) **polysome** (C) nucleosome (D) spliceosome

58. The Golgi complex was discovered in 1898 by:
(A) Robert Brown (B) **Camillo Golgi** (C) George Palade (D) Hans Krebs

59. The forming face of the Golgi complex is called the:
(A) trans face (B) **cis face** (C) maturing face (D) lumen

60. The Golgi complex gives rise to which structures?
(A) Mitochondria and chloroplasts (B) Ribosomes and centrioles (C) **Lysosomes, peroxisomes and glyoxysomes** (D) Nucleoli and chromosomes

61. During cytokinesis in plant cells, Golgi vesicles fuse at the equator to form the:
(A) cleavage furrow (B) **phragmoplast** (C) spindle (D) aster

62. Lysosomes contain about:
(A) 4 digestive enzymes (B) 14 digestive enzymes (C) **40 digestive enzymes** (D) 400 digestive enzymes

63. The contents of a lysosome are:
(A) alkaline (B) neutral (C) **acidic** (D) oily

64. The digestion of the cell's own worn-out organelles by lysosomes is called:
(A) phagocytosis (B) **autophagy** (C) pinocytosis (D) exocytosis

65. Lysosomes are called suicidal bags because:
(A) they destroy bacteria (B) **they can burst and digest the cell during autolysis** (C) they store water (D) they produce hydrogen peroxide

66. Peroxisomes are abundant in liver cells because they:
(A) make bile (B) store glycogen (C) **detoxify alcohol using catalase** (D) synthesize proteins

67. The enzyme that breaks down hydrogen peroxide into water and oxygen is:
(A) amylase (B) **catalase** (C) lipase (D) pepsin

68. Glyoxysomes are found only in:
(A) animal liver cells (B) **germinating oil-rich seeds** (C) bacteria (D) mature leaves

69. In glyoxysomes the glyoxylate cycle converts:
(A) proteins to fats (B) **stored fatty acids to carbohydrates** (C) glucose to starch (D) carbon dioxide to sugar

70. The membrane that surrounds the central vacuole of a plant cell is the:
(A) plasmalemma (B) **tonoplast** (C) cell wall (D) envelope

71. Contractile vacuoles in freshwater protists:
(A) store food (B) **pump excess water out of the cell** (C) digest bacteria (D) make ATP

72. The inner mitochondrial membrane is folded into:
(A) grana (B) thylakoids (C) **cristae** (D) cisternae

73. Fo-F1 particles on the cristae are actually:
(A) ribosomes (B) **ATP synthase enzymes** (C) porins (D) DNA polymerases

74. The outer mitochondrial membrane is freely permeable because of the presence of:
(A) cristae (B) **porins** (C) histones (D) cholesterol

75. The mitochondrial matrix contains:
(A) linear DNA and 80S ribosomes (B) **small circular DNA, RNA and 70S ribosomes** (C) only enzymes (D) chlorophyll

76. Mitochondria divide by:
(A) mitosis (B) meiosis (C) **fission** (D) budding

77. The stack of smaller thylakoids in a chloroplast is called a:
(A) stroma (B) **granum** (C) cristae (D) matrix

78. Light-dependent reactions of photosynthesis occur in the:
(A) stroma (B) **grana** (C) matrix (D) cytosol

79. Enzymes for the light-independent reactions are found in the:
(A) **stroma** (B) grana (C) intergrana only (D) intermembrane space

80. Colourless plastids found in roots, stems and seeds are:
(A) chromoplasts (B) chloroplasts (C) **leucoplasts** (D) proplastids

81. Centrioles are composed of:
(A) nine singlets of microtubules (B) nine doublets of microtubules (C) **nine triplets of microtubules** (D) twelve microfilaments

82. Centrioles also give rise to the:
(A) cell wall (B) **basal bodies of cilia and flagella** (C) nucleolus (D) ribosomes

83. The three types of cytoskeleton fibres are:
(A) microtubules, ribosomes, centrioles (B) **microfilaments, microtubules, intermediate filaments** (C) actin, myosin, keratin only (D) cilia, flagella, pili

84. The nuclear pores are composed of a transport protein called:
(A) histone (B) **nucleoporin** (C) porin (D) tubulin

85. The nucleolus is involved in the:
(A) synthesis of lipids (B) **construction of ribosomes** (C) synthesis of ATP (D) formation of lysosomes

86. The two chromatids of a chromosome are joined at the:
(A) chiasma (B) **centromere** (C) telomere (D) nucleolus

87. Which of the following is the correct pair for prokaryotic cells?
(A) 80S ribosomes, DNA in the nucleus (B) **70S ribosomes, one circular chromosome and plasmids** (C) Mitochondria, Golgi complex (D) Mitosis and meiosis

88. Prokaryotic cells divide by:
(A) mitosis (B) meiosis (C) **binary fission** (D) budding only

89. The locomotory structure of prokaryotes is made of:
(A) dynein (B) tubulin (C) **flagellin** (D) actin

90. Stem cells that can differentiate into ALL possible cell types, such as the first cells of the zygote, are:
(A) unipotent (B) multipotent (C) **totipotent** (D) oligopotent

91. Adult hematopoietic stem cells that give red cells, white cells and platelets are:
(A) totipotent (B) pluripotent (C) **multipotent** (D) unipotent

92. Induced pluripotent stem cells (iPSCs) were first described in 2006 by:
(A) Camillo Golgi (B) **Shinya Yamanaka** (C) Theodor Svedberg (D) Robert Hooke

93. A major disadvantage of iPSCs is that:
(A) they cannot form any cell type (B) **retroviruses used to make them may trigger cancer** (C) they raise ethical issues of embryo destruction (D) they are rejected by the patient

94. Phagocytosis is also called:
(A) cell drinking (B) **cell eating** (C) cell division (D) cell signaling

95. Pinocytosis is also called:
(A) cell eating (B) **cell drinking** (C) cell death (D) cell fusion

96. The vesicle formed during pinocytosis is called a:
(A) phagosome (B) **pinosome** (C) lysosome (D) peroxisome

97. Exocytosis is the process of:
(A) taking in large particles (B) **transporting material from inside the cell to the outside using vesicles** (C) diffusing water (D) dividing the cytoplasm

98. Cholesterol absorption by cells is an example of:
(A) phagocytosis (B) exocytosis (C) **receptor-mediated endocytosis** (D) facilitated diffusion

99. The shortest phase of the cell cycle is the:
(A) G1 phase (B) S phase (C) G2 phase (D) **M phase**

100. Chromosomes are duplicated only during the:
(A) G1 phase (B) **S phase** (C) G2 phase (D) M phase

101. The word "mitosis" comes from the Greek word "mitos" meaning:
(A) division (B) cell (C) **thread** (D) nucleus

102. Which is the longest stage of mitosis?
(A) Prophase (B) **Metaphase** (C) Anaphase (D) Telophase

103. Which is the shortest stage of mitosis?
(A) Prophase (B) Metaphase (C) **Anaphase** (D) Telophase

104. Chromosomes line up on the metaphase plate during:
(A) prophase (B) **metaphase** (C) anaphase (D) telophase

105. Sister chromatids separate and move to opposite poles during:
(A) metaphase (B) **anaphase** (C) prophase (D) interphase

106. Nuclear envelopes re-form around the two sets of chromosomes in:
(A) anaphase (B) prometaphase (C) **telophase** (D) metaphase

107. The pinching of the animal cell membrane during cytokinesis forms the:
(A) phragmoplast (B) **cleavage furrow** (C) spindle (D) aster

108. Meiosis in animals produces:
(A) somatic cells (B) **sperms and eggs** (C) spores only in plants (D) zygotes

109. The pairing of homologous chromosomes in prophase I is called:
(A) crossing over (B) **synapsis** (C) cytokinesis (D) disjunction

110. A tetrad (bivalent) consists of:
(A) two chromatids and one centromere (B) **four chromatids and two centromeres** (C) two chromosomes and four centromeres (D) four chromosomes

111. The X-shaped point where homologous chromatids cross is the:
(A) centromere (B) kinetochore (C) **chiasma** (D) telomere

112. Exchange of chromosome segments between homologues is called:
(A) synapsis (B) **crossing over** (C) replication (D) translocation

113. Meiosis II is similar to:
(A) meiosis I (B) **mitosis** (C) binary fission (D) interphase

114. DNA does NOT replicate during:
(A) Interphase I (B) **Interphase II** (C) S phase (D) Interphase of mitosis

115. At the end of meiosis I, the two daughter cells are:
(A) diploid (B) **haploid** (C) triploid (D) tetraploid

116. Which is a significance of meiosis?
(A) Wound healing (B) Growth of the body (C) **Genetic variability and constant chromosome number across generations** (D) Asexual reproduction

117. Which is a significance of mitosis?
(A) Reduces the chromosome number to half (B) **Growth, wound healing and regeneration with identical daughter cells** (C) Produces gametes (D) Produces genetic variation by crossing over

118. In an electron microscope the denser regions of the specimen:
(A) transmit more electrons (B) **scatter more electrons** (C) absorb light (D) produce colour

119. The cell cycle checkpoint at the G1/S transition is called the:
(A) **G1 checkpoint** (B) G2 checkpoint (C) spindle checkpoint (D) M checkpoint

120. Which of the following has a double membrane?
(A) Lysosome (B) Peroxisome (C) **Chloroplast** (D) Golgi complex

Scenario based MCQs

Scenario 1: A student looks at a prepared slide of onion root tip under a light microscope with a 10X ocular lens and a 40X objective lens. The cells show a plant-type wall but no chloroplasts.

121. The total magnification used is:
(A) 50X (B) 4X (C) **400X** (D) 1000X

122. The student cannot see the ribosomes in this slide because the light microscope has:
(A) no lenses (B) **a resolving power of about 250 nm, too low for ribosomes** (C) a vacuum (D) an electron source

123. To see the internal ultrastructure of the mitochondria she should use a:
(A) dissecting microscope (B) hand lens (C) **transmission electron microscope** (D) stereo microscope

124. Why are chloroplasts absent in these cells?
(A) They are animal cells (B) Root tip cells are prokaryotic (C) **Chloroplasts occur in green parts and root cells contain leucoplasts instead** (D) They lost their DNA

Scenario 2: A pancreatic gland cell is making digestive enzymes for secretion. A scientist labels the proteins and follows them through the cell.

125. The proteins are first made by ribosomes attached to the:
(A) smooth ER (B) **rough ER** (C) Golgi complex (D) lysosome

126. The proteins then move in transport vesicles to the:
(A) nucleus (B) mitochondrion (C) **Golgi complex** (D) peroxisome

127. The Golgi complex of this cell would be:
(A) very small (B) absent (C) **abundant, as the cell is secretory** (D) the same as in a muscle cell

128. The final step in releasing the enzymes out of the cell is:
(A) endocytosis (B) **exocytosis** (C) osmosis (D) phagocytosis

Scenario 3: During the metamorphosis of a tadpole into a frog, the tail shrinks and disappears. A biologist studies the cells of the tail.

129. The organelle that increases in activity in the tail cells is the:
(A) ribosome (B) **lysosome** (C) Golgi complex (D) centriole

130. The type of programmed cell death in which lysosomes burst and release enzymes is:
(A) autophagy (B) phagocytosis (C) **autolysis** (D) pinocytosis

131. The fragments of the dead cells are removed by:
(A) exocytosis (B) **phagocytosis by other cells** (C) osmosis (D) diffusion

132. The enzymes responsible are mainly:
(A) oxidases (B) polymerases (C) **hydrolases** (D) ligases

Scenario 4: A red blood cell is placed in a salt solution and the cell then takes in glucose from the blood plasma. Later a sodium-potassium pump removes sodium from a nerve cell.

133. Entry of glucose into the red cell down its gradient through a carrier protein is:
(A) simple diffusion (B) **facilitated diffusion** (C) active transport (D) exocytosis

134. The sodium-potassium pump uses:
(A) no energy (B) light energy (C) **ATP** (D) osmotic pressure

135. In the pump, sodium ions are moved:
(A) into the cell, and potassium out (B) **out of the cell, and potassium in** (C) both out of the cell (D) both into the cell

136. Active transport is stopped if the cell stops:
(A) photosynthesis (B) transcription (C) **respiration** (D) cell division

Scenario 5: A patient has a damaged spinal cord. Doctors discuss treating with stem cells made from the patient's own skin cells by reprogramming them.

137. These reprogrammed cells are called:
(A) embryonic stem cells (B) adult stem cells (C) **induced pluripotent stem cells** (D) unipotent cells

138. An advantage of using the patient's own cells is the:
(A) use of retroviruses (B) **lower risk of rejection and no ethical concern of destroying embryos** (C) certainty of no cancer (D) loss of all potency

139. Pluripotent cells can:
(A) form only one cell type (B) form only blood cells (C) **turn into almost any cell type** (D) form the placenta and embryo equally

140. One risk of the technique is:
(A) no cell division (B) **cancer from viral vectors or overgrowth of transplanted cells** (C) loss of DNA (D) no cell differentiation possible

Scenario 6: A cell has 4 chromosomes (2n = 4). It enters the cell cycle and later undergoes meiosis for gamete formation.

141. After DNA replication in the S phase the number of chromatids is:
(A) 4 (B) 2 (C) **8** (D) 16

142. At the end of mitosis each daughter cell has:
(A) 2 chromosomes (B) **4 chromosomes** (C) 8 chromosomes (D) 1 chromosome

143. At the end of meiosis the gametes have:
(A) 4 chromosomes (B) **2 chromosomes** (C) 8 chromosomes (D) 1 chromosome

144. Number of daughter cells produced by meiosis of one cell is:
(A) 2 (B) 3 (C) **4** (D) 8

Unit 2: Molecular Biology (Biological Molecules)

Straight MCQs

1. Biochemistry is the study of:
(A) only the structure of cells (B) **the composition and structure of chemical compounds in living organisms and the chemical processes in them** (C) only the diseases of the body (D) only the classification of organisms

2. Molecular biology is a:
(A) branch of ecology (B) **specialized branch of biochemistry** (C) branch of physics (D) branch of taxonomy

3. The most prevalent type of chemical bond in biological molecules is the:
(A) ionic bond (B) hydrogen bond (C) **covalent bond** (D) hydrophobic bond

4. Which of the following is NOT a covalent bond found in biomolecules?
(A) Peptide bond (B) Glycosidic bond (C) Phosphodiester bond (D) **Hydrogen bond**

5. An ionic bond is formed when:
(A) two atoms share electrons equally (B) **one atom donates electrons to another, forming oppositely charged ions that attract** (C) a hydrogen atom bonds with a lone pair (D) two non-polar regions cluster in water

6. Hydrogen bonds form between a hydrogen atom bonded to a highly electronegative atom and:
(A) a carbon atom (B) **a lone pair of electrons on a neighbouring electronegative atom** (C) a metal ion (D) another hydrogen atom

7. In DNA, the number of hydrogen bonds between guanine and cytosine is:
(A) one (B) two (C) **three** (D) four

8. In DNA, adenine and thymine are joined by:
(A) one hydrogen bond (B) **two hydrogen bonds** (C) three hydrogen bonds (D) a covalent bond

9. Hydrophobic interactions occur between:
(A) polar molecules in water (B) **non-polar molecules or regions in the presence of water** (C) ions of opposite charge (D) sugar molecules only

10. In the cell membrane, phospholipid hydrophobic tails are oriented:
(A) outward toward water (B) **towards each other, away from water** (C) towards the cytoplasm only (D) randomly

11. Hydrophilic literally means:
(A) fat loving (B) afraid of water (C) **water loving** (D) heat loving

12. The living mass of the cell and the organism is called:
(A) cytosol (B) matrix (C) **protoplasm** (D) nucleoplasm

13. Approximately how many bioelements are found in living organisms?
(A) 6 (B) **25** (C) 92 (D) 118

14. The six major bioelements constituting about 99 percent of protoplasm include:
(A) C, H, O, N, K, Na (B) **C, H, O, N, Ca, P** (C) C, H, O, S, Cl, Mg (D) C, H, O, N, Fe, Zn

15. The most abundant element in the human body is:
(A) carbon (B) hydrogen (C) **oxygen** (D) nitrogen

16. Which of the following is a minor bioelement?
(A) Carbon (B) Calcium (C) **Potassium** (D) Nitrogen

17. The percentage of water in both bacterial and mammalian cells is about:
(A) 15 percent (B) 50 percent (C) **70 percent** (D) 90 percent

18. The four fundamental biological molecules are:
(A) water, minerals, vitamins, enzymes (B) **carbohydrates, proteins, lipids, nucleic acids** (C) fats, oils, waxes, steroids (D) DNA, RNA, ATP, NAD

19. A macromolecule made of many repeating units is called a:
(A) monomer (B) dimer (C) **polymer** (D) isomer

20. In condensation reaction two monomers join with the release of:
(A) carbon dioxide (B) **water** (C) oxygen (D) hydrogen peroxide

21. When 20 monomers are condensed to form a polymer, the number of water molecules released is:
(A) 20 (B) **19** (C) 21 (D) 10

22. Condensation is also called:
(A) hydration (B) **dehydration synthesis** (C) oxidation (D) hydrolysis

23. Hydrolysis is:
(A) joining of monomers with release of water (B) **breakdown of a polymer into monomers by the addition of water** (C) addition of water without breaking bonds (D) release of energy by oxidation

24. All digestion reactions are examples of:
(A) condensation (B) **hydrolysis** (C) hydration (D) polymerization

25. The percentage of water in the jellyfish body is about:
(A) 70 percent (B) 85 percent (C) **99 percent** (D) 20 percent

26. The water molecule is polar because:
(A) it carries a net positive charge (B) it has ionic bonds (C) **electrons are shared unequally between oxygen and hydrogen** (D) it has no hydrogen

27. Polarity makes water an excellent solvent for:
(A) non-polar substances (B) **polar substances and ionic compounds** (C) lipids (D) waxes

28. The attraction among water molecules themselves is called:
(A) adhesion (B) **cohesion** (C) surface area (D) ionization

29. The attraction between water molecules and polar surfaces is called:
(A) cohesion (B) **adhesion** (C) polarity (D) dissociation

30. The specific heat capacity of water is:
(A) 0.1 calorie per gram per degree (B) 0.5 calorie per gram per degree (C) **1 calorie per gram per degree Celsius** (D) 5 calories per gram per degree

31. Water has a high specific heat because:
(A) it has no hydrogen bonds (B) **much of the absorbed heat is used to break hydrogen bonds** (C) it is a solid (D) it has a low density

32. Heat of vapourization of water is about:
(A) 54 calories per gram (B) 174 calories per gram (C) **574 calories per gram** (D) 974 calories per gram

33. Sweating cools an animal because of water's:
(A) high density (B) low specific heat (C) **high heat of vapourization** (D) cohesion

34. When oil drops on water join into a single drop, the property shown is:
(A) ionization (B) adhesion (C) **hydrophobic exclusion** (D) polarity

35. When water ionizes it releases:
(A) H2 and O2 (B) **an equal number of hydrogen ions and hydroxyl ions** (C) only hydrogen ions (D) sodium and chloride ions

36. Ice floats on water because:
(A) it is denser than water (B) **it is less dense, having a lattice with maximum hydrogen bonding** (C) it contains air only (D) it is colder

37. The word carbohydrate literally means:
(A) sugar polymers (B) **hydrates of carbon** (C) oxygenated carbon (D) hydrogen sugar

38. The general formula of a carbohydrate by the classic concept is:
(A) CnH2nO (B) **Cn(H2O)n** (C) C2nHnOn (D) CnHnOn

39. Carbohydrates are now defined as:
(A) only sweet compounds (B) **polyhydroxy aldehydes or polyhydroxy ketones or their complex derivatives** (C) all compounds with C, H and O (D) all water soluble compounds

40. Carbohydrates are classified on the basis of:
(A) their taste (B) their solubility (C) **the number of saccharide units** (D) their colour

41. Oligosaccharides are made of:
(A) one saccharide unit (B) **2 to 10 saccharide units** (C) 11 to 20 saccharide units (D) more than 100 units

42. The general formula of monosaccharides is:
(A) C12H22O11 (B) **(CH2O)n** (C) C6H12O5 (D) CnH2n

43. Monosaccharides contain carbon atoms ranging from:
(A) 1 to 3 (B) 2 to 5 (C) **3 to 7** (D) 5 to 10

44. Monosaccharides containing an aldehyde group are called:
(A) ketoses (B) **aldoses** (C) trioses (D) oligosaccharides

45. Fructose is a:
(A) aldohexose (B) **ketohexose** (C) aldopentose (D) ketopentose

46. Ribose and deoxyribose belong to:
(A) trioses (B) tetroses (C) **pentoses** (D) hexoses

47. Glyceraldehyde is a:
(A) **triose** (B) tetrose (C) pentose (D) hexose

48. Galactose is a component of:
(A) cane sugar (B) malt sugar (C) **milk sugar** (D) starch

49. The five-cornered ring structure of monosaccharides is called:
(A) pyranose (B) **furanose** (C) aldose (D) ketose

50. The six-cornered ring with one oxygen and five carbon atoms is called:
(A) furanose (B) **pyranose** (C) triose (D) heptose

51. In glucopyranose the ring oxygen links:
(A) C1 and C4 (B) C2 and C5 (C) **C1 and C5** (D) C1 and C6

52. Ribose in solution forms a ring called:
(A) ribopyranose (B) **ribofuranose** (C) glucopyranose (D) riboketose

53. Monosaccharides are called reducing sugars because they have:
(A) a double bond (B) **a free aldehyde or ketone group that can donate electrons** (C) a glycosidic bond (D) a phosphate group

54. Glucose and fructose are examples of:
(A) stereoisomers (B) enantiomers (C) **functional (structural) isomers** (D) anomers

55. The number of stereoisomers of a monosaccharide is calculated by:
(A) n squared (B) n plus 2 (C) **2 raised to n, where n is the number of asymmetric carbons** (D) n times 2

56. The number of stereoisomers of glucose is:
(A) 4 (B) 8 (C) **16** (D) 32

57. An asymmetric carbon is one which:
(A) is part of the carbonyl group (B) **is bonded to four different atoms or groups** (C) has a double bond (D) forms the ring

58. Anomers differ in the position of -OH at:
(A) C-2 (B) C-5 (C) **C-1 (anomeric carbon)** (D) C-6

59. In alpha glucose the -OH on C-1 is:
(A) upward (B) **downward** (C) absent (D) in the ring

60. Non-superimposable mirror image stereoisomers are called:
(A) epimers (B) anomers (C) **enantiomers** (D) diastereoisomers

61. In D-glucose the -OH of the penultimate carbon (C-5) is on the:
(A) left side (B) **right side** (C) top (D) bottom

62. Stereoisomers that differ at only ONE asymmetric carbon are:
(A) enantiomers (B) anomers (C) **epimers** (D) isomers of ring

63. D-glucose and D-mannose are:
(A) enantiomers (B) anomers (C) **epimers** (D) functional isomers

64. Living organisms can use only:
(A) L-sugars (B) **D-sugars** (C) both D- and L-sugars (D) neither

65. Artificial sweeteners like sucralose are left-handed sugars so they are:
(A) broken down quickly (B) **not metabolized by right-handed enzymes** (C) stored as starch (D) converted to fat

66. The general formula of disaccharides is:
(A) C6H12O6 (B) **C12H22O11** (C) C5H10O5 (D) (C6H10O5)n

67. Cane sugar is chemically:
(A) maltose (B) lactose (C) **sucrose** (D) fructose

68. On hydrolysis, sucrose yields:
(A) two molecules of glucose (B) **one alpha-glucose and one beta-fructose** (C) galactose and glucose (D) two fructose

69. The transport sugar in plants is:
(A) maltose (B) glucose (C) **sucrose** (D) lactose

70. Malt sugar is also called:
(A) sucrose (B) lactose (C) **maltose** (D) cellobiose

71. Maltose is formed from:
(A) glucose and fructose (B) galactose and glucose (C) **two alpha-glucose molecules** (D) two beta-glucose molecules

72. Lactose is formed from:
(A) two glucose molecules (B) glucose and fructose (C) **beta-galactose and beta-glucose** (D) alpha-galactose and fructose

73. Milk sugar content is highest in:
(A) goat milk (B) cow milk (C) **human milk** (D) buffalo milk

74. The glycosidic bond in maltose is:
(A) **alpha-1,4** (B) alpha-1,2 (C) beta-1,4 (D) alpha-1,6

75. The glycosidic bond in sucrose is:
(A) alpha-1,4 (B) **alpha-1,2** (C) beta-1,4 (D) beta-1,6

76. The glycosidic bond in lactose is:
(A) alpha-1,4 (B) alpha-1,2 (C) **beta-1,4** (D) alpha-1,6

77. Which disaccharide is a non-reducing sugar?
(A) Maltose (B) Lactose (C) **Sucrose** (D) Cellobiose

78. Polysaccharides yield on hydrolysis:
(A) 2 to 10 monosaccharides (B) 1 monosaccharide (C) **more than 10 monosaccharides** (D) exactly 100 monosaccharides

79. Which is a homopolysaccharide?
(A) Hyaluronic acid (B) **Starch** (C) Heparin (D) Peptidoglycan

80. Starch is made of condensation of:
(A) beta-glucose (B) fructose (C) **alpha-glucose** (D) galactose

81. Iodine solution gives blue-black colour with:
(A) glycogen (B) cellulose (C) **starch** (D) glucose

82. Iodine solution gives a red colour with:
(A) starch (B) cellulose (C) **glycogen** (D) chitin

83. Which of the following shows no colour with iodine?
(A) Starch (B) Glycogen (C) **Cellulose** (D) Amylose

84. Amylose is a:
(A) branched chain of glucose joined by alpha-1,6 bonds (B) **linear unbranched chain of glucose joined by alpha-1,4 bonds** (C) chain of beta-glucose (D) protein

85. The branches of amylopectin are attached by:
(A) alpha-1,4 bonds (B) beta-1,4 bonds (C) **alpha-1,6 bonds** (D) peptide bonds

86. Glycogen is stored mainly in:
(A) stem and leaves (B) **liver and muscles** (C) roots and seeds (D) kidney

87. Glycogen is also called:
(A) plant starch (B) **animal starch** (C) fungal starch (D) fibre

88. Which has the most branching?
(A) Amylose (B) Amylopectin (C) **Glycogen** (D) Cellulose

89. Cellulose is made up of:
(A) alpha-glucose joined by alpha-1,4 bonds (B) **beta-glucose joined by beta-1,4 bonds** (C) fructose units (D) N-acetylglucosamine

90. The most abundant carbohydrate on earth is:
(A) starch (B) glycogen (C) **cellulose** (D) chitin

91. Cellulose in the human diet works as:
(A) an energy source (B) **roughage (fibre)** (C) a protein source (D) a vitamin

92. Herbivores digest cellulose with the help of:
(A) their own amylase (B) **symbiotic bacteria secreting cellulase** (C) pepsin (D) bile

93. Chitin is a polymer of:
(A) glucose (B) fructose (C) **N-acetylglucosamine** (D) galactose

94. Chitin is found in:
(A) plant cell walls (B) **fungal cell walls and the exoskeleton of arthropods** (C) bacterial cell walls (D) animal cell membranes

95. The second most abundant organic molecule on earth is:
(A) starch (B) cellulose (C) **chitin** (D) glycogen

96. The iodine test for starch gives:
(A) green colour (B) **dark blue-black colour** (C) brick red precipitate (D) purple ring

97. Benedict's test detects:
(A) proteins (B) lipids (C) **reducing sugars such as glucose** (D) starch

98. In Molisch's test the colour of the ring formed at the junction is:
(A) blue (B) red (C) **purple** (D) yellow

99. Which elements are present in ALL proteins?
(A) C, H, O, P (B) **C, H, O, N** (C) C, H, O, S (D) C, H, N, Fe

100. Proteins are polymers of:
(A) monosaccharides (B) fatty acids (C) **amino acids** (D) nucleotides

101. How many amino acids are commonly found in proteins?
(A) 10 (B) **20** (C) 30 (D) 40

102. The group attached to the alpha carbon of an amino acid that differs among amino acids is the:
(A) amino group (B) carboxyl group (C) **R group** (D) hydrogen

103. The two simplest amino acids are:
(A) leucine and valine (B) **glycine and alanine** (C) serine and proline (D) lysine and arginine

104. The number of essential amino acids is:
(A) 5 (B) **9** (C) 11 (D) 20

105. Which is an essential amino acid?
(A) Alanine (B) Glycine (C) **Lysine** (D) Serine

106. Which of the following is a non-essential amino acid?
(A) Valine (B) Tryptophan (C) **Proline** (D) Methionine

107. The number of non-essential amino acids listed in the book is:
(A) 9 (B) **11** (C) 20 (D) 13

108. The bond between two amino acids is the:
(A) glycosidic bond (B) phosphodiester bond (C) **peptide bond** (D) ester bond

109. A peptide bond forms between the:
(A) C of the amino group and N of the carboxyl group (B) **C of the carboxyl group and N of the amino group** (C) two R groups (D) two alpha carbons

110. The formation of a polypeptide on the ribosome under instructions of mRNA is called:
(A) transcription (B) replication (C) **translation** (D) transduction

111. Peptide bonds are broken in the gut by:
(A) amylase (B) lipase (C) **pepsin and trypsin** (D) maltase

112. The primary structure of a protein is:
(A) an alpha helix (B) **a linear sequence of amino acids** (C) a pleated sheet (D) a globular shape

113. Alpha helix and beta-pleated sheet are:
(A) primary structures (B) **secondary structures held by hydrogen bonds** (C) tertiary structures (D) quaternary structures

114. A protein with more than one polypeptide, held by hydrophobic interactions, shows:
(A) primary structure (B) secondary structure (C) tertiary structure (D) **quaternary structure**

115. Haemoglobin is made of:
(A) one polypeptide chain (B) **four polypeptide chains: two alpha and two beta** (C) three chains (D) two beta chains only

116. Each alpha chain of haemoglobin has how many amino acids?
(A) 146 (B) **141** (C) 120 (D) 574

117. Each beta chain of haemoglobin has how many amino acids?
(A) 141 (B) **146** (C) 100 (D) 174

118. Sickle cell anaemia is caused by a point mutation which replaces:
(A) valine by glutamic acid at position 6 of beta chain (B) **glutamic acid by valine at position 6 of beta chain** (C) lysine by valine at position 6 of alpha chain (D) glycine by alanine at position 6

119. Sickle cell haemoglobin is symbolized as:
(A) HbA (B) **HbS** (C) HbO (D) HbF

120. Fibrous proteins are:
(A) soluble in water and crystallize easily (B) **insoluble in water, elastic and cannot be crystallized** (C) spherical in shape (D) enzymes and hormones

121. Which is a fibrous protein?
(A) Haemoglobin (B) Insulin (C) **Keratin** (D) Antibody

122. Which is a globular protein?
(A) Collagen (B) Myosin (C) **Enzyme** (D) Keratin

123. Globular proteins exist in:
(A) primary structure only (B) secondary structure (C) **tertiary or quaternary structure** (D) no structure

124. The structural protein that forms the matrix of bone and cartilage is:
(A) elastin (B) keratin (C) **collagen** (D) histone

125. Keratin strengthens:
(A) tendons (B) **hair, nails, feathers and horns** (C) blood (D) membranes

126. Histone proteins function to:
(A) transport oxygen (B) **arrange DNA into chromosomes** (C) clot blood (D) digest food

127. Fibrinogen is involved in:
(A) oxygen transport (B) **blood clotting** (C) immunity (D) storage of amino acids

128. Ovalbumin and casein are involved in:
(A) defence (B) **storage of amino acids** (C) movement (D) transport

129. The Biuret test for proteins gives a:
(A) blue colour (B) **pink or violet colour** (C) brick red precipitate (D) dark red ring

130. Lipids are soluble in:
(A) water (B) **organic solvents like acetone and ether** (C) dilute acid only (D) salt solution

131. Lipids contain relatively:
(A) more oxygen than carbohydrates (B) **less oxygen in proportion to carbon and hydrogen than carbohydrates** (C) equal oxygen (D) nitrogen as main element

132. Lipids provide about how much energy compared with carbohydrates?
(A) Half (B) Equal (C) **Double** (D) Ten times

133. Acylglycerols are esters of:
(A) glycerol and amino acids (B) **glycerol and fatty acids** (C) glucose and fatty acids (D) cholesterol and fatty acids

134. Glycerol is a:
(A) dihydroxy alcohol (B) **trihydroxy alcohol with three carbons** (C) fatty acid (D) sugar

135. The reaction between an alcohol and an acid to form an ester is:
(A) hydrolysis (B) **esterification** (C) hydration (D) oxidation

136. Triglycerides are called neutral lipids because:
(A) they are neutral in pH (B) **all three OH groups of glycerol are occupied by fatty acids** (C) they carry a phosphate (D) they carry sugars

137. Fatty acids found in lipids have:
(A) odd number of carbons (B) **even number of carbons** (C) any number of carbons (D) only one carbon

138. The 16-carbon saturated fatty acid is:
(A) stearic acid (B) oleic acid (C) **palmitic acid** (D) lauric acid

139. The 18-carbon saturated fatty acid is:
(A) **stearic acid** (B) palmitic acid (C) oleic acid (D) butyric acid

140. Oleic acid is:
(A) a saturated fatty acid (B) **an unsaturated fatty acid with one double bond** (C) a wax (D) a steroid

141. Saturated fatty acids are:
(A) liquid at room temperature (B) **solid at room temperature and common in animal fats** (C) rich in double bonds (D) found only in plants

142. Tristearin melts at 71 degrees Celsius while triolein melts at:
(A) 40 degrees (B) 0 degrees (C) **minus 17 degrees** (D) 100 degrees

143. Hydrogenation of acylglycerols produces:
(A) cholesterol (B) **margarine** (C) waxes (D) soap

144. Natural waxes are esters of:
(A) glycerol and short fatty acids (B) **long chain fatty acids and long chain alcohols** (C) amino acids (D) sugars

145. Beeswax and cutin are examples of:
(A) phospholipids (B) steroids (C) **natural waxes** (D) terpenes

146. Phospholipids are amphipathic, which means they have:
(A) only polar ends (B) only non-polar ends (C) **both a polar and a non-polar region** (D) no charge

147. A phospholipid is formed when phosphatidic acid combines with:
(A) glucose (B) **choline, ethanolamine, inositol or serine** (C) cholesterol (D) isoprene

148. Lecithin is chemically:
(A) phosphatidylserine (B) **phosphatidylcholine** (C) a steroid (D) a terpene

149. The hydrophilic head of a phospholipid contains the:
(A) fatty acid tails (B) **phosphate group and the additional compound** (C) glycerol only (D) cholesterol

150. Terpenes are synthesized from a five-carbon unit called:
(A) glycerol (B) **isoprene** (C) choline (D) acetyl

151. Two isoprene units form a:
(A) **monoterpene** (B) diterpene (C) triterpene (D) polyterpene

152. Natural rubber is a:
(A) monoterpene (B) diterpene (C) triterpene (D) **polyterpene**

153. Menthol is an example of a:
(A) **monoterpene** (B) diterpene (C) triterpene (D) steroid

154. Vitamin A and phytol (chlorophyll tail) are:
(A) monoterpenes (B) **diterpenes** (C) triterpenes (D) waxes

155. The steroid nucleus has how many carbon atoms in four fused rings?
(A) 12 (B) 15 (C) **17** (D) 20

156. The steroid nucleus rings are:
(A) four rings of six carbons each (B) **three six-carbon rings and one five-carbon ring** (C) two six and two five (D) one six and three five

157. The precursor of bile acids, testosterone, progesterone and estrogen is:
(A) glycerol (B) **cholesterol** (C) arachidonic acid (D) isoprene

158. Prostaglandins are derived from:
(A) cholesterol (B) **arachidonic acid** (C) oleic acid (D) glycerol

159. Aspirin reduces fever and pain by inhibiting the synthesis of:
(A) cholesterol (B) **prostaglandins** (C) insulin (D) bile

160. Nucleic acids were first reported in 1869 by:
(A) Watson (B) Crick (C) **a Swiss physician (Miescher), from pus cells** (D) Chargaff

161. The monomers of nucleic acids are:
(A) amino acids (B) fatty acids (C) **nucleotides** (D) nucleosides

162. A nucleoside consists of:
(A) base and phosphate (B) **base and pentose sugar** (C) sugar and phosphate (D) base, sugar and phosphate

163. The nitrogenous base is linked to which carbon of the pentose sugar?
(A) 5 prime (B) 3 prime (C) **1 prime** (D) 2 prime

164. The phosphate group is linked to which carbon of the sugar?
(A) 1 prime (B) 3 prime (C) **5 prime** (D) 2 prime

165. Pyrimidine bases are:
(A) adenine and guanine (B) **cytosine, thymine and uracil** (C) adenine and thymine (D) guanine and cytosine

166. Purine bases are:
(A) **adenine and guanine** (B) cytosine and thymine (C) uracil and thymine (D) cytosine and uracil

167. The base found only in RNA is:
(A) thymine (B) adenine (C) **uracil** (D) cytosine

168. The base found only in DNA is:
(A) **thymine** (B) uracil (C) adenine (D) guanine

169. Adenosine is a:
(A) nucleotide (B) **ribonucleoside** (C) base (D) dinucleotide

170. The bond that joins nucleotides in a polynucleotide chain is the:
(A) peptide bond (B) glycosidic bond (C) **phosphodiester bond** (D) hydrogen bond

171. In polymerization of nucleotides the molecule released is:
(A) water (B) **pyrophosphate** (C) carbon dioxide (D) ammonia

172. A polynucleotide has a free phosphate at one end and a free hydroxyl at the other, which are:
(A) 3 prime phosphate and 5 prime OH (B) **5 prime phosphate and 3 prime OH** (C) 1 prime phosphate and 5 prime OH (D) 2 prime phosphate and 3 prime OH

173. ATP is a:
(A) dinucleotide (B) **mononucleotide** (C) nucleoside (D) coenzyme only

174. The covalent bonds linking the phosphates in ATP are called:
(A) weak bonds (B) peptide bonds (C) **high-energy bonds** (D) hydrogen bonds

175. NAD is a:
(A) mononucleotide (B) **dinucleotide coenzyme** (C) protein (D) steroid

176. Chargaff's rule states that:
(A) A = G and T = C (B) **the amount of A equals T and G equals C** (C) A + T = G + C always (D) purines are twice pyrimidines

177. X-ray diffraction of DNA was done by:
(A) Watson and Crick (B) Chargaff and Miescher (C) **Maurice Wilkins and Rosalind Franklin** (D) Meselson and Stahl

178. The Watson and Crick model of DNA was published in:
(A) 1869 (B) 1920 (C) **1953** (D) 1962

179. The width of the DNA double helix is:
(A) 0.34 nm (B) 3.4 nm (C) **2 nm** (D) 20 nm

180. The length of one turn of the DNA helix is:
(A) 2 nm (B) 0.34 nm (C) **3.4 nm** (D) 34 nm

181. One turn of the DNA helix contains:
(A) 5 base pairs (B) **10 base pairs** (C) 20 base pairs (D) 34 base pairs

182. The two strands of DNA are:
(A) parallel (B) **antiparallel and complementary** (C) identical (D) unrelated

183. Watson and Crick received the Nobel Prize for the DNA model in:
(A) 1953 (B) 1986 (C) **1962** (D) 1980

184. RNA is generally:
(A) double stranded (B) **single stranded** (C) triple stranded (D) circular only

185. Sugar in RNA is:
(A) deoxyribose (B) **ribose** (C) glucose (D) fructose

186. The RNA that carries genetic message from nucleus to ribosome is:
(A) rRNA (B) tRNA (C) **mRNA** (D) snRNA

187. A group of three nucleotides in mRNA coding for an amino acid is a:
(A) anticodon (B) **codon** (C) gene (D) exon

188. The mRNA for a protein of 100 amino acids will be how many nucleotides long?
(A) 100 (B) 200 (C) **300** (D) 600

189. The RNA that makes up about 80 percent of the total cellular RNA is:
(A) mRNA (B) **rRNA** (C) tRNA (D) DNA

190. The smallest RNA, with 75 to 90 nucleotides, is:
(A) mRNA (B) rRNA (C) **tRNA** (D) none

191. tRNA has the shape of a:
(A) double helix (B) **cloverleaf** (C) straight rod (D) globule

192. The 3 prime end of tRNA always ends with the sequence:
(A) GGA (B) UAA (C) **CCA** (D) AUG

193. The amino acid attaches to the tRNA at its:
(A) anticodon (B) D loop (C) **3 prime CCA end** (D) 5 prime end

194. The anticodon of tRNA is complementary to the:
(A) DNA template (B) **codon of mRNA** (C) rRNA (D) amino acid

195. The flow of information DNA to RNA to protein is called the:
(A) genetic code (B) **central dogma** (C) mutation (D) replication

196. The synthesis of RNA from a DNA template is:
(A) translation (B) **transcription** (C) replication (D) conjugation

197. In transcription, adenine in DNA pairs with which base in mRNA?
(A) Thymine (B) Cytosine (C) **Uracil** (D) Guanine

198. Translation takes place on the:
(A) nucleus (B) **ribosome** (C) Golgi (D) lysosome

199. Transcription and translation together are known as:
(A) replication (B) **gene expression** (C) mutation (D) conjugation

200. Glycolipids are found in:
(A) blood plasma only (B) **white matter of the brain, myelin sheath and chloroplast membrane** (C) milk only (D) cell wall only

201. Proteins covalently attached to carbohydrates are:
(A) lipoproteins (B) **glycoproteins** (C) nucleoproteins (D) glycolipids

202. Blood group antigens contain:
(A) lipoproteins (B) **glycoproteins** (C) nucleoproteins (D) glycolipids

203. Nucleoproteins are found in:
(A) plasma membrane (B) **chromosomes and ribosomes** (C) milk (D) egg yolk only

204. Lipoproteins are found in:
(A) only the nucleus (B) **milk, blood, egg yolk membrane and chloroplasts** (C) only hair (D) only bone

205. Fatty acids vary in length; the simplest are acetic acid and:
(A) stearic acid (B) **butyric acid** (C) palmitic acid (D) oleic acid

206. The Sudan II test gives a:
(A) blue ring (B) **dark red colour ring or layer** (C) violet colour (D) green precipitate

207. A translucent greasy spot on filter paper (spot test) indicates:
(A) proteins (B) sugars (C) **lipids** (D) nucleic acids

Scenario based MCQs

Scenario 1: A student chews a piece of boiled rice for a few minutes and finds it becomes slightly sweet. Later she adds a drop of iodine to a sample of rice paste.

208. The blue-black colour with iodine confirms the presence of:
(A) glycogen (B) **starch** (C) cellulose (D) protein

209. The enzyme in saliva responsible for the sweet taste is:
(A) pepsin (B) lipase (C) **amylase** (D) trypsin

210. The sweet disaccharide first produced from starch is:
(A) sucrose (B) lactose (C) **maltose** (D) fructose

211. The reaction by which starch is broken into maltose is:
(A) condensation (B) **hydrolysis** (C) dehydration synthesis (D) oxidation

Scenario 2: A sample of unknown food gives a pink-violet colour with sodium hydroxide and copper sulphate, and gives a greasy translucent spot on filter paper.

212. The pink-violet colour indicates the presence of:
(A) starch (B) **protein** (C) reducing sugar (D) nucleic acid

213. The test used for it is the:
(A) Benedict's test (B) Molisch's test (C) **Biuret test** (D) Iodine test

214. The greasy translucent spot indicates:
(A) protein (B) **lipid** (C) starch (D) glucose

215. The bond between amino acids in the protein that gave the pink-violet colour is:
(A) glycosidic (B) ester (C) **peptide** (D) hydrogen

Scenario 3: A baby is diagnosed with sickle cell anaemia. His red cells are crescent shaped and block small blood vessels, causing pain.

216. The cause of this disease is a change in the:
(A) alpha globin chain by deletion (B) **sequence of amino acids of the beta chain of haemoglobin** (C) lipid of the membrane (D) carbohydrate of the cell

217. The change is caused by:
(A) a viral infection (B) **a point mutation in the beta-globin gene** (C) lack of iron only (D) loss of a chromosome

218. At position 6 of the beta chain:
(A) valine is replaced by glutamic acid (B) **glutamic acid is replaced by valine** (C) lysine is replaced by serine (D) glycine is replaced by valine

219. This example proves the importance of:
(A) water in cells (B) **the sequence of amino acids in primary structure** (C) carbohydrates (D) lipids

Scenario 4: A scientist studying a DNA sample finds that adenine forms 30 percent of the bases.

220. The percentage of thymine will be:
(A) 20 percent (B) 70 percent (C) **30 percent** (D) 40 percent

221. The percentage of guanine will be:
(A) 30 percent (B) 40 percent (C) **20 percent** (D) 10 percent

222. The total of purines is equal to the total of:
(A) nucleosides (B) **pyrimidines** (C) phosphates (D) sugars

223. Which rule explains these ratios?
(A) Mendel's law (B) **Chargaff's rule** (C) Hardy-Weinberg (D) Avery's rule

Scenario 5: During protein synthesis in a cell, a codon on mRNA is read by a tRNA at the ribosome.

224. The tRNA has a triplet complementary to the codon, called the:
(A) codon (B) **anticodon** (C) promoter (D) operon

225. The first step in making the protein, forming mRNA from a gene, is:
(A) translation (B) **transcription** (C) replication (D) mutation

226. The sugar of the nucleotide in mRNA is:
(A) deoxyribose (B) glucose (C) **ribose** (D) fructose

227. The structure that carries amino acids to the ribosome is:
(A) mRNA (B) rRNA (C) **tRNA** (D) DNA

Scenario 6: In a hot desert, a camel loses water by sweating and the body temperature stays steady. In cold weather a pond freezes only on the top while fish live below.

228. The cooling effect of sweating is due to water's:
(A) low specific heat (B) **high heat of vapourization** (C) low density (D) ionization

229. Fish survive under the ice because ice:
(A) is denser than water (B) **is less dense, floats and acts as an insulating layer** (C) is warmer than water (D) is a good conductor

230. Steady body temperature despite heat is because water has high:
(A) density (B) **specific heat capacity** (C) pH (D) viscosity

231. The reason ice is less dense is its:
(A) ionic bonding (B) **lattice structure with maximum hydrogen bonding** (C) polar covalent bonds only (D) low mass

Scenario 7: A biochemist tests four solutions. Solution P gives a brick red precipitate with Benedict's reagent. Solution Q gives no change with Benedict's,

but after boiling with dilute acid it gives a red precipitate. Solution R gives red colour with iodine.

232. Solution P likely contains:
(A) sucrose (B) **glucose** (C) starch (D) cellulose

233. Solution Q likely contains:
(A) glucose (B) fructose (C) **sucrose** (D) maltose

234. Solution R likely contains:
(A) starch (B) cellulose (C) **glycogen** (D) chitin

235. Sucrose gives a positive result only after boiling with acid because:
(A) it is a protein (B) **it is a non-reducing sugar that must first be hydrolysed** (C) it is a lipid (D) it has no glycosidic bond

Unit 3: Enzymes

Straight MCQs

1. The sum of all chemical reactions going on in a cell is called:
(A) homeostasis (B) **metabolism** (C) catabolism only (D) digestion

2. Enzymes are defined as:
(A) non-living inorganic catalysts (B) **biological polymers that catalyse biochemical reactions** (C) hormones that regulate growth (D) vitamins required by cells

3. The name "diastase" was given by Payen and Persoz to the substance that:
(A) digested proteins (B) digested fats (C) **digested starch in ground barley** (D) synthesized glucose

4. Enzymes exist in the cell as:
(A) true solutions (B) suspensions (C) **colloids** (D) crystals only

5. All enzymes are:
(A) fibrous proteins (B) **globular proteins made up of one or more polypeptides (except ribozymes)** (C) lipids (D) carbohydrates

6. Ribozymes are enzymes made up of:
(A) protein (B) **RNA** (C) lipid (D) DNA

7. An example of a ribozyme which forms peptide bonds during protein synthesis is:
(A) pepsin (B) **peptidyl transferase** (C) trypsin (D) amylase

8. The catalytic activity of an enzyme is located in its:
(A) allosteric site (B) **active site** (C) cofactor (D) coenzyme

9. The active site of an enzyme is a:
(A) flat surface (B) **specific charge-bearing three-dimensional cavity** (C) random region (D) fatty acid chain

10. The substrate is attached to the active site by:
(A) covalent bonds (B) ionic bonds only (C) **non-covalent interactions such as hydrogen bonds and hydrophobic interactions** (D) peptide bonds

11. An active site usually consists of how many amino acids?
(A) 1 to 2 (B) **3 to 12** (C) 20 to 30 (D) more than 100

12. The two functional regions of an active site are the:
(A) allosteric and regulatory sites (B) **binding site and catalytic site** (C) N-terminal and C-terminal (D) cofactor and inhibitor site

13. The part of the active site that converts substrate into product is the:
(A) binding site (B) **catalytic site** (C) allosteric site (D) cofactor site

14. The non-protein part of an enzyme that helps in catalysis is the:
(A) substrate (B) product (C) **cofactor** (D) inhibitor

15. An enzyme that is active together with its cofactor is called a:
(A) apoenzyme (B) **holoenzyme** (C) proenzyme (D) isoenzyme

16. The protein part of an enzyme that is inactive without its cofactor is the:
(A) holoenzyme (B) **apoenzyme** (C) coenzyme (D) prosthetic group

17. Pepsin is secreted in the stomach as an inactive form called:
(A) pepsinase (B) **pepsinogen** (C) peptidase (D) trypsinogen

18. Pepsinogen is converted into pepsin by:
(A) NaOH (B) bile (C) **HCl** (D) amylase

19. The three types of cofactors are:
(A) enzymes, vitamins and hormones (B) **inorganic ions, organic molecules (coenzymes) and prosthetic groups** (C) proteins, lipids and sugars (D) substrates, products and inhibitors

20. Inorganic ion cofactors are also called:
(A) coenzymes (B) **activators** (C) inhibitors (D) prosthetic groups

21. Which of these is a metal ion cofactor for hexokinase?
(A) Na plus (B) **Mg two plus** (C) Cl minus (D) K plus

22. Coenzymes are generally derived from:
(A) minerals (B) lipids (C) **vitamins** (D) nucleic acids only

23. Which of these is a coenzyme?
(A) Zn two plus (B) Fe two plus (C) **NAD plus** (D) Mg two plus

24. A prosthetic group is:
(A) loosely attached and detachable (B) **covalently bonded and permanently attached to the enzyme** (C) a substrate (D) an inhibitor

25. An iron-containing porphyrin ring in cytochromes is an example of a:
(A) coenzyme (B) activator (C) **prosthetic group** (D) substrate

26. In the equation E + S, ES, EP, E + P the "ES" is called the:
(A) enzyme-product complex (B) **enzyme-substrate complex** (C) holoenzyme (D) inhibitor complex

27. The lock and key model was proposed by:
(A) Koshland (B) **Emil Fischer** (C) Watson (D) Michaelis

28. The lock and key model was proposed in:
(A) 1959 (B) **1894** (C) 1920 (D) 1953

29. According to the lock and key model the enzyme active site is:
(A) flexible (B) **rigid** (C) absent (D) changeable by substrate

30. In the lock and key model, the lock represents the:
(A) substrate (B) **enzyme** (C) product (D) inhibitor

31. Enzymes working according to the lock and key model are called:
(A) regulatory enzymes (B) allosteric enzymes (C) **non-regulatory enzymes** (D) coenzymes

32. Sucrase and maltase follow the:
(A) induced fit model (B) **lock and key model** (C) both models (D) neither model

33. The ability of an enzyme to act on only one substrate is:
(A) relative specificity (B) **absolute specificity** (C) group specificity (D) optical specificity

34. Urease, which breaks down urea, shows:
(A) group specificity (B) **absolute specificity** (C) no specificity (D) broad specificity

35. The induced fit model was proposed by:
(A) Fischer (B) **Koshland** (C) Chargaff (D) Svedberg

36. The induced fit model was proposed in:
(A) 1894 (B) **1959** (C) 1953 (D) 1986

37. In the induced fit model the active site is:
(A) rigid (B) **flexible and modified as the substrate approaches** (C) absent (D) permanent unchanged

38. Enzymes following induced fit are called:
(A) non-regulatory (B) **regulatory or allosteric enzymes** (C) ribozymes (D) coenzymes

39. Hexokinase is an example of an enzyme working by:
(A) lock and key model (B) **induced fit model** (C) neither (D) feedback only

40. Carbonic anhydrase catalyses the reaction between:
(A) glucose and ATP (B) **carbon dioxide and water forming carbonic acid** (C) starch and water (D) urea and water

41. The energy that must be supplied to make molecules react is the:
(A) kinetic energy (B) free energy (C) **energy of activation** (D) bond energy

42. Enzymes speed up reactions by:
(A) supplying energy to the reactants (B) **lowering the activation energy** (C) raising the temperature (D) shifting the equilibrium

43. Large amounts of heat cannot be used as activation energy in living systems because:
(A) cells are cold (B) **cells contain temperature-sensitive proteins** (C) heat is absent (D) enzymes need heat

44. Living systems work in:
(A) adiabatic conditions (B) **isothermal conditions** (C) high pressure conditions (D) vacuum conditions

45. The rate of an enzymatic reaction is measured by:
(A) size of the enzyme (B) **amount of substrate changed or product formed in unit time** (C) number of cofactors (D) colour of the product

46. A 10 degree Celsius rise in temperature (up to a limit) generally:
(A) halves the rate (B) has no effect (C) **doubles the rate** (D) stops the reaction

47. The temperature at which an enzyme shows maximum activity is the:
(A) maximum temperature (B) **optimum temperature** (C) minimum temperature (D) critical temperature

48. Loss of catalytic activity of an enzyme due to high temperature is called:
(A) inhibition (B) activation (C) **denaturation** (D) hydrolysis

49. The bonds most sensitive to temperature change in an enzyme are the:
(A) peptide bonds (B) **hydrogen bonds** (C) covalent bonds (D) ester bonds

50. Optimum temperature for most human enzymes is:
(A) 20 to 25 degrees (B) **37 to 38 degrees** (C) 50 degrees (D) 70 degrees

51. Bacteria living in hot springs may have enzymes with an optimum of:
(A) 20 degrees (B) 37 degrees (C) **70 degrees or higher** (D) 5 degrees

52. At or below freezing point enzymes are:
(A) denatured (B) destroyed (C) **inactivated but not denatured** (D) converted to substrates

53. Enzymes inactivated by cold regain activity when:
(A) they are boiled (B) **temperature is restored to a higher level** (C) pH is changed to 1 (D) never

54. Most enzymes have optimum pH in the range of:
(A) 1 to 3 (B) 3 to 5 (C) **6 to 8** (D) 10 to 12

55. Pepsin is most active at:
(A) pH 8 (B) pH 7 (C) **pH 2** (D) pH 10

56. Trypsin shows maximum activity at:
(A) pH 2 (B) pH 5 (C) pH 7 only (D) **pH 8**

57. Papain from green papaya latex is a:
(A) serine protease (B) **cysteine protease active in both acidic and alkaline media** (C) lipase (D) carbohydrase

58. The optimum temperature of papain is about:
(A) 37 degrees (B) 50 degrees (C) **65 degrees** (D) 20 degrees

59. The effect of pH on enzyme activity is due to a change in:
(A) the substrate colour (B) **the charges on amino acid side chains** (C) the cofactor only (D) the size of the cell

60. When substrate is in excess, the rate of reaction is directly proportional to:
(A) temperature only (B) **enzyme concentration** (C) pH only (D) product concentration

61. If an enzyme solution is saturated with substrate, to obtain faster product formation the best method is to:
(A) add more substrate (B) **add more enzyme** (C) add an allosteric inhibitor (D) add a non-competitive inhibitor

62. Enzyme inhibition is the phenomenon in which:
(A) enzyme is produced more (B) **an enzyme fails to catalyse a reaction due to binding of inhibitor** (C) substrate concentration increases (D) temperature rises

63. A competitive inhibitor:
(A) binds the allosteric site (B) **competes with the substrate for the active site** (C) destroys the enzyme permanently (D) activates the enzyme

64. A competitive inhibitor is usually structurally:
(A) different from the substrate (B) **similar to the substrate** (C) a protein (D) a metal

65. Malonate competitively inhibits:
(A) amylase (B) **succinate dehydrogenase** (C) catalase (D) pepsin

66. Succinate dehydrogenase converts succinate to:
(A) malonate (B) **fumarate** (C) citrate (D) pyruvate

67. Competitive inhibition can be overcome by:
(A) lowering temperature (B) **increasing substrate concentration** (C) adding more inhibitor (D) lowering pH

68. Competitive inhibition is usually:
(A) irreversible (B) **reversible** (C) permanent (D) absent

69. Sulphonamides act as:
(A) non-competitive inhibitors (B) **competitive inhibitors used against bacterial infection** (C) cofactors (D) activators

70. In non-competitive inhibition the inhibitor binds to:
(A) the active site (B) the substrate (C) **the allosteric site** (D) the product

71. Increasing substrate concentration has no effect on:
(A) competitive inhibition (B) **non-competitive inhibition** (C) enzyme activity (D) temperature effect

72. Feedback inhibition is an example of:
(A) competitive inhibition (B) irreversible non-competitive inhibition (C) **reversible non-competitive inhibition** (D) denaturation

73. In feedback inhibition the enzyme is inhibited by its own:
(A) substrate (B) **end product** (C) cofactor (D) coenzyme

74. In the aspartate to threonine pathway, excess threonine binds to the allosteric site of:
(A) the last enzyme (B) **enzyme 1** (C) enzyme 3 (D) the substrate

75. Cyanides kill organisms by inhibiting:
(A) catalase (B) amylase (C) **cytochrome oxidase** (D) lipase

76. Cyanides act by combining with:
(A) magnesium (B) **iron in the prosthetic group** (C) calcium (D) sodium

77. Ions of mercury, silver and copper combine with:
(A) amino groups (B) **thiol (-SH) groups of the enzyme** (C) carboxyl groups (D) phosphate groups

78. Heavy metals denature enzymes by breaking:
(A) peptide bonds (B) **disulphide bridges** (C) glycosidic bonds (D) phosphodiester bonds

79. Penicillin kills bacteria by blocking:
(A) human enzymes (B) **the active site of an enzyme unique to bacteria** (C) DNA replication in humans (D) cytochrome oxidase

80. Which is a non-competitive inhibitor?
(A) Malonate (B) Sulphonamide (C) **Cyanide** (D) Penicillin

81. DFP (nerve gas) is a:
(A) competitive inhibitor (B) **non-competitive inhibitor** (C) coenzyme (D) activator

82. The international classification of enzymes by reaction type divides enzymes into how many groups?
(A) Four (B) Five (C) **Six** (D) Eight

83. The IUB system of enzyme nomenclature was given in:
(A) 1894 (B) 1953 (C) **1961** (D) 1986

84. Enzymes catalysing oxidation and reduction are:
(A) transferases (B) **oxidoreductases** (C) hydrolases (D) ligases

85. Cytochrome oxidase belongs to:
(A) hydrolases (B) transferases (C) **oxidoreductases** (D) isomerases

86. Hexokinase transferring a phosphate group from ATP to glucose is a:
(A) hydrolase (B) **transferase** (C) lyase (D) ligase

87. Enzymes breaking down large molecules by adding water are:
(A) lyases (B) isomerases (C) **hydrolases** (D) ligases

88. Pepsin, renin and trypsin belong to:
(A) lyases (B) **hydrolases** (C) ligases (D) transferases

89. Enzymes that remove groups without hydrolysis, e.g. histidine decarboxylase, are:
(A) hydrolases (B) **lyases** (C) ligases (D) isomerases

90. Histidine decarboxylase produces carbon dioxide and:
(A) glucose (B) **histamine** (C) insulin (D) urea

91. Enzymes which bring intramolecular rearrangement are:
(A) lyases (B) hydrolases (C) **isomerases** (D) ligases

92. Phosphohexose isomerase changes glucose 6-phosphate to:
(A) glucose 1-phosphate (B) **fructose 6-phosphate** (C) ribose (D) pyruvate

93. Enzymes joining two molecules together using energy from ATP are:
(A) hydrolases (B) lyases (C) isomerases (D) **ligases (synthetases)**

94. DNA ligase belongs to the class:
(A) hydrolases (B) lyases (C) **ligases** (D) isomerases

95. Which is a protease?
(A) Amylase (B) **Erypsin** (C) Lipase (D) Maltase

96. Amylase digests:
(A) proteins (B) fats (C) **starch or glycogen into maltose** (D) sucrose

97. Cellulase digests cellulose into:
(A) glucose (B) maltose (C) **cellobiose** (D) sucrose

98. Maltase digests maltose into:
(A) fructose (B) galactose (C) **glucose** (D) cellobiose

99. Sucrase digests sucrose into:
(A) two glucose (B) galactose and glucose (C) **glucose and fructose** (D) two fructose

100. Lactase digests lactose into:
(A) glucose and fructose (B) two glucose (C) **galactose and glucose** (D) fructose and galactose

101. RNases digest RNA into:
(A) amino acids (B) **ribonucleotides** (C) deoxyribonucleotides (D) glucose

102. DNases digest DNA into:
(A) ribonucleotides (B) **deoxyribonucleotides** (C) amino acids (D) fatty acids

103. ATPases cause hydrolysis of:
(A) DNA (B) RNA (C) **ATP** (D) protein

104. Enzymes are named by adding "ase" to the name of the:
(A) product (B) cofactor (C) **substrate** (D) inhibitor

105. The enzyme lipase digests:
(A) proteins (B) carbohydrates (C) **fats** (D) nucleic acids

106. A diagnostic enzyme for damage to the pancreas is:
(A) LDH (B) **lipase** (C) creatine phosphokinase (D) GGT

107. Creatine phosphokinase is used to detect damage to:
(A) liver (B) pancreas (C) **muscle cells** (D) kidney

108. Gamma-glutamyl transpeptidase is used to assess:
(A) heart (B) **liver function** (C) lungs (D) brain

109. Snake venom inhibits the enzyme:
(A) amylase (B) **cholinesterase** (C) pepsin (D) lipase

110. Venom that acts on the nervous system and the brain is:
(A) hemotoxic (B) **neurotoxic** (C) cytotoxic (D) cardiotoxic

111. Venom acting locally at the bite site is:
(A) hemotoxic (B) neurotoxic (C) **cytotoxic** (D) endotoxic

112. Immobilized lactase in sodium alginate beads is used to make:
(A) sugar-free tea (B) **lactose-free milk** (C) protein-free milk (D) cheese

113. Alginate beads for immobilizing enzymes are hardened in:
(A) sodium chloride (B) **calcium chloride solution** (C) glucose (D) HCl

114. Benedict's test on lactose-free milk detects:
(A) proteins (B) **reducing sugars galactose and glucose** (C) fats (D) starch

115. Which enzyme works in a protein digestion at the very last step converting dipeptides into amino acids?
(A) Pepsin (B) Trypsin (C) **Erypsin** (D) Amylase

116. The molecule on which an enzyme acts is called:
(A) product (B) cofactor (C) **substrate** (D) inhibitor

117. An enzyme added to a solution at equilibrium would:
(A) form more products (B) form more substrate (C) **change nothing, the reaction stays at equilibrium** (D) lower the free energy

118. A key feature of an allosteric site is that it is often involved in:
(A) substrate binding (B) **feedback inhibition** (C) cofactor synthesis (D) denaturation

119. Many enzymes are secreted in an inactive form to protect:
(A) DNA (B) mitochondria (C) **cell proteins** (D) cell membrane

120. The specificity of an enzyme is due to its:
(A) molecular weight (B) pH (C) **surface configuration of the active site** (D) hydrogen bonding

121. Salivary amylase activity decreases when chloride ions are reduced because chloride ions are:
(A) inhibitors (B) **cofactors (activators)** (C) substrates (D) coenzymes

122. Enzymes change the rate of a reaction by:
(A) shifting the equilibrium (B) supplying energy (C) increasing random collisions (D) **bringing the reacting molecules into a precise orientation and lowering activation energy**

Scenario based MCQs

Scenario 1: A student boils a solution of salivary amylase for 10 minutes and then tests it with starch. No digestion occurs even after cooling. In another tube the enzyme was kept in an ice bath and gave no digestion, but on warming to 37 degrees Celsius, digestion started.

123. The boiled enzyme failed because it was:
(A) frozen (B) **denatured** (C) inhibited competitively (D) converted to substrate

124. The enzyme in the ice bath was:
(A) denatured (B) destroyed (C) **inactivated only** (D) converted to coenzyme

125. The bonds disrupted first by heating are the:
(A) covalent bonds (B) **hydrogen bonds** (C) peptide bonds (D) glycosidic bonds

126. The optimum temperature for this human enzyme is about:
(A) 10 degrees (B) 20 degrees (C) **37 degrees** (D) 70 degrees

Scenario 2: A researcher measures the rate of an enzyme reaction at different pH values. The rate is maximum at pH 2 and falls sharply at pH 8.

127. The enzyme is most likely:
(A) trypsin (B) **pepsin** (C) salivary amylase (D) lipase

128. The rate falls at pH 8 because:
(A) substrate is lost (B) **charges on amino acids change and the enzyme shape is altered** (C) temperature falls (D) product increases

129. The enzyme that works best at pH 8 is:
(A) pepsin (B) **trypsin** (C) rennin (D) none

130. The enzyme is secreted in the stomach as:
(A) pepsinase (B) **pepsinogen** (C) trypsinogen (D) proenzyme X

Scenario 3: A patient accidentally swallows a poison. His cells stop respiring because cytochrome oxidase is blocked. The poison combines with iron in the enzyme.

131. The poison is most likely:
(A) malonate (B) **cyanide** (C) sulphonamide (D) penicillin

132. This is an example of:
(A) competitive inhibition (B) **non-competitive (irreversible) inhibition** (C) feedback inhibition (D) lock and key action

133. Iron in cytochrome oxidase belongs to the:
(A) coenzyme (B) activator (C) **prosthetic group** (D) substrate

134. Increasing substrate concentration will:
(A) reverse the inhibition fully (B) **not overcome this inhibition** (C) destroy the poison (D) activate the enzyme

Scenario 4: Malonate is added to succinate dehydrogenase. The rate of fumarate formation drops. When the amount of succinate is greatly increased, the rate recovers.

135. Malonate acts as a:
(A) non-competitive inhibitor (B) **competitive inhibitor** (C) cofactor (D) coenzyme

136. Malonate resembles the substrate in:
(A) colour (B) **structure** (C) size of enzyme (D) pH

137. The recovery is because succinate:
(A) destroys malonate (B) **outcompetes malonate for the active site** (C) changes the enzyme (D) binds the allosteric site

138. This type of inhibition supports the:
(A) induced fit only (B) **lock and key hypothesis** (C) cell theory (D) fluid mosaic model

Scenario 5: In a bacterial cell, aspartate is converted to threonine by five enzymes. When threonine accumulates, the pathway slows down.

139. This is an example of:
(A) competitive inhibition (B) **feedback inhibition** (C) denaturation (D) hydrolysis

140. Threonine binds to the:
(A) active site of enzyme 5 (B) **allosteric site of enzyme 1** (C) substrate (D) DNA

141. When threonine is used up, the pathway:
(A) stays blocked (B) **resumes activity** (C) produces more threonine permanently (D) is destroyed

142. Threonine is the:
(A) substrate (B) coenzyme (C) **end product** (D) cofactor

Scenario 6: A factory wants to produce lactose-free milk. They use lactase trapped in sodium alginate beads and pour milk over them.

143. The enzyme splits lactose into:
(A) glucose and fructose (B) **galactose and glucose** (C) two glucose (D) maltose and glucose

144. Immobilized enzymes are advantageous because they can be:
(A) consumed in milk (B) **separated from the product and reused** (C) denatured easily (D) changed into substrate

145. The bead hardening solution is:
(A) NaCl (B) **CaCl2** (C) HCl (D) glucose

146. Lactase belongs to the class:
(A) ligases (B) **hydrolases** (C) isomerases (D) lyases

Unit 4: Bioenergetics

Straight MCQs

1. The quantitative study of energy conversions and energy relationships in biological systems is called:
(A) thermodynamics (B) **bioenergetics** (C) biochemistry (D) ecology

2. Photosynthesis is an energy conversion process in which energy-poor molecules are transformed into energy-rich molecules. The energy-poor molecules are:
(A) glucose and oxygen (B) **carbon dioxide and water** (C) ATP and NADPH (D) pyruvate and water

3. In the overall photosynthesis equation, glucose is formed by the:
(A) oxidation of carbon dioxide (B) **reduction of carbon dioxide** (C) oxidation of oxygen (D) fermentation of water

4. The ultimate source of energy for life on earth is:
(A) ATP (B) glucose (C) **sunlight** (D) heat of the earth

5. The full range of electromagnetic radiation is called the:
(A) visible spectrum (B) **electromagnetic spectrum** (C) action spectrum (D) absorption spectrum

6. The visible light range effective for photosynthesis is about:
(A) 100 to 400 nm (B) **400 to 750 nm** (C) 750 to 1000 nm (D) 10 to 100 nm

7. A graph showing the effectiveness of different wavelengths of light for photosynthesis is the:
(A) absorption spectrum (B) **action spectrum** (C) emission spectrum (D) reflection spectrum

8. The most effective wavelengths for photosynthesis in the action spectrum are:
(A) green and yellow (B) **blue (430 nm) and red (670 nm)** (C) green only (D) yellow and orange

9. Air contains about what percentage of carbon dioxide?
(A) 0.3 to 0.4 (B) 3 to 4 (C) **0.03 to 0.04** (D) 21

10. When carbon dioxide concentration rises above 1 percent, the rate of photosynthesis:
(A) increases rapidly (B) stays the same (C) **slows down rapidly due to stomatal closing** (D) becomes zero at once

11. Carbon dioxide is utilized in photosynthesis in the:
(A) light dependent reaction (B) **light independent reaction (Calvin cycle)** (C) photolysis (D) cyclic electron flow

12. The splitting of water in the presence of light is called:
(A) hydrolysis (B) **photolysis** (C) glycolysis (D) lysis

13. Photolysis of water produces:
(A) glucose and CO2 (B) **2H plus, 2 electrons and half O2** (C) ATP only (D) NADH and O2

14. The role of water in photosynthesis was first proposed by:
(A) Calvin (B) Hatch and Slack (C) **Van Niel (1931)** (D) Krebs

15. Van Niel's hypothesis was confirmed in 1940 using an isotope of:
(A) carbon-14 (B) **oxygen-18** (C) hydrogen-3 (D) nitrogen-15

16. When water labelled with oxygen-18 was given to alga, the evolved oxygen was:
(A) non-radioactive (B) **labelled (radioactive)** (C) absent (D) converted to CO2

17. These experiments proved that the oxygen evolved in photosynthesis comes from:
(A) carbon dioxide (B) glucose (C) **water** (D) chlorophyll

18. Photosynthetic pigments in plants are embedded in:
(A) cytoplasm (B) stroma (C) **thylakoid membranes** (D) cell wall

19. The two major groups of pigments in higher plants are:
(A) xanthophylls and carotenes (B) **chlorophylls and carotenoids** (C) anthocyanins and flavonoids (D) phycocyanin and phycoerythrin

20. Chlorophylls absorb mainly:
(A) green and yellow (B) **violet, blue, orange and red** (C) only green (D) infrared

21. Chlorophyll-a is:
(A) yellowish green (B) **bluish green and found in all photosynthetic organisms except bacteria** (C) found only in algae (D) absent in plants

22. Chlorophyll-b is:
(A) bluish green (B) **yellowish green** (C) red (D) brown

23. The pigment of photosynthetic bacteria is:
(A) chlorophyll-c (B) chlorophyll-d (C) **bacteriochlorophyll** (D) chlorophyll-b

24. A chlorophyll molecule consists of:
(A) a head and one tail (B) **a head and two tails** (C) two heads and one tail (D) only a ring

25. The head of chlorophyll is made up of:
(A) one ring of carbon (B) **four pyrrole rings around a central magnesium atom** (C) a long hydrocarbon chain (D) iron porphyrin

26. The central atom in chlorophyll is:
(A) iron (B) copper (C) **magnesium** (D) zinc

27. The difference between chlorophyll-a and chlorophyll-b is that chlorophyll-a has:
(A) an aldehyde group on the second pyrrole ring (B) **a methyl group (-CH3) on the second pyrrole ring** (C) no magnesium (D) no tail

28. Chlorophyll-b has a:
(A) methyl group (B) **aldehyde group (-CHO)** (C) carboxyl group (D) phosphate group

29. The head of chlorophyll is:
(A) hydrophobic (B) **hydrophilic and light absorbing** (C) embedded in membrane (D) non-polar

30. The tails of chlorophyll are:
(A) hydrophilic (B) **hydrophobic and embedded in the thylakoid membrane** (C) light absorbing (D) made of pyrrole

31. The side chains in chlorophyll tails are:
(A) glycerol and choline (B) **phytol and methyl ester** (C) palmitic and stearic acid (D) isoprene and cholesterol

32. Deficiency of chlorophyll in leaves is called:
(A) etiolation (B) **chlorosis** (C) senescence (D) necrosis

33. Synthesis of chlorophyll requires sunlight, nitrogen, warm temperature and:
(A) calcium (B) potassium (C) **magnesium** (D) iron

34. Carotenoids are:
(A) proteins (B) **terpenoid lipids, yellow, orange, red or brown pigments** (C) carbohydrates (D) nucleic acids

35. Carotenoids act as:
(A) reaction centre pigments (B) **accessory pigments that protect chlorophyll-a from excess light** (C) electron acceptors (D) enzymes

36. The two types of carotenoids are:
(A) chlorophyll and carotene (B) **carotenes and xanthophylls** (C) lutein and chlorophyll (D) anthocyanin and carotene

37. Carotenes are:
(A) yellow pigments (B) **orange-red pigments found in all photosynthetic eukaryotes** (C) green pigments (D) found only in animals

38. Which pigment is responsible for the yellow colour of foliage in autumn?
(A) Carotene (B) Chlorophyll-a (C) **Lutein (a xanthophyll)** (D) Chlorophyll-b

39. The primary pigment which converts light energy into chemical energy is:
(A) chlorophyll-b (B) carotene (C) **chlorophyll-a** (D) xanthophyll

40. Accessory pigments:
(A) convert light into chemical energy (B) **absorb light and transfer the energy to chlorophyll-a** (C) produce ATP (D) fix carbon

41. A graph showing the relative absorption of different wavelengths by a pigment is an:
(A) action spectrum (B) **absorption spectrum** (C) emission spectrum (D) electron spectrum

42. Chlorophyll a and b show more absorption in:
(A) green and yellow regions (B) **violet-blue and orange-red regions** (C) infrared only (D) ultraviolet only

43. An instrument used to determine the absorption spectrum of a pigment is the:
(A) microscope (B) colorimeter only (C) **spectrophotometer** (D) centrifuge

44. Clusters of photosynthetic pigment molecules in the thylakoid membrane are called:
(A) grana (B) **photosystems** (C) stroma (D) cristae

45. The peripheral part of a photosystem is called the:
(A) reaction centre (B) **antenna complex** (C) stroma (D) cytochrome

46. The antenna complex contains:
(A) only chlorophyll-a (B) **accessory pigments such as chlorophyll-b and carotenoids** (C) only proteins (D) only enzymes

47. The central part of a photosystem is the:
(A) **reaction centre** (B) antenna complex (C) stroma (D) lumen

48. The reaction centre contains only:
(A) chlorophyll-b (B) carotenoids (C) **chlorophyll-a and associated proteins** (D) xanthophylls

49. The reaction centre of photosystem I is:
(A) P680 (B) **P700** (C) P660 (D) P720

50. The reaction centre of photosystem II is:
(A) P700 (B) **P680** (C) P660 (D) P600

51. The photosystems are named according to:
(A) the order in which they occur in the membrane (B) **the order in which they were discovered** (C) their size (D) their colour

52. The first phase of photosynthesis is the:
(A) light independent phase (B) **light dependent phase** (C) Calvin cycle (D) dark reaction

53. The light dependent phase occurs in the:
(A) stroma (B) **thylakoid membranes** (C) cytosol (D) matrix

54. The products of the light reactions are:
(A) glucose and CO2 (B) **ATP, NADPH and oxygen** (C) ATP, PGA and oxygen (D) NADP plus and ADP

55. ATP is called the assimilating power and NADPH is called the:
(A) fixing power (B) oxidizing power (C) **reducing power** (D) cycling power

56. The light independent phase occurs in the:
(A) thylakoid membrane (B) grana (C) **stroma** (D) intergrana only

57. The output of the light independent phase is:
(A) NADPH (B) ATP (C) **glyceraldehyde-3-phosphate (G3P)** (D) oxygen

58. ATP production during the light reaction is called:
(A) oxidative phosphorylation (B) substrate level phosphorylation (C) **photophosphorylation** (D) glycolysis

59. The mechanism of ATP production in the light reaction is called:
(A) photolysis (B) **chemiosmosis** (C) fermentation (D) transpiration

60. In non-cyclic photophosphorylation the electrons:
(A) return to their photosystem (B) **do not return but are finally accepted by NADP plus** (C) are lost to the stroma (D) go to oxygen

61. The most important event of the light reaction is the production of:
(A) glucose (B) **ATP** (C) RuBP (D) starch

62. Non-cyclic photophosphorylation uses:
(A) only photosystem I (B) only photosystem II (C) **both photosystem I and II** (D) neither

63. When two photons strike PS-II, electrons are captured by the:
(A) NADP plus (B) ferredoxin (C) **primary electron acceptor** (D) cytochrome oxidase

64. The electron holes of P680 are filled by electrons from:
(A) CO2 (B) NADPH (C) **water by photolysis** (D) ATP

65. The electron holes of P700 are filled by electrons from:
(A) water directly (B) **P680 via the electron transport chain** (C) NADPH (D) ATP

66. The proton gradient formed in thylakoid space activates:
(A) RuBisCO (B) **ATP synthase** (C) NADP reductase (D) ferredoxin

67. Ferredoxin is:
(A) a copper protein (B) **an iron-containing protein** (C) a lipid (D) a pigment

68. The enzyme that transfers electrons from ferredoxin to NADP plus is:
(A) ATP synthase (B) RuBisCO (C) **NADP reductase (a flavoprotein)** (D) catalase

69. NADP plus combines with electrons and H plus to form:
(A) ATP (B) **NADPH** (C) NADH (D) FADH2

70. The zigzag path of electrons in non-cyclic photophosphorylation is called the:
(A) Calvin cycle (B) Krebs cycle (C) **Z-scheme** (D) Hatch-Slack cycle

71. In cyclic photophosphorylation only which photosystem is used?
(A) Photosystem II (B) **Photosystem I** (C) Both (D) Neither

72. In cyclic photophosphorylation there is:
(A) NADPH production (B) photolysis of water (C) release of oxygen (D) **only ATP production with no NADPH and no oxygen**

73. Cyclic electron flow occurs when the cell needs:
(A) more NADPH than ATP (B) **more ATP, until ATP supply meets demand** (C) more oxygen (D) less ATP

74. The Calvin cycle is also known as the:
(A) C4 pathway (B) **C3 pathway** (C) Hatch-Slack pathway (D) Krebs pathway

75. Melvin Calvin won the Nobel Prize in:
(A) 1931 (B) 1953 (C) **1961** (D) 1986

76. The three phases of the Calvin cycle are:
(A) glycolysis, link reaction, Krebs (B) **carbon fixation, reduction and regeneration of RuBP** (C) photolysis, ETC, chemiosmosis (D) transcription, translation, replication

77. RuBP is a:
(A) three-carbon compound (B) four-carbon compound (C) **five-carbon phosphorylated sugar and CO2 acceptor** (D) six-carbon compound

78. The enzyme that fixes CO2 to RuBP is:
(A) PEP carboxylase (B) **RuBisCO** (C) ATP synthase (D) aldolase

79. The unstable six-carbon compound formed after CO2 combines with RuBP splits into:
(A) two molecules of G3P (B) **two molecules of 3-phosphoglycerate (3-PGA)** (C) glucose (D) pyruvate

80. The first stable compound of the Calvin cycle is:
(A) RuBP (B) G3P (C) **3-PGA** (D) oxaloacetate

81. In the reduction phase 3-PGA reacts with:
(A) NADH only (B) **ATP and is reduced by NADPH to form G3P** (C) oxygen (D) water only

82. Out of six G3P molecules made in the Calvin cycle, the number released from the cycle is:
(A) six (B) three (C) **one** (D) two

83. The remaining five G3P are used to regenerate:
(A) 3-PGA (B) glucose (C) **RuBP (through ribulose phosphate)** (D) NADPH

84. To release one G3P, the Calvin cycle uses:
(A) 3 CO2, 3 NADPH and 6 ATP (B) **3 CO2, 6 NADPH and 9 ATP** (C) 6 CO2, 6 NADPH and 9 ATP (D) 3 CO2, 9 NADPH and 6 ATP

85. To produce one glucose molecule, the number of G3P required is:
(A) one (B) **two** (C) three (D) six

86. Plants in which only the Calvin cycle occurs in the dark reaction are called:
(A) C4 plants (B) **C3 plants** (C) CAM plants (D) C2 plants

87. Cellular respiration is a series of complex:
(A) condensation reactions (B) **oxidation-reduction reactions by which cells obtain energy from organic matter** (C) hydrolysis reactions (D) photochemical reactions

88. Respiratory fuel in most cells is:
(A) fat (B) protein (C) **glucose** (D) starch

89. In both aerobic and anaerobic respiration glucose is first broken down into:
(A) acetyl CoA (B) **two molecules of pyruvate** (C) lactate (D) citrate

90. The ATP yield of aerobic respiration in eukaryotes is:
(A) 2 ATP (B) 38 ATP (C) **36 ATP** (D) 40 ATP

91. The ATP yield of aerobic respiration in prokaryotes is:
(A) 36 ATP (B) **38 ATP** (C) 2 ATP (D) 30 ATP

92. The ATP yield of anaerobic respiration is:
(A) 36 (B) 38 (C) **2** (D) 4

93. Anaerobic respiration is also known as:
(A) oxidation (B) **fermentation** (C) photorespiration (D) photolysis

94. The two types of fermentation are:
(A) aerobic and anaerobic (B) **lactic acid fermentation and alcoholic fermentation** (C) acetic and citric (D) glycolysis and Krebs

95. In lactic acid fermentation, pyruvate is reduced by NADH to form:
(A) ethanol (B) **lactic acid** (C) acetaldehyde (D) citrate

96. Lactic acid fermentation occurs in:
(A) yeast (B) **anaerobic bacteria and mammalian muscles during strenuous exercise** (C) plant leaves (D) mitochondria only

97. Muscle fatigue is caused by accumulation of:
(A) ethanol (B) carbon dioxide (C) **lactic acid** (D) pyruvate

98. Alcoholic fermentation is found in:
(A) muscle (B) **yeast** (C) human liver (D) leaves

99. In alcoholic fermentation pyruvate is first decarboxylated to:
(A) lactate (B) ethanol (C) **acetaldehyde** (D) oxaloacetate

100. The end products of alcoholic fermentation are:
(A) lactic acid and water (B) **ethanol and carbon dioxide** (C) acetic acid and water (D) pyruvate and ATP

101. The role of fermentation in regenerating NAD plus is that:
(A) it makes ATP (B) **NADH gives its electrons to pyruvate or acetaldehyde so NAD plus returns to glycolysis** (C) it breaks glucose (D) it makes oxygen

102. Aerobic respiration is completed in four phases:
(A) photolysis, ETC, Calvin, fermentation (B) **glycolysis, oxidation of pyruvate, Krebs cycle, electron transport chain** (C) glycolysis, fermentation, Krebs, Calvin (D) link, Calvin, ETC, photolysis

103. Glycolysis occurs in the:
(A) mitochondrial matrix (B) nucleus (C) **cytoplasm** (D) chloroplast

104. The preparatory phase of glycolysis is called the:
(A) payoff phase (B) **investment phase, consuming two ATP** (C) oxidative phase (D) link phase

105. The oxidative phase of glycolysis is the:
(A) investment phase (B) preparatory phase (C) **payoff phase producing ATP and NADH** (D) link phase

106. In the first step of glycolysis glucose is phosphorylated by:
(A) phosphofructokinase (B) **hexokinase or glucokinase** (C) aldolase (D) enolase

107. Glucose-6-phosphate is converted to fructose-6-phosphate by:
(A) aldolase (B) **phosphohexose isomerase** (C) enolase (D) pyruvate kinase

108. Fructose-6-phosphate becomes fructose-1,6-bisphosphate by:
(A) hexokinase (B) **phosphofructokinase** (C) aldolase (D) enolase

109. The splitting of fructose-1,6-bisphosphate is catalysed by:
(A) enolase (B) kinase (C) **aldolase** (D) mutase

110. The splitting produces glyceraldehyde-3-phosphate and:
(A) pyruvate (B) **dihydroxyacetone phosphate** (C) oxaloacetate (D) glucose

111. Dihydroxyacetone phosphate is converted to G3P by:
(A) aldolase (B) **phosphotriose isomerase** (C) hexokinase (D) enolase

112. G3P donates hydrogen to NAD plus and accepts inorganic phosphate to form:
(A) 3-phosphoglycerate (B) **1,3-bisphosphoglycerate** (C) pyruvate (D) PEP

113. The conversion of 1,3-bisphosphoglycerate to 3-phosphoglycerate yields ATP by:
(A) chemiosmosis (B) photophosphorylation (C) **substrate level phosphorylation** (D) oxidative phosphorylation

114. The enzyme for the conversion of 3-phosphoglycerate to 2-phosphoglycerate is:
(A) enolase (B) **phosphoglycerate mutase** (C) pyruvate kinase (D) aldolase

115. Dehydration of 2-phosphoglycerate gives:
(A) pyruvate (B) **phosphoenolpyruvate (PEP)** (C) oxaloacetate (D) G3P

116. The final step of glycolysis to form pyruvate uses the enzyme:
(A) enolase (B) aldolase (C) hexokinase (D) **pyruvate kinase**

117. The net gain of ATP in glycolysis is:
(A) 4 (B) **2** (C) 6 (D) 8

118. The number of ATP produced directly in glycolysis (gross) is:
(A) 2 (B) **4** (C) 6 (D) 36

119. Pyruvate enters the mitochondrion by:
(A) simple diffusion (B) osmosis (C) **active transport via pyruvate translocase** (D) endocytosis

120. The link reaction converts pyruvate to:
(A) citrate (B) oxaloacetate (C) lactate (D) **acetyl CoA**

121. The three steps of the link reaction are:
(A) hydration, dehydration, oxidation (B) **decarboxylation, dehydrogenation, addition of coenzyme A** (C) phosphorylation, isomerization, splitting (D) reduction, fixation, regeneration

122. The enzyme complex of the link reaction is:
(A) citrate synthetase (B) **pyruvate dehydrogenase complex** (C) aconitase (D) fumarase

123. The Krebs cycle takes place in the:
(A) cytosol (B) **mitochondrial matrix** (C) intermembrane space (D) outer membrane

124. The Krebs cycle was discovered by:
(A) Calvin (B) Mitchell (C) **Sir Hans Krebs** (D) Hatch

125. The Krebs cycle is also called the:
(A) Calvin cycle (B) **citric acid or TCA cycle** (C) Hatch-Slack cycle (D) urea cycle

126. The first compound formed in the Krebs cycle is:
(A) oxaloacetate (B) **citrate** (C) malate (D) succinate

127. Acetyl CoA (2C) combines with oxaloacetate (4C) to form:
(A) **a 6-carbon citrate** (B) a 5-carbon compound (C) malate (D) succinate

128. The enzyme that forms citrate is:
(A) aconitase (B) **citrate synthetase** (C) fumarase (D) malate dehydrogenase

129. Citrate is converted to isocitrate by:
(A) citrate synthetase (B) **aconitase** (C) fumarase (D) succinate dehydrogenase

130. Isocitrate is converted to alpha-ketoglutarate by:
(A) dehydration (B) **oxidative decarboxylation** (C) hydration (D) isomerization

131. Alpha-ketoglutarate is converted to:
(A) citrate (B) fumarate (C) **succinyl CoA** (D) oxaloacetate

132. Substrate level phosphorylation in the Krebs cycle occurs when succinyl CoA is converted to:
(A) fumarate (B) **succinate** (C) malate (D) citrate

133. In the Krebs cycle succinate is oxidized to fumarate by succinate dehydrogenase and the hydrogen is taken up by:
(A) NAD plus (B) NADP plus (C) **FAD** (D) FMN

134. Fumarate is converted to malate by:
(A) dehydration (B) **hydration (fumarase)** (C) oxidation (D) decarboxylation

135. Malate is oxidized to:
(A) fumarate (B) succinate (C) citrate (D) **oxaloacetate**

136. In the Krebs cycle (two turns per glucose) the number of CO2 released is:
(A) 2 (B) 6 (C) **4** (D) 8

137. The outputs of two turns of the Krebs cycle include:
(A) 2 NADH, 6 FADH2, 4 ATP (B) **6 NADH, 2 FADH2, 2 ATP** (C) 8 NADH, 2 FADH2, 2 ATP (D) 4 NADH, 4 FADH2, 2 ATP

138. The final acceptor of electrons in the respiratory electron transport chain is:
(A) NAD plus (B) cytochrome c (C) **molecular oxygen** (D) coenzyme Q

139. The electron transport chain is located in the:
(A) outer mitochondrial membrane (B) matrix (C) **inner mitochondrial membrane** (D) cytosol

140. Complex I of the ETC is:
(A) FADH dehydrogenase (B) **NADH-Q reductase (NADH dehydrogenase) with FMN and Fe-S** (C) cytochrome oxidase (D) cytochrome reductase

141. The mobile electron carriers of the ETC are:
(A) cytochrome a and a3 (B) **coenzyme Q (ubiquinone) and cytochrome c** (C) FMN and FAD (D) NAD and NADP

142. Coenzyme Q (ubiquinone) is:
(A) a protein (B) **a small lipid-soluble molecule** (C) a metal ion (D) a nucleotide

143. Cytochromes are:
(A) proteins with magnesium (B) **proteins with iron which gain or lose an electron** (C) lipids (D) carbohydrates

144. Cytochrome oxidase complex IV consists of:
(A) cyto-b, Fe-S and cyto-c1 (B) FMN and Fe-S (C) **cyto-a, cyto-a3 and copper** (D) coenzyme Q and cyt c

145. The number of proton pumping sites in the ETC is:
(A) 1 (B) 2 (C) **3** (D) 4

146. The ETC releases energy used to pump:
(A) electrons to the stroma (B) **H plus from the matrix to the intermembrane space** (C) oxygen outside (D) ATP to the cytoplasm

147. Oxidative phosphorylation is the synthesis of ATP using energy liberated during:
(A) photolysis (B) **oxidation of NADH and FADH2 in the presence of oxygen** (C) glycolysis (D) hydrolysis of ATP

148. The enzyme which synthesizes ATP in mitochondria is:
(A) catalase (B) **ATP synthetase (ATP synthase)** (C) kinase (D) dehydrogenase

149. ATP synthase has two parts called:
(A) Fa and Fb (B) **Fo and F1** (C) Fx and Fy (D) F1 and F2

150. The Fo part:
(A) is the head projecting into matrix (B) **is embedded in the membrane and forms the proton channel** (C) makes ATP (D) is in the stroma

151. The F1 particle:
(A) is a channel (B) **projects into the matrix and catalyses ATP synthesis** (C) pumps protons (D) carries electrons

152. Oxidation of one NADH produces:
(A) 2 ATP (B) **3 ATP** (C) 4 ATP (D) 1 ATP

153. Oxidation of one FADH2 produces:
(A) **2 ATP** (B) 3 ATP (C) 4 ATP (D) 1 ATP

154. The theory of ATP production by the proton gradient is called:
(A) photolysis (B) fermentation (C) **chemiosmosis** (D) glycolysis

155. Direct synthesis of ATP from an organic phosphorylated substrate is:
(A) oxidative phosphorylation (B) photophosphorylation (C) **substrate level phosphorylation** (D) chemiosmosis

156. Out of 36 ATP in aerobic respiration, the number from substrate level phosphorylation is:
(A) 2 (B) **4** (C) 32 (D) 10

157. The number of ATP produced by chemiosmosis in the ETC is:
(A) 4 (B) 2 (C) **32** (D) 36

158. The ATP yield from glycolysis of NADH is lower in eukaryotes because:
(A) glycolysis is absent (B) **mitochondria are impermeable to NADH so electrons enter via FAD to form FADH2** (C) less glucose is used (D) oxygen is limited

159. G3P is an important intermediate of:
(A) only respiration (B) only photosynthesis (C) **both respiration and photosynthesis** (D) neither

160. In the Calvin cycle G3P molecules are converted into:
(A) pyruvate (B) **glucose phosphate within the chloroplast** (C) oxaloacetate (D) lactate

161. When fat is used as an energy source it breaks down to:
(A) amino acids and glucose (B) **glycerol and three fatty acids** (C) only glycerol (D) pyruvate directly

162. Glycerol is converted into:
(A) acetyl CoA (B) **G3P** (C) citrate (D) oxaloacetate

163. Fatty acids are converted to:
(A) G3P (B) pyruvate (C) **acetyl CoA that enters the Krebs cycle** (D) lactate

164. An 18-carbon fatty acid yields how many acetyl CoA molecules?
(A) 6 (B) 18 (C) **9** (D) 3

165. The removal of the amino group from an amino acid is called:
(A) transamination (B) **deamination** (C) decarboxylation (D) hydrolysis

166. The amino group becomes ammonia, which enters the:
(A) Krebs cycle (B) Calvin cycle (C) **urea cycle** (D) glycolysis

167. Photorespiration is:
(A) the same as aerobic respiration (B) **light dependent uptake of oxygen and release of CO2 in green plant cells, without ATP production** (C) fermentation in plants (D) nitrogen fixation

168. Photorespiration needs:
(A) CO2 (B) **oxygen** (C) nitrogen (D) hydrogen

169. Photorespiration starts when the CO2 level in the leaf drops to about:
(A) 500 ppm (B) 300 ppm (C) **50 ppm** (D) 5 ppm

170. In photorespiration RuBisCO combines RuBP with:
(A) CO2 (B) **O2** (C) N2 (D) H2

171. The toxic 2-carbon molecule formed in photorespiration is:
(A) G3P (B) PGA (C) **phosphoglycolate** (D) oxaloacetate

172. Phosphoglycolate is converted to:
(A) glycerate (B) **glycolate** (C) malate (D) citrate

173. Glycolate is transported to the:
(A) chloroplast (B) mitochondrion (C) **peroxisome** (D) nucleus

174. Photorespiration involves which organelles?
(A) Chloroplast and nucleus (B) **Chloroplast, peroxisome and mitochondrion** (C) Golgi and ER (D) Lysosome and vacuole

175. Glycine is converted to serine in the:
(A) chloroplast (B) peroxisome (C) **mitochondrion** (D) cytosol

176. In most plants photorespiration reduces the amount of carbon fixed by about:
(A) 5 percent (B) **25 percent** (C) 50 percent (D) 75 percent

177. Photorespiration is more serious in:
(A) temperate climates (B) polar areas (C) **tropical climates** (D) aquatic habitats

178. RuBisCO has both:
(A) kinase and phosphatase activity (B) **carboxylase and oxygenase activity** (C) isomerase and ligase activity (D) protease and lipase activity

179. Photorespiration started to occur when:
(A) CO2 was absent (B) **oxygen began to accumulate in the atmosphere** (C) plants began to flower (D) animals evolved

180. Stomata closed in hot dry conditions lead to:
(A) a rise in CO2 inside leaf (B) **a rise in the O2 to CO2 ratio and photorespiration** (C) more photosynthesis (D) cessation of respiration

181. The additional pathway of some tropical plants to avoid photorespiration is the:
(A) Calvin cycle (B) Krebs cycle (C) **Hatch-Slack cycle (C4 pathway)** (D) urea cycle

182. In C4 plants CO2 is first fixed by:
(A) RuBisCO (B) **PEP carboxylase** (C) aldolase (D) enolase

183. In the C4 pathway CO2 is fixed to PEP to form:
(A) PGA (B) **oxaloacetate (4C)** (C) citrate (D) G3P

184. The C4 first fixation occurs in the:
(A) bundle sheath cells (B) guard cells (C) **mesophyll cell cytoplasm** (D) root cells

185. Oxaloacetate is converted to malate and transported to:
(A) mesophyll chloroplasts (B) **bundle sheath cells** (C) phloem directly (D) epidermis

186. In bundle sheath cells malate is converted to pyruvate with the release of:
(A) O2 (B) **CO2** (C) ATP (D) NADPH

187. The Calvin cycle in C4 plants occurs in the:
(A) mesophyll cells (B) **bundle sheath cells** (C) guard cells (D) epidermis

188. Which of these is a C4 plant?
(A) Wheat (B) Rice (C) **Maize** (D) Potato

189. Sugarcane and sorghum are:
(A) C3 plants (B) **C4 plants** (C) CAM plants only (D) C2 plants

190. Pyruvate re-enters mesophyll cells and regenerates PEP using:
(A) two ATP (B) **one ATP** (C) NADPH (D) GTP

191. Electrons removed from reduced carbon compounds are mostly transferred to:
(A) FAD (B) **NAD plus to produce NADH** (C) oxygen (D) CO2

192. The detachment of the phosphate group from ATP drives:
(A) exergonic reactions (B) **endergonic reactions** (C) photolysis (D) fermentation

193. Energy-releasing reactions are called:
(A) endergonic (B) **exergonic** (C) anabolic (D) isothermal

194. Why do mitochondria not take up cytosolic NADH?
(A) They lack enzymes (B) **The inner membrane is impermeable to NADH** (C) NADH is too large (D) NADH is toxic

Scenario based MCQs

Scenario 1: A student illuminates a pond weed in separate coloured lights and measures the rate of oxygen release. The rate is highest in blue and red light and lowest in green light.

195. The graph he draws is called the:
(A) absorption spectrum (B) **action spectrum** (C) emission spectrum (D) spectrum of carotene

196. The plant appears green because it:
(A) absorbs green light most (B) **reflects green light** (C) emits green light (D) has no pigment

197. The oxygen released comes from:
(A) CO2 (B) glucose (C) **water** (D) chlorophyll

198. Which instrument would give the exact absorption of a pigment?
(A) Microscope (B) **Spectrophotometer** (C) Centrifuge (D) Thermometer

Scenario 2: In an experiment with isolated chloroplasts, carbon dioxide is suddenly removed while light is on.

199. The level of RuBP will:
(A) decrease (B) **increase** (C) remain unchanged (D) become zero

200. The level of PGA will:
(A) **decrease** (B) increase (C) remain unchanged (D) double

201. The level of ATP will:
(A) decrease (B) **increase because it is not used in the Calvin cycle** (C) remain unchanged (D) become zero

202. The first stable compound to carry the labelled carbon-14 in the Calvin cycle is:
(A) glucose (B) **PGA** (C) RuBP (D) starch

Scenario 3: A sprinter runs 100 metres and later feels pain and fatigue in the leg muscles. A baker uses yeast in dough which rises and smells of alcohol.

203. Muscle pain is due to:
(A) ethanol (B) **lactic acid** (C) CO2 (D) pyruvate

204. Dough rises because yeast releases:
(A) oxygen (B) lactic acid (C) **carbon dioxide during alcoholic fermentation** (D) water only

205. Both processes begin with:
(A) Krebs cycle (B) **glycolysis** (C) ETC (D) photolysis

206. The net ATP produced in both processes is:
(A) 36 (B) 38 (C) **2** (D) 4

Scenario 4: During glycolysis one glucose is converted step by step into two pyruvates.

207. The investment phase uses how many ATP?
(A) 1 (B) **2** (C) 4 (D) 6

208. Substrate level phosphorylation in glycolysis occurs when 1,3-bisphosphoglycerate becomes 3-phosphoglycerate and when:
(A) glucose becomes G6P (B) **PEP becomes pyruvate** (C) G3P becomes DHAP (D) F6P becomes FBP

209. The enzyme that splits the six-carbon sugar is:
(A) hexokinase (B) **aldolase** (C) enolase (D) mutase

210. The coenzyme reduced in glycolysis is:
(A) FAD (B) **NAD plus** (C) NADP plus (D) CoA

Scenario 5: A maize plant (C4) and a wheat plant (C3) are kept in a hot, dry, sunny field with partly closed stomata.

211. The plant less affected by photorespiration is:
(A) wheat (B) **maize** (C) both equally (D) neither

212. In maize the CO2 concentration is raised in the:
(A) mesophyll cells (B) **bundle sheath cells** (C) guard cells (D) phloem

213. Wheat suffers loss of carbon because RuBisCO binds:
(A) CO2 only (B) **O2 when CO2 is low** (C) water (D) nitrogen

214. The first stable product in maize is a:
(A) 3-carbon compound (B) 5-carbon compound (C) **4-carbon compound** (D) 6-carbon compound

Scenario 6: A cell oxidizes one molecule of glucose completely in the presence of oxygen. The mitochondria of this cell show cristae with ATP synthase.

215. The final electron acceptor is:
(A) NAD plus (B) **oxygen** (C) FAD (D) CO2

216. The proton gradient accumulates in the:
(A) matrix (B) **intermembrane space** (C) cytosol (D) stroma

217. The ATP synthase makes ATP when protons flow through:
(A) F1 into the intermembrane space (B) **the Fo channel to the matrix side** (C) the outer membrane (D) cytochrome c

218. The total ATP yield per glucose in this eukaryotic cell is:
(A) 2 (B) 38 (C) **36** (D) 30

Scenario 7: A man burns fat and eats a high protein diet for a prolonged period.

219. Glycerol from fat enters respiration as:
(A) acetyl CoA (B) **G3P** (C) citrate (D) oxaloacetate

220. Fatty acids enter the Krebs cycle as:
(A) G3P (B) pyruvate (C) **acetyl CoA** (D) lactate

221. Protein breakdown in liver involves removal of amino group by:
(A) decarboxylation (B) **deamination** (C) hydrolysis (D) phosphorylation

222. The toxic ammonia from this is converted in the:
(A) Krebs cycle (B) **urea cycle into urea** (C) Calvin cycle (D) glycolysis

Unit 5: Acellular Life

Straight MCQs

1. Viruses are considered acellular because they:
(A) have a thick cell wall (B) **are not made of cells and have no cell machinery** (C) have chloroplasts only (D) divide by mitosis

2. The word "virus" is derived from a Latin word meaning:
(A) small (B) life (C) **poison (venom)** (D) thread

3. In 1884, who found that the causative agent of rabies could pass through a porcelain filter?
(A) Iwanowsky (B) **Charles Chamberland** (C) Stanley (D) Prusiner

4. Tobacco mosaic disease was shown to be caused by a filterable agent in 1892 by:
(A) Chamberland (B) Stanley (C) **Iwanowsky** (D) Baltimore

5. Who crystallized the tobacco mosaic virus in 1935?
(A) Iwanowsky (B) Chamberland (C) Prusiner (D) **W. M. Stanley**

6. The study of viruses is called:
(A) bacteriology (B) mycology (C) **virology** (D) protozoology

7. Which of the following is a living characteristic of viruses?
(A) They can be crystallized (B) They do not respire (C) **They have genetic material (DNA or RNA) that can mutate** (D) They lack enzymes

8. Which of the following is a non-living characteristic of viruses?
(A) They reproduce inside host cells (B) They mutate (C) **They can be crystallized and stored in bottles** (D) They cause disease

9. Viruses are described as:
(A) extracellular saprotrophs (B) **intracellular obligate parasites** (C) free living cells (D) facultative parasites

10. A complete viral particle is called a:
(A) capsid (B) capsomere (C) **virion** (D) prophage

11. The core of a virion consists of:
(A) protein coat only (B) **viral genome and enzymes** (C) lipid envelope (D) glycoprotein spikes

12. The protective protein coat of a virus is the:
(A) envelope (B) core (C) **capsid** (D) spike

13. The capsid is made up of identical subunits called:
(A) nucleotides (B) **capsomeres** (C) virions (D) spikes

14. Herpes virus has how many capsomeres?
(A) 252 (B) **162** (C) 20 (D) 100

15. The adenovirus capsid has how many capsomeres?
(A) 162 (B) **252** (C) 20 (D) 100

16. A capsid with capsomeres arranged in 20 triangles is:
(A) helical (B) **icosahedral** (C) complex (D) rod-shaped

17. Tobacco mosaic virus has a:
(A) polyhedral capsid (B) **helical (rod-shaped) capsid** (C) complex capsid (D) no capsid

18. Reverse transcriptase is found in:
(A) all DNA viruses (B) bacteriophages (C) **retroviruses and hepatitis B virus** (D) TMV

19. The enzyme reverse transcriptase converts:
(A) DNA to RNA (B) protein to RNA (C) **RNA to DNA** (D) DNA to protein

20. The viral envelope is derived from the:
(A) viral genome (B) capsid (C) **host cell membrane** (D) nucleus

21. Glycoprotein spikes on the viral envelope help the virus to:
(A) replicate (B) **recognize the host cell** (C) synthesize proteins (D) make ATP

22. The Baltimore classification places viruses into how many groups?
(A) Four (B) Five (C) Six (D) **Seven**

23. The Baltimore classification is based on:
(A) the size of the capsid (B) host organism only (C) **mode of replication and genome type** (D) shape of the virus only

24. A virus that attacks bacteria is a:
(A) plant virus (B) animal virus (C) **bacteriophage** (D) viroid

25. Potato yellow dwarf virus is an example of:
(A) animal virus (B) **plant virus** (C) bacteriophage (D) prion

26. Rous sarcoma virus causes:
(A) warts (B) polio (C) **cancer in animals** (D) measles

27. Papovirus causes:
(A) smallpox (B) **warts** (C) measles (D) polio

28. Poxvirus causes:
(A) polio (B) warts (C) **smallpox** (D) mumps

29. Picornavirus causes:
(A) measles and mumps (B) **polio and hepatitis A** (C) smallpox (D) warts

30. Paramyxovirus causes:
(A) polio (B) **measles and mumps** (C) warts (D) smallpox

31. Influenza virus is an example of:
(A) helical virus (B) polyhedral virus (C) **enveloped virus** (D) complex virus

32. Adenoviruses have:
(A) helical capsid (B) **polyhedral capsid** (C) complex capsid (D) no capsid

33. A bacteriophage has a:
(A) helical capsid (B) polyhedral capsid (C) envelope only (D) **complex capsid**

34. HIV is classified as:
(A) dsDNA virus (B) ssDNA virus (C) dsRNA virus (D) **ssRNA virus with template for DNA synthesis**

35. Smallpox virus is a:
(A) **dsDNA virus** (B) ssDNA virus (C) ssRNA virus (D) dsRNA virus

36. Viruses show host specificity because their surface proteins attach to specific:
(A) enzymes (B) **receptors on the host cells** (C) DNA molecules (D) ribosomes

37. The polio virus can enter the cells of:
(A) all mammals (B) **humans and other primates** (C) plants only (D) bacteria only

38. Rabies virus can enter:
(A) only primates (B) only humans (C) **all mammalian cells** (D) only birds

39. Hepatitis viruses infect:
(A) nerve cells (B) white blood cells (C) **liver cells** (D) lung cells

40. Poliovirus reproduces in:
(A) liver cells (B) T cells (C) **spinal nerve cells** (D) skin cells

41. A virus must have a host cell because it lacks:
(A) nucleic acid (B) capsid (C) **metabolic enzymes and ribosomes** (D) envelope

42. The capsid protects the viral genome from:
(A) light (B) **nucleases of the host cell** (C) antibodies only (D) water

43. Viruses survive outside the host as:
(A) active cells (B) growing cells (C) **dormant or inactive particles** (D) spores

44. Outside the host, viruses are mainly threatened by changes in:
(A) food (B) light only (C) **pH and temperature** (D) oxygen

45. Enveloped viruses survive outside the host for:
(A) a longer time than non-enveloped (B) **a shorter time than non-enveloped viruses** (C) an unlimited time (D) zero time

46. A bacteriophage is generally:
(A) rod shaped (B) spherical (C) **tadpole shaped** (D) cube shaped

47. The head of a bacteriophage is:
(A) helical (B) **icosahedral** (C) spherical (D) flat

48. The bacteriophage head contains:
(A) double stranded RNA (B) **a DNA genome** (C) protein only (D) lipid

49. The tail of a bacteriophage is:
(A) solid rod (B) **a hollow tube surrounded by a contractile sheath** (C) a flat plate (D) a fibre

50. The enzyme at the bottom of the phage tail core tube is:
(A) lipase (B) amylase (C) **lysozyme** (D) nuclease

51. Lysozyme in the phage tail:
(A) makes DNA (B) **digests a portion of the host cell wall** (C) makes proteins (D) destroys the capsid

52. Tail fibres and tail pins of bacteriophage help in:
(A) synthesis (B) **adsorption (attachment)** (C) lysis (D) maturation

53. The first step in the infection process of a phage is:
(A) penetration (B) genome injection (C) **adsorption** (D) lysis

54. Contraction of the sheath pushes the core tube through the bacterial envelope. This step is:
(A) adsorption (B) **penetration** (C) maturation (D) lysis

55. Only the viral nucleic acid is injected in the host. The protein coat:
(A) enters the cell (B) **remains outside the bacterium** (C) is digested (D) is replicated

56. A phage which immediately lyses its host cell after multiplication is:
(A) temperate (B) lysogenic (C) **virulent (lytic)** (D) defective

57. The disintegration of host DNA in the lytic cycle is done by:
(A) host nuclease only (B) lysozyme (C) **virally encoded DNase** (D) RNase

58. Viral DNA is not digested by the DNase because it:
(A) is RNA (B) is inside capsid (C) **has undergone certain chemical modification** (D) is circular

59. The correct order in lytic cycle is:
(A) maturation, adsorption, penetration, lysis (B) **adsorption, penetration, synthesis, assembly (maturation), lysis** (C) lysis, adsorption, penetration, maturation (D) penetration, adsorption, lysis, synthesis

60. In the lytic cycle, about how many phage particles are produced in 20 to 25 minutes?
(A) 20 (B) 50 (C) **200** (D) 2000

61. Packaging of nucleic acid into the phage head is called:
(A) penetration (B) **maturation** (C) lysis (D) induction

62. Phages which can either multiply via lytic cycle or enter a dormant state are:
(A) virulent phages (B) **temperate (lysogenic) phages** (C) lytic phages (D) defective phages

63. Integrated phage DNA in the bacterial chromosome is called:
(A) provirus (B) **prophage** (C) plasmid (D) episome only

64. Bacteria harbouring a prophage are called:
(A) lytic bacteria (B) **lysogenic bacteria** (C) temperate viruses (D) immune bacteria

65. Termination of lysogenic state by adverse conditions is called:
(A) lysis (B) adsorption (C) **induction** (D) conversion

66. Which of these favour induction of the lysogenic phage?
(A) Nutrients (B) **UV radiation, desiccation or mutagenic chemicals** (C) High pH only (D) Oxygen

67. Change in properties of a bacterium due to prophage genes is called:
(A) induction (B) adsorption (C) **lysogenic (phage) conversion** (D) transformation

68. Clostridium botulinum toxins are partly encoded by:
(A) plasmids (B) **prophage genomes** (C) viroids (D) prions

69. Bacteriophage DNA is used in genetic engineering as a:
(A) protein (B) enzyme (C) **vector** (D) antibody

70. Phage therapy is the application of phages to:
(A) kill viruses (B) **kill pathogenic bacteria without harming normal flora** (C) cure AIDS (D) boost immunity

71. HIV was identified in 1984 by the research teams from Pasteur Institute in France and:
(A) WHO (B) **National Institute of Health, USA** (C) Harvard (D) CDC

72. The virus was named HIV in:
(A) 1984 (B) **1986** (C) 1980 (D) 1990

73. HIV is a:
(A) bacteriophage (B) **retrovirus** (C) plant virus (D) prion

74. The outer glycoprotein of HIV needed to attach to the host cell is:
(A) gp41 (B) **gp120** (C) gp160 (D) p24

75. The transmembrane glycoprotein critical for cell fusion in HIV is:
(A) gp120 (B) **gp41** (C) p24 (D) CD4

76. The shape of the HIV capsid is:
(A) icosahedral (B) helical (C) **somewhat conical** (D) spherical only

77. The HIV core contains:
(A) one double stranded DNA (B) **two single stranded RNA molecules and enzymes** (C) protein only (D) one single stranded DNA

78. The enzyme of HIV that converts viral RNA to viral DNA is:
(A) integrase (B) protease (C) **reverse transcriptase** (D) ribonuclease

79. The enzyme that incorporates viral DNA into host DNA is:
(A) reverse transcriptase (B) **integrase** (C) protease (D) lysozyme

80. The enzyme that cuts large viral proteins into smaller units is:
(A) integrase (B) reverse transcriptase (C) **protease** (D) RNase

81. HIV attacks specific host cells called:
(A) CD8 cells (B) **CD4 cells** (C) B cells (D) red blood cells

82. Which cells are CD4 cells?
(A) Cytotoxic T cells only (B) **Helper T cells, macrophages and certain brain cells** (C) Red blood cells (D) Platelets

83. The first step in the HIV life cycle is:
(A) fusion (B) integration (C) **attachment of gp120 to CD4 receptor** (D) budding

84. HIV enters the host cell by:
(A) injection (B) **fusion and endocytosis** (C) diffusion (D) phagocytosis only

85. Removal of the protective coat inside the host cell is called:
(A) fusion (B) **uncoating** (C) budding (D) assembly

86. The DNA made from HIV RNA by reverse transcriptase is called:
(A) mRNA (B) **complementary DNA (cDNA)** (C) rRNA (D) tRNA

87. After reverse transcription the viral RNA is broken down by:
(A) integrase (B) protease (C) **ribonuclease** (D) lysozyme

88. The integrated viral DNA in host DNA is called:
(A) prophage (B) **provirus** (C) plasmid (D) virion

89. Viral mRNA is transcribed from provirus by:
(A) viral RNA polymerase (B) **host cell RNA polymerase** (C) reverse transcriptase (D) integrase

90. New HIV virions are released from the host cell by:
(A) lysis (B) **budding** (C) diffusion (D) exocytosis only

91. HIV got its name Human Immunodeficiency Virus because it destroys:
(A) red blood cells (B) **helper T cells which regulate the immune system** (C) B cells only (D) platelets

92. Helper T cells:
(A) destroy B cells (B) **activate B cells and cytotoxic T cells** (C) make antibodies directly (D) carry oxygen

93. AIDS stands for:
(A) Acquired Immune Disease Syndrome (B) **Acquired Immuno-Deficiency Syndrome** (C) Active Immune Deficiency Syndrome (D) Acute Infective Disease Syndrome

94. The three stages of HIV infection are:
(A) mild, moderate, severe (B) **asymptomatic carrier, AIDS Related Complex, full blown AIDS** (C) acute, chronic, latent (D) primary, secondary, tertiary

95. In the asymptomatic carrier stage the person:
(A) shows no antibodies (B) **shows antibodies positive but few symptoms for nine months or more** (C) is in full AIDS (D) is cured

96. Opportunistic diseases of AIDS are caused due to:
(A) destruction of RBCs (B) **weak defence from loss of T cells** (C) bacteria in water (D) lack of nutrients

97. HIV itself:
(A) causes cancer directly (B) kills the patient directly (C) **only destroys T cells, and the patient dies from opportunistic diseases** (D) causes TB directly

98. ART stands for:
(A) Anti-Retroviral Technique (B) **Antiretroviral Therapy** (C) Active Retroviral Treatment (D) AIDS Remedy Therapy

99. Antiretroviral therapy:
(A) completely cures HIV (B) **controls the virus so the patient lives longer and risk of transmission falls** (C) kills bacteria (D) is a vaccine

100. AIDS is NOT transmitted by:
(A) sharing needles (B) unscreened blood transfusion (C) **mosquito bites, toilets or door knobs** (D) mother to child

101. Hepatitis is the:
(A) inflammation of kidney (B) inflammation of lung (C) **inflammation of the liver** (D) inflammation of brain

102. Hepatitis A is transmitted by:
(A) blood (B) **faecal-oral route** (C) sexual contact (D) mosquitoes

103. Hepatitis B is also called:
(A) infectious hepatitis (B) **serum hepatitis** (C) viroid hepatitis (D) delta hepatitis

104. Hepatitis B is treated by:
(A) penicillin (B) **alpha interferon** (C) ribavirin only (D) antibiotics

105. Hepatitis C is transmitted only through:
(A) food (B) **blood** (C) air (D) faeces

106. The treatment of chronic hepatitis C is a combination of alpha interferon and:
(A) penicillin (B) acyclovir (C) **ribavirin** (D) tetracycline

107. A vaccine is available for:
(A) Hepatitis C (B) Hepatitis E (C) **Hepatitis A and B** (D) Hepatitis C and E

108. The only human disease known to be caused by a viroid is:
(A) hepatitis A (B) hepatitis B (C) hepatitis C (D) **hepatitis D**

109. Hepatitis D viroid enters the liver cell enclosed in a capsid obtained from:
(A) hepatitis A virus (B) **hepatitis B virus** (C) hepatitis C virus (D) HIV

110. Herpes simplex is characterized by:
(A) paralysis (B) **painful fluid-filled blisters** (C) jaundice (D) high fever only

111. Oral herpes is caused by:
(A) HSV-2 (B) **HSV-1** (C) HBV (D) HIV

112. Genital herpes is usually caused by:
(A) HSV-1 (B) **HSV-2** (C) HBV (D) HAV

113. Herpes sores last for about:
(A) 1 to 2 days (B) **7 to 10 days** (C) 1 month (D) 6 months

114. Herpes is treated by:
(A) vaccines (B) antibiotics (C) **antiviral drugs** (D) surgery

115. Poliovirus is an:
(A) adenovirus (B) **enterovirus** (C) retrovirus (D) bacteriophage

116. Poliovirus is transmitted by the:
(A) blood (B) **faecal-oral route** (C) insects (D) sexual contact

117. Paralysis in polio is due to destruction of:
(A) sensory neurons (B) **motor neurons in the spinal cord** (C) muscle cells (D) brain cells

118. The inactivated polio vaccine is the:
(A) Sabin vaccine (B) **Salk vaccine (IPV)** (C) OPV (D) BCG

119. The oral polio vaccine (OPV) is a:
(A) killed vaccine (B) **live attenuated Sabin vaccine** (C) toxoid (D) subunit vaccine

120. Cotton leaf curl disease is caused by:
(A) a bacterium (B) **Begomoviruses** (C) a fungus (D) a viroid

121. The vector of cotton leaf curl virus is:
(A) aphid (B) mosquito (C) **whitefly** (D) beetle

122. Control of cotton leaf curl disease mainly depends on:
(A) antibiotics (B) **insecticide treatment against the insect vector** (C) antiviral drugs (D) vaccines

123. A characteristic symptom of cotton leaf curl disease is the development of:
(A) blisters (B) **cup-shaped leaf-like structures (enations) on leaves** (C) white spots (D) wilting

124. The GDP loss of the world due to COVID-19 pandemic is more than:
(A) 1 trillion (B) 3.5 trillion (C) **8.5 trillion** (D) 100 billion

125. A flu vaccine is of limited use because:
(A) influenza virus is a bacterium (B) **flu virus strains evolve constantly and immune response changes over time** (C) it has no antigen (D) it is toxic

126. More than how many viruses cause the common cold?
(A) 20 (B) 50 (C) 100 (D) **200**

127. Prions are:
(A) viruses with DNA (B) **infectious protein particles with no nucleic acid** (C) RNA particles (D) bacteria

128. Prions were convincingly shown to exist by:
(A) Stanley (B) Iwanowsky (C) Baltimore (D) **Stanley Prusiner**

129. Prions are more resistant to:
(A) nucleases (B) **UV light and heat than viruses** (C) acids (D) salts

130. A prion disease of humans is:
(A) polio (B) **Kuru** (C) AIDS (D) measles

131. A prion disease of cattle is:
(A) foot and mouth disease (B) anthrax (C) **mad cow disease** (D) rabies

132. Prions are composed of:
(A) DNA and protein (B) RNA only (C) **a single protein encoded by a cellular gene** (D) lipids

133. Viroids are:
(A) protein particles (B) **short, circular, single-stranded RNA without protein coat** (C) double stranded DNA (D) enveloped viruses

134. Viroid RNA:
(A) codes for one protein (B) **does not code for any protein** (C) codes for capsid (D) is double stranded

135. Viroids replicate using the enzyme:
(A) DNA polymerase (B) reverse transcriptase (C) **RNA polymerase II** (D) integrase

136. Which is a plant disease caused by viroid?
(A) Cotton leaf curl (B) TMV (C) **Potato spindle tuber disease** (D) Rice blast

137. Viroids spread via:
(A) air (B) **mechanical damage, seed, pollen or biological vectors** (C) water only (D) soil only

138. Some viroids are ribozymes, meaning they can:
(A) make proteins (B) **self-cleave due to catalytic properties** (C) synthesize DNA (D) fix nitrogen

139. TMV infects only:
(A) mammals (B) bacteria (C) **tobacco and related plants** (D) insects

140. Human cold viruses infect only the cells lining the:
(A) intestine (B) liver (C) **upper respiratory tract** (D) brain

141. Which cells does HIV enter?
(A) Liver cells (B) Spinal nerve cells (C) **Certain types of white blood cells** (D) Red cells

142. Viruses are destroyed by:
(A) visible light (B) **ultraviolet rays** (C) sound (D) cold

143. Hepatitis E is prevented by:
(A) a vaccine (B) **proper hygiene as no vaccine or antiviral exists** (C) antibiotics (D) interferon

144. Which of the following can be used as a targeted drug delivery vehicle in nanomedicine?
(A) Prions (B) Viroids (C) **Bacteriophages** (D) HIV

145. A collection of clones containing all genes of an individual's genome is called a:
(A) gene bank (B) **genomic library** (C) plasmid library (D) vector bank

146. In HIV, the lipid membrane is acquired during:
(A) entry (B) **budding** (C) fusion (D) uncoating

Scenario based MCQs

Scenario 1: A scientist adds a bacteriophage to a bacterial culture. Within 25 minutes the culture clears and many new phage particles are found in the medium.

147. The type of life cycle shown is:
(A) lysogenic (B) **lytic** (C) latent (D) temperate

148. The first step of this cycle is:
(A) penetration (B) **adsorption** (C) assembly (D) lysis

149. The enzyme that digests the bacterial wall to let the core tube enter is:
(A) DNase (B) **lysozyme** (C) RNase (D) protease

150. The structure that enters the bacterium is the:
(A) whole phage (B) **phage DNA** (C) phage tail (D) phage sheath

Scenario 2: Another phage inserts its DNA into the bacterial chromosome and stays dormant for many generations. After UV exposure the bacteria suddenly burst.

151. The integrated phage DNA is called a:
(A) provirus (B) **prophage** (C) plasmid (D) episome only

152. The UV-triggered change is called:
(A) adsorption (B) **induction** (C) conversion (D) maturation

153. Such a phage is called:
(A) virulent (B) **temperate** (C) defective (D) lytic only

154. Prophage genes can give the bacterium new properties, a process called:
(A) transformation (B) conjugation (C) **lysogenic conversion** (D) induction

Scenario 3: A patient tests positive for antibodies against HIV. He has no symptoms except swollen lymph glands for months. Later he develops persistent diarrhoea, weight loss and skin cancer.

155. The first stage was the:
(A) full blown AIDS (B) **asymptomatic carrier stage** (C) ARC (D) incubation of TB

156. The final stage is:
(A) ARC (B) asymptomatic stage (C) **full blown AIDS** (D) carrier stage

157. The skin cancer is an example of:
(A) a chronic disease (B) **an opportunistic disease** (C) an autoimmune disease (D) a hereditary disease

158. The drug combination used to control his infection is called:
(A) IPV (B) OPV (C) **antiretroviral therapy (ART)** (D) phage therapy

Scenario 4: A farmer finds that his cotton plants have curled leaves with cup-shaped leaf-like outgrowths. Many whiteflies are present on the plants.

159. The disease is:
(A) TMV disease (B) **cotton leaf curl disease** (C) potato spindle tuber (D) bacterial blight

160. The causal agent is a:
(A) viroid (B) prion (C) **Begomovirus** (D) bacterium

161. The best control is:
(A) antibiotic spray (B) **insecticide against whitefly** (C) vaccine (D) antiviral drug

162. The role of whitefly is as:
(A) host (B) **vector** (C) reservoir (D) parasite

Scenario 5: A community health worker records that a child has fever, loss of appetite, nausea and jaundice. The family used contaminated water.

163. The most likely disease is:
(A) hepatitis A (B) hepatitis C (C) **hepatitis A, spread by faecal-oral route** (D) herpes

164. A preventive step available is:
(A) antibiotics (B) **vaccine with inactivated HAV and good hygiene** (C) phage therapy (D) interferon only

165. Another disease spread by faecal-oral route is:
(A) HIV (B) hepatitis B (C) **poliomyelitis** (D) herpes

166. Polio causes paralysis due to damage of:
(A) sensory nerves (B) **motor neurons in spinal cord** (C) skin (D) bone

Scenario 6: A farm animal develops memory loss and abnormal movement. Laboratory tests show no DNA or RNA in the infectious particle and it survives boiling.

167. The infectious agent is a:
(A) virus (B) bacteria (C) viroid (D) **prion**

168. It is composed of:
(A) DNA (B) RNA (C) **protein** (D) lipid

169. A similar human disease is:
(A) polio (B) **Kuru** (C) AIDS (D) hepatitis

170. The disease can be treated by:
(A) antibiotics (B) antiviral drugs (C) vaccine (D) **no treatment or cure is known**

Unit 6: Prokaryotes

Straight MCQs

1. Which of the following is absent in prokaryotic cells?
(A) Ribosomes (B) Cell membrane (C) **Membrane-bound nucleus and organelles** (D) Cytoplasm

2. The five-kingdom system was introduced in 1969 by:
(A) Carl Woese (B) **Robert H. Whittaker** (C) Lynn Margulis (D) Ernst Haeckel

3. The kingdom Monera for all prokaryotes was designated in 1988 by:
(A) Whittaker (B) Woese (C) **Lynn Margulis and Karlene Schwartz** (D) Linnaeus

4. Phylogenetics is the study of:
(A) classification of cells (B) **evolutionary relatedness among groups of organisms** (C) diseases of bacteria (D) cell structure

5. The three-domain system includes:
(A) Monera, Protista, Fungi (B) **Bacteria, Archaea and Eukarya** (C) Plantae, Animalia, Fungi (D) Archaea, Protista, Plantae

6. Carl Woese in 1977 identified that archaea have:
(A) the same lineage as bacteria (B) **a separate evolutionary lineage from bacteria** (C) no ribosomes (D) a nucleus

7. Ancestors of present bacteria emerged on earth about:
(A) 4 million years ago (B) 400 million years ago (C) **4 billion years ago** (D) 40 billion years ago

8. The most recent common ancestor of bacteria and archaea was probably a:
(A) psychrophile (B) **hyperthermophile** (C) halophile (D) mesophile

9. Archaea differ from bacteria because archaeal cell walls lack:
(A) proteins (B) **peptidoglycan** (C) lipids (D) cellulose

10. Introns are present in some genes of:
(A) eubacteria (B) **archaea** (C) cyanobacteria (D) none

11. RNA polymerase of archaea is:
(A) simple, like eubacteria (B) **complex, similar to eukaryotes** (C) absent (D) same as virus

12. Membrane lipids of archaea have:
(A) unbranched carbon chains (B) **branched carbon chains** (C) no carbon chains (D) only proteins

13. Methane producing archaea are called:
(A) halophiles (B) **methanogens** (C) thermoacidophiles (D) acidophiles

14. Methanobacterium smithii lives in the:
(A) hot springs (B) salty lakes (C) **human gut** (D) soil only

15. Salt-loving archaea are called:
(A) methanogens (B) **halophiles** (C) thermophiles (D) acidophiles

16. An example of a halophile is:
(A) Methanobacterium (B) **Halobacterium halobium** (C) Thermus aquaticus (D) Thermoplasma

17. Archaea which thrive in hot and acidic conditions are:
(A) halophiles (B) methanogens (C) **thermoacidophiles** (D) mesophiles

18. An example of a thermoacidophile is:
(A) Halobacterium (B) Methanobacterium (C) **Thermoplasma acidophilum** (D) Escherichia

19. The study of bacteria is called:
(A) mycology (B) **bacteriology** (C) virology (D) phycology

20. Bacteria were first discovered in 1674 by:
(A) Robert Koch (B) **Antonie van Leeuwenhoek** (C) Louis Pasteur (D) Ehrenberg

21. Leeuwenhoek called the bacteria he saw:
(A) bacilli (B) cocci (C) **animalcules** (D) germs

22. The name "bacterium" was introduced in 1882 by:
(A) Leeuwenhoek (B) Pasteur (C) **Christian Gottfried Ehrenberg** (D) Koch

23. The Greek word "bakteria" means:
(A) little cell (B) **little stick** (C) small ball (D) tiny thread

24. Hair-like structures on the bacterial surface which help in adhesion are:
(A) flagella (B) **pili** (C) capsule (D) mesosomes

25. Pili are made up of the protein:
(A) flagellin (B) **pilin** (C) keratin (D) collagen

26. Endospores in bacteria provide:
(A) a means of reproduction (B) **a means of survival in harsh conditions** (C) a means of movement (D) a means of feeding

27. Branching cell chains or filaments are a feature of the bacterial group:
(A) cyanobacteria (B) spirochetes (C) **actinomycetes** (D) mycoplasma

28. Actinomycetes are very common in:
(A) water (B) air (C) **soil** (D) animals only

29. The oldest branch of the bacterial domain is:
(A) Cyanobacteria (B) **Aquificales** (C) Proteobacteria (D) Bacteroides

30. The group with Escherichia and Salmonella is:
(A) Gram-positive (B) **Proteobacteria (purple bacteria)** (C) Cyanobacteria (D) Green sulfur bacteria

31. Staphylococcus, Clostridium and Bacillus belong to:
(A) Proteobacteria (B) Cyanobacteria (C) **Gram-positive bacteria** (D) Aquificales

32. Nostoc, Anabaena and Oscillatoria are:
(A) purple bacteria (B) **cyanobacteria** (C) archaea (D) spirochetes

33. Chlorobium is a:
(A) cyanobacterium (B) **green sulfur bacterium that does not produce oxygen** (C) methanogen (D) archaeon

34. Cyanobacteria are also called:
(A) red algae (B) green algae (C) **blue-green algae** (D) brown algae

35. The word "cyano" means:
(A) green (B) red (C) **blue** (D) yellow

36. Cyanobacteria are a type of:
(A) Gram-positive bacteria (B) **Gram-negative bacteria** (C) archaea (D) viruses

37. Cyanobacteria can live in hot springs up to:
(A) 45 degrees (B) 65 degrees (C) **85 degrees** (D) 100 degrees

38. Cyanobacteria in association with fungi form:
(A) mycorrhiza (B) **lichens** (C) nodules (D) biofilms

39. Cyanobacteria are believed to be among the first life forms to:
(A) live in oceans (B) **colonize land** (C) produce methane (D) cause disease

40. Photosynthesis in cyanobacteria takes place in:
(A) chloroplasts (B) **extensive membrane system in the outer zone of cytoplasm** (C) mitochondria (D) nucleoid

41. Cyanobacteria release oxygen during photosynthesis. They are responsible for:
(A) methane in atmosphere (B) **oxygen in the primitive atmosphere** (C) nitrogen (D) carbon dioxide

42. Sexual reproduction in cyanobacteria is:
(A) common (B) rare (C) **absent** (D) by conjugation

43. Akinetes are:
(A) motile spores (B) **enlarged resting cells of filament** (C) nitrogen fixing cells (D) toxins

44. The thick-walled cells with no nuclei where nitrogen fixation occurs in cyanobacteria are called:
(A) akinetes (B) hormogonia (C) **heterocysts** (D) endospores

45. Hormogonia are formed by:
(A) spore formation (B) **fragmentation of filament next to heterocyst** (C) binary fission (D) conjugation

46. In Pakistan cyanobacteria like Nostoc and Anabaena are cultivated to:
(A) produce oxygen (B) produce food (C) **enhance soil fertility by nitrogen fixation** (D) produce toxins

47. The outermost component common to all bacteria is the:
(A) capsule (B) cell membrane (C) **cell wall** (D) flagellum

48. The cell wall is absent in:
(A) Bacillus (B) E. coli (C) **Mycoplasma** (D) Clostridium

49. The bacterial cell wall is made of:
(A) cellulose (B) chitin (C) **peptidoglycan** (D) lignin

50. Peptidoglycan is also called:
(A) keratin (B) **murein or mucopeptide** (C) cutin (D) suberin

51. The capsule of bacteria is chemically a:
(A) protein (B) **polysaccharide (except in Anthrax bacillus)** (C) lipid (D) nucleic acid

52. The capsule of Anthrax bacillus is made of:
(A) polysaccharide (B) **polymerized D-glutamic acid** (C) lipid (D) cellulose

53. Gram-positive bacteria have a:
(A) thinner peptidoglycan than gram negative (B) **thicker peptidoglycan layer**

(C) outer membrane (D) no cell wall

54. Teichoic acid is found in:
(A) Gram-negative bacteria (B) **Gram-positive bacteria** (C) archaea only (D) cyanobacteria only

55. Lipopolysaccharide outer membrane is found in:
(A) Gram-positive bacteria (B) **Gram-negative bacteria** (C) both (D) neither

56. The space between the outer membrane and the cytoplasmic membrane in Gram-negative bacteria is the:
(A) cytosol (B) **periplasmic space** (C) nucleoid (D) lumen

57. Beta-lactamases in the periplasmic space break down:
(A) proteins (B) **penicillin and other beta-lactam drugs** (C) lipids (D) DNA

58. The three main shapes of bacteria are:
(A) rod, plate and cube (B) **spherical, rod-shaped and spiral** (C) cubic, oval and rod (D) star, round and rod

59. A spherical bacterium is a:
(A) bacillus (B) **coccus** (C) vibrio (D) spirillum

60. Cocci occurring in pairs are called:
(A) streptococci (B) **diplococci** (C) staphylococci (D) tetrad

61. Cocci in long chains are:
(A) **streptococci** (B) diplococci (C) staphylococci (D) tetrads

62. Cocci in grape-like clusters are:
(A) streptococci (B) diplococci (C) **staphylococci** (D) sarcina

63. A packet of eight cocci is called:
(A) tetrad (B) staphylococci (C) **sarcina (octad)** (D) diplococci

64. A packet of four cocci is a:
(A) sarcina (B) **tetrad** (C) staphylococci (D) streptococci

65. Rod-shaped bacteria are called:
(A) cocci (B) **bacilli** (C) spirochetes (D) vibrios

66. Comma-shaped curved bacteria are called:
(A) coccobacilli (B) diplobacilli (C) **vibrio** (D) palisade

67. Which is an example of a rod-shaped bacterium?
(A) Streptococcus (B) Neisseria (C) **Escherichia coli** (D) Treponema

68. Thin-walled, flexible spiral bacteria are:
(A) cocci (B) bacilli (C) **spirochetes** (D) vibrios

69. Treponema pallidum, causing syphilis, is a:
(A) coccus (B) bacillus (C) **spirochete** (D) vibrio

70. The size range of bacteria in a single dimension is about:
(A) 0.001 to 0.01 micrometre (B) **0.1 to 600 micrometres** (C) 10 to 100 mm (D) 1 to 5 cm

71. Endospore formation is also called:
(A) fission (B) budding (C) **sporulation** (D) conjugation

72. Endospores are formed by bacteria like:
(A) E. coli and Salmonella (B) **Clostridium and Bacillus** (C) Vibrio and Treponema (D) Nostoc and Anabaena

73. Endospore formation is not a means of reproduction because:
(A) spores are dead (B) **there is no increase in cell number** (C) spores are sterile (D) spores are asexual

74. The endospore has a thick coat of a:
(A) chitin-like material (B) **keratin-like material** (C) cellulose (D) glycogen

75. The smaller cell formed by asymmetric division during sporulation is the:
(A) mother cell (B) **forespore** (C) cortex (D) spore coat

76. Tetanus bacteria are resistant to conventional heat treatment because they:
(A) have a thick wall (B) have special enzymes (C) **form heat-resistant spores** (D) have an outer membrane

77. Motile bacteria move by:
(A) only flagella (B) only pili (C) **flagella, gliding, twitching motility or buoyancy changes** (D) cilia

78. In twitching motility bacteria use their:
(A) flagella (B) **pili as grappling hooks** (C) capsule (D) cell wall

79. Bacteria with a single flagellum are:
(A) amphitrichous (B) lophotrichous (C) **monotrichous** (D) peritrichous

80. Bacteria with a flagellum at each end are:
(A) monotrichous (B) **amphitrichous** (C) lophotrichous (D) peritrichous

81. Bacteria with clusters of flagella at the poles are:
(A) monotrichous (B) amphitrichous (C) **lophotrichous** (D) peritrichous

82. Bacteria with flagella all over the surface are:
(A) monotrichous (B) amphitrichous (C) lophotrichous (D) **peritrichous**

83. The two modes of movement in E. coli are swimming and:
(A) gliding (B) **tumbling** (C) twitching (D) floating

84. Movement of bacteria in response to chemical stimulus is:
(A) phototaxis (B) magnetotaxis (C) **chemotaxis** (D) thigmotaxis

85. Movement toward light is:
(A) chemotaxis (B) **phototaxis** (C) magnetotaxis (D) geotaxis

86. A bacterial flagellum is made of the protein:
(A) pilin (B) **flagellin** (C) tubulin (D) actin

87. The three parts of a bacterial flagellum are:
(A) head, tail and neck (B) **basal body, hook and filament** (C) axoneme, basal body and sheath (D) cap, stalk and base

88. The part that produces rotatory motion is the:
(A) filament (B) hook (C) **basal body** (D) capsule

89. The hook of the flagellum connects the basal body to the:
(A) cell wall (B) **filament** (C) cell membrane (D) DNA

90. The diameter of a bacterial flagellum is about:
(A) 2 nm (B) **20 nm** (C) 200 nm (D) 2 micrometre

91. Bacterial flagella lack:
(A) proteins (B) **microtubules** (C) a hook (D) a filament

92. The genetic material of E. coli is a:
(A) linear double stranded DNA (B) **single circular DNA of about 5 million base pairs** (C) RNA (D) several linear chromosomes

93. Spirochetes of the genus Borrelia contain:
(A) a circular chromosome (B) two circular chromosomes (C) **a single linear chromosome** (D) no DNA

94. Accessory rings of DNA in bacteria are called:
(A) nucleoids (B) **plasmids** (C) episomes only (D) mesosomes

95. Autotrophic bacteria obtain carbon from:
(A) organic compounds (B) **carbon dioxide** (C) glucose (D) proteins

96. The two major groups of autotrophic bacteria are:
(A) saprotrophic and parasitic (B) **photosynthetic and chemoautotrophic** (C) aerobic and anaerobic (D) Gram positive and Gram negative

97. Photosynthetic bacteria contain:
(A) chlorophyll a only (B) chlorophyll b (C) **bacteriochlorophyll** (D) carotene only

98. Chemoautotrophic bacteria obtain energy by:
(A) sunlight (B) **oxidation of inorganic substances** (C) eating organic matter (D) fermentation of sugar

99. Which is a chemoautotrophic bacterium?
(A) Nostoc (B) Purple sulphur bacteria (C) **Nitrifying bacteria and sulphur bacteria** (D) E. coli

100. Heterotrophic bacteria obtain carbon from:
(A) CO_2 (B) light (C) **organic carbon compounds** (D) nitrogen

101. Saprotrophic bacteria obtain nutrition from:
(A) living hosts (B) sunlight (C) **dead organic matter** (D) CO_2

102. Saprotrophs break down organic matter by secreting:
(A) toxins (B) **extracellular enzymes** (C) antibiotics (D) acids only

103. Example of a saprotrophic bacterium:
(A) Rickettsia (B) **Pseudomonas or Azotobacter** (C) Vibrio cholerae (D) Nitrosomonas

104. Rickettsia is an obligate:
(A) saprotroph (B) **parasite** (C) autotroph (D) symbiont

105. E. coli is a:
(A) obligate aerobe (B) obligate anaerobe (C) **facultative bacterium growing with or without oxygen** (D) microaerophile

106. Bacteria requiring low concentration of oxygen are:
(A) aerobic (B) anaerobic (C) facultative (D) **microaerophilic**

107. An example of a microaerophilic bacterium is:
(A) E. coli (B) Spirochaeta (C) Pseudomonas (D) **Campylobacter**

108. Cyanobacteria perform photosynthesis in:
(A) chromatophores (B) **thylakoids** (C) mesosomes (D) cytoplasm only

109. Phycobiliproteins in cyanobacteria include:
(A) carotene and xanthophyll (B) **phycocyanin and phycoerythrin** (C) chlorophyll b and c (D) anthocyanin

110. Other photosynthetic bacteria (purple and green) have pigments embedded in:
(A) thylakoids (B) **cell membrane invaginations called chromatophores** (C) chloroplasts (D) mitochondria

111. Other photosynthetic bacteria mostly:
(A) produce oxygen (B) **do not produce oxygen and use H_2S or organic molecules as electron donors** (C) use water as electron donor (D) do not photosynthesize

112. Bacteria reproduce asexually by:
(A) mitosis (B) meiosis (C) **binary fission** (D) budding only

113. One bacterium will produce how many bacteria after four generations?
(A) 4 (B) 8 (C) **16** (D) 32

114. Bacterial growth is described as:
(A) linear (B) **exponential (logarithmic)** (C) constant (D) declining

115. The bacterial growth curve has how many phases?
(A) 2 (B) 3 (C) **4** (D) 5

116. The correct sequence of phases of bacterial growth is:
(A) log, lag, stationary, death (B) **lag, log, stationary, death** (C) lag, stationary, log, death (D) stationary, lag, log, death

117. During the lag phase the bacteria:
(A) multiply rapidly (B) **adapt to the new environment** (C) die (D) stop metabolism

118. In the log phase the bacteria:
(A) do not grow (B) **divide at the maximum rate** (C) die rapidly (D) are dormant

119. In the stationary phase:
(A) growth rate is the highest (B) **the rate of new cell production equals the rate of cell death** (C) all cells die (D) the lag restarts

120. The death phase is characterized by:
(A) no division (B) adaptation (C) **increased death rate with cells stopping multiplication** (D) maximum division

121. Stationary phase occurs due to:
(A) excess nutrients (B) **exhaustion of nutrients, accumulation of toxic wastes and oxygen depletion** (C) addition of nutrients (D) lower temperature

122. The doubling time of E. coli is about:
(A) 2 minutes (B) **20 minutes** (C) 2 hours (D) 24 hours

123. The doubling time of Mycobacterium tuberculosis is more than:
(A) 20 minutes (B) 2 hours (C) **24 hours** (D) 5 minutes

124. In binary fission DNA replication begins at the:
(A) centromere (B) **origin of replication, proceeding bidirectionally** (C) telomere (D) end of chromosome

125. DNA of a bacterium is located in the:
(A) nucleus (B) **nucleoid region** (C) mesosome (D) plasmid only

126. Sexual reproduction in bacteria is:
(A) gamete fusion (B) **genetic recombination** (C) binary fission (D) sporulation

127. Genetic recombination in bacteria occurs by:
(A) mitosis, meiosis, fission (B) **conjugation, transduction and transformation** (C) budding, fragmentation, spores (D) replication, translation, transcription

128. Bacterial conjugation was demonstrated in 1946 by:
(A) Hershey and Chase (B) Griffith and Avery (C) **Lederberg and Tatum** (D) Meselson and Stahl

129. In conjugation the genetic material usually transferred is a:
(A) mRNA (B) **plasmid** (C) exon (D) promoter

130. Conjugation takes place through a:
(A) phage tail (B) capsule (C) **bridge-like connection (pilus)** (D) flagellum

131. The bacterium that gives the DNA is called the:
(A) recipient (B) **donor** (C) clone (D) host

132. Transfer of bacterial DNA by bacteriophages is called:
(A) conjugation (B) transformation (C) **transduction** (D) mutation

133. Absorption of naked DNA fragments from the environment into a cell is:
(A) conjugation (B) transduction (C) **transformation** (D) fission

134. Cells that take up DNA in transformation are called:
(A) donor cells (B) **transformed cells** (C) lysogenic cells (D) clones

135. Bacteria are described as clonal because they:
(A) reproduce sexually (B) **inherit identical copies of the parent's genes** (C) have no DNA (D) never mutate

136. Mutations in bacteria arise from:
(A) cell wall (B) **errors in DNA replication or exposure to mutagens** (C) nutrition only (D) oxygen only

137. Nitrogen fixing bacteria in legumes belong to genus:
(A) Nitrosomonas (B) **Rhizobium** (C) Nitrobacter (D) Clostridium

138. Nitrosomonas and Nitrobacter convert:
(A) nitrogen to ammonia (B) **ammonia to nitrate (nitrification)** (C) nitrate to nitrogen (D) protein to amino acids

139. Denitrifying bacteria convert:
(A) nitrogen to ammonia (B) ammonia to nitrate (C) **nitrates into nitrogen gas** (D) nitrite to ammonia

140. Bacteria and fungi as decomposers give rise to:
(A) peat (B) **humus** (C) coal (D) oil

141. Humus improves the soil by enriching nutrients and:
(A) reducing moisture (B) **enhancing capacity to retain moisture** (C) adding salts (D) lowering pH only

142. Bacteria which synthesize vitamin K and vitamin B12 in the gut include:
(A) Rhizobium (B) Bacillus (C) **Escherichia coli** (D) Vibrio

143. Acetic acid for vinegar production is made using:
(A) yeast (B) **bacteria** (C) algae (D) viruses

144. Streptomycin, Auromycin and Tetramycin are antibiotics obtained from:
(A) fungi (B) cyanobacteria (C) **actinomycetes (bacteria)** (D) yeast

145. Biogas is mainly composed of:
(A) carbon dioxide (B) hydrogen (C) **methane (about 54 to 70 percent)** (D) nitrogen

146. Single cell protein can be obtained from:
(A) only bacteria (B) only yeast (C) **bacteria, yeast, fungi and algae** (D) only algae

147. Hershey and Chase in 1952 used T2 bacteriophage to prove that:
(A) protein is genetic material (B) **DNA is the hereditary material** (C) RNA is genetic material (D) lipids are genetic material

148. Organisms with a foreign gene inserted into them are called:
(A) clones (B) mutants (C) **transgenic organisms** (D) hybrids

149. Insulin and growth hormone are produced using:
(A) viruses (B) **genetically engineered bacteria** (C) fungi only (D) algae

150. Bacteria used to clean oil spills show:
(A) biomagnification (B) **bioremediation** (C) biopiracy (D) bioleaching only

151. Bacteria used to extract copper, uranium and gold from low-grade ores is an example of:
(A) food processing (B) **mineral processing** (C) biogas production (D) fermentation

152. The main symptom of cholera is:
(A) high fever (B) cough with blood (C) **profuse watery diarrhoea** (D) jaundice

153. The causative agent of cholera is:
(A) Salmonella typhi (B) **Vibrio cholerae** (C) Mycobacterium tuberculosis (D) Streptococcus pneumoniae

154. The primary treatment of cholera is:
(A) antibiotics only (B) **replacement of fluids and electrolytes** (C) vaccines only (D) surgery

155. Cholera is mainly prevented by:
(A) antibiotics (B) **clean water supply and public health measures** (C) only a vaccine (D) isolation only

156. The causative agent of typhoid is:
(A) Vibrio cholerae (B) **Salmonella typhi** (C) Mycobacterium tuberculosis (D) Streptococcus pneumoniae

157. A characteristic symptom of typhoid is:
(A) watery diarrhoea (B) cough with blood (C) **high fever and rose coloured spots on abdomen** (D) paralysis

158. Typhoid is prevented by:
(A) smoking cessation (B) **hand washing, pasteurization of milk, proper cooking and vaccines** (C) mosquito control (D) only quarantine

159. The causative agent of tuberculosis is:
(A) Salmonella typhi (B) Vibrio cholerae (C) **Mycobacterium tuberculosis** (D) Streptococcus pneumoniae

160. Symptoms of secondary TB include:
(A) profuse diarrhoea (B) paralysis (C) **evening fever, night sweats, weight loss and bloodstained sputum** (D) jaundice

161. DOTS stands for:
(A) Direct Oral Treatment System (B) **Directly Observed Treatment Short course** (C) Disease Observation and Therapy System (D) Drug Oriented Treatment Scheme

162. The vaccine for TB, BCG, contains live:
(A) Mycobacterium tuberculosis (B) **Mycobacterium bovis** (C) Vibrio cholerae (D) Salmonella

163. BCG stands for:
(A) Bacillus Cell Growth (B) **Bacillus Calmette-Guerin** (C) Bacterial Culture Group (D) Biological Culture Gel

164. Multiple drug therapy is used in TB to prevent emergence of:
(A) toxins (B) **drug resistant mutants** (C) viruses (D) new vaccines

165. Pneumonia begins with sudden chills, cough and:
(A) diarrhoea (B) **pleuritic pain, with rusty coloured sputum** (C) paralysis (D)

jaundice

166. The causative agent of pneumonia is:
(A) Vibrio cholerae (B) Mycobacterium (C) **Streptococcus pneumoniae** (D) Salmonella

167. Pneumococci are susceptible to:
(A) tetracycline only (B) **penicillin and erythromycin** (C) streptomycin only (D) no drug

168. Important bacterial plant diseases include:
(A) rusts and smuts (B) **leaf spots, blights, soft rots, wilts and galls** (C) mosaic only (D) leaf curl only

169. Ring disease of potato is caused by:
(A) Erwinia (B) Pseudomonas (C) **Aplanobacter sepedonicum** (D) Xanthomonas

170. Soft rot of potato is caused by:
(A) Aplanobacter (B) **Erwinia atroseptica** (C) Agrobacterium (D) Rhizobium

171. In soft rot, the necrotized tissue becomes:
(A) dry and hard (B) **wet to touch and soft** (C) green (D) dark and woody

172. Pseudomonas solanacearum causes:
(A) soft rot (B) galls (C) **wilt disease of potato** (D) leaf spots

173. In wilt diseases the plant loses turgidity because of interference with:
(A) respiration (B) **upward transport of water through the stem** (C) photosynthesis (D) root growth

174. Crown gall in plants is caused by:
(A) Erwinia (B) **Agrobacterium tumefaciens** (C) Xanthomonas (D) Pseudomonas solanacearum

175. Olive knot is caused by:
(A) Agrobacterium (B) Rhizobium (C) **Pseudomonas savastanoi** (D) Erwinia

176. Root nodules of legumes are galls produced by:
(A) Agrobacterium (B) **Rhizobium leguminosarum** (C) Xanthomonas (D) Pseudomonas

177. Blight symptoms appear rapidly because:
(A) cells grow rapidly (B) **necrosis damages plant cell structure quickly and may kill the whole plant** (C) roots decay (D) flowers die

178. Normal flora refers to:
(A) harmful bacteria (B) **bacteria permanently resident in certain body parts** (C) bacteria in soil (D) viruses of the skin

179. In the human body, bacterial cells outnumber human cells by about:
(A) two times (B) five times (C) **ten times** (D) a hundred times

180. Normal flora is found especially in the:
(A) **skin, oropharynx, colon and vagina** (B) brain and heart (C) muscles and bone (D) blood and lymph

181. Lactobacillus is found in the:
(A) nose and skin (B) **mouth, colon and vagina** (C) lungs (D) blood

182. Staphylococcus aureus is normally found in the:
(A) colon (B) mouth (C) **nose and skin** (D) liver

183. Lactobacilli in the vagina keep it:
(A) alkaline (B) **acidic, preventing overgrowth of harmful bacteria and yeast** (C) neutral (D) sterile

184. The short-chain fatty acid made by gut bacteria is:
(A) citrate (B) **butyrate** (C) pyruvate (D) lactate

185. The gut bacteria produce vitamins:
(A) A and D (B) C and E (C) **B vitamins and K** (D) none

186. Competitive exclusion by normal flora means:
(A) they kill human cells (B) **they prevent harmful bacteria from colonizing the gut** (C) they digest the gut (D) they inactivate vitamins

187. Chemicals used to kill bacteria on inanimate surfaces are:
(A) antiseptics (B) **disinfectants** (C) preservatives (D) antibiotics

188. Chemicals used on living tissue to prevent infection are:
(A) disinfectants (B) **antiseptics** (C) preservatives (D) sterilants

189. Bleach is chemically:
(A) hydrogen peroxide (B) **sodium hypochlorite** (C) iodine (D) alcohol

190. Sodium benzoate and potassium sorbate are:
(A) disinfectants (B) antiseptics (C) **preservatives** (D) antibiotics

191. Chlorine is used in water treatment to:
(A) add minerals (B) **disinfect drinking water** (C) remove salts (D) raise pH

192. Sulfonamides and nitrofurans are used in:
(A) disinfection (B) **chemotherapy** (C) preservation (D) pasteurization

193. The process of killing all life forms is:
(A) disinfection (B) pasteurization (C) **sterilization** (D) preservation

194. Moist heat kills microbes by:
(A) oxidation (B) **protein coagulation** (C) dehydration (D) hydrolysis

195. Dry heat kills microbes by:
(A) protein coagulation (B) **oxidation of microbial constituents** (C) hydrolysis (D) osmosis

196. Heat-sensitive substances such as antibiotics and sera are sterilized by:
(A) autoclave (B) dry heat (C) **membrane filters** (D) boiling

197. Pasteurization of milk is done at:
(A) 37 degrees for 1 hour (B) 100 degrees for 30 minutes (C) **71 degrees for 15 seconds or 62 degrees for 30 minutes** (D) 121 degrees for 15 minutes

198. Pasteurization reduces the risk of:
(A) cholera and polio (B) **typhoid and tuberculosis** (C) AIDS (D) hepatitis B

199. Food preservation by low temperature is done at:
(A) minus 18 degrees (B) **10 to 15 degrees** (C) 37 degrees (D) 50 degrees

200. Freezing for food preservation uses temperatures of:
(A) 10 to 15 degrees (B) 0 to 5 degrees (C) **minus 10 to minus 18 degrees** (D) minus 80 degrees

201. Which method prevents growth by removal of water?
(A) Freezing (B) Pasteurization (C) **Drying (dehydration)** (D) Filtration

202. The cell wall of Gram-positive bacteria is differentiated from Gram-negative by:
(A) absence of peptidoglycan (B) **thicker peptidoglycan and teichoic acid** (C) presence of outer membrane (D) presence of periplasmic space

203. Bacteria can be classified by methods of obtaining energy and:
(A) size (B) **carbon** (C) colour (D) shape

Scenario based MCQs

Scenario 1: A microbiologist isolates a rod-shaped Gram-positive bacterium from soil. When the culture is starved and heated, the cells form oval bodies inside them which survive boiling for some minutes.

204. The oval bodies are:
(A) plasmids (B) **endospores** (C) capsules (D) mesosomes

205. This bacterium is probably:
(A) E. coli (B) Vibrio (C) **Bacillus or Clostridium** (D) Nostoc

206. This process is a means of:
(A) reproduction (B) **survival** (C) conjugation (D) movement

207. When conditions become favourable the spore:
(A) dies (B) forms two cells at once (C) **germinates into an active vegetative cell** (D) forms a plasmid

Scenario 2: Two mutant strains of E. coli, one needing substance A and the other needing substance B, are grown together in rich medium and then plated on minimal medium. Some colonies grow without A or B.

208. These colonies show:
(A) mutation (B) **genetic recombination** (C) binary fission (D) endospore formation

209. The experiment was done by:
(A) Hershey and Chase (B) **Lederberg and Tatum** (C) Griffith (D) Avery

210. The bridge between the two bacteria is formed by:
(A) flagella (B) **pilus (conjugation bridge)** (C) capsule (D) phage tail

211. The genetic material transferred is usually a:
(A) chromosome (B) **plasmid** (C) mitochondrion (D) ribosome

Scenario 3: A water sample from a flooded area causes watery rice-water stools in many children. Doctors give them oral rehydration salts.

212. The disease is most likely:
(A) typhoid (B) TB (C) **cholera** (D) pneumonia

213. The causative bacterium is:
(A) Salmonella typhi (B) **Vibrio cholerae** (C) Mycobacterium (D) Streptococcus

214. The main treatment is:
(A) surgery (B) **replacement of fluids and electrolytes** (C) vaccination only (D) isolation only

215. The key prevention is:
(A) mosquito nets (B) **clean water supply** (C) masks (D) sunlight

Scenario 4: A lab grows E. coli in nutrient broth and counts cells at intervals. At first the number rises slowly, then rapidly, then levels off, and finally falls.

216. The first phase is the:
(A) log phase (B) **lag phase** (C) stationary phase (D) death phase

217. In the second phase the cells:
(A) do not divide (B) **divide at maximum rate** (C) die (D) form spores

218. Levelling off occurs due to:
(A) excess food (B) **nutrient exhaustion and toxic wastes** (C) rising oxygen (D) lowered temperature

219. The last phase is called:
(A) lag phase (B) log phase (C) stationary phase (D) **death phase**

Scenario 5: A farmer in Punjab applies a blue-green algal culture (Nostoc and Anabaena) to his rice field instead of extra nitrogen fertilizer.

220. These organisms are:
(A) archaea (B) **cyanobacteria** (C) green algae (D) fungi

221. They improve soil fertility by:
(A) adding phosphorus (B) **fixing atmospheric nitrogen in heterocysts** (C) adding potash (D) adding water

222. The special cell for nitrogen fixation is the:
(A) akinete (B) **heterocyst** (C) hormogonium (D) endospore

223. These bacteria release oxygen during:
(A) respiration (B) fermentation (C) **photosynthesis** (D) decomposition

Scenario 6: A sample is taken from hot spring water. The microbe found there has no peptidoglycan in its cell wall and has introns in some of its genes.

224. The microbe belongs to:
(A) eubacteria (B) **archaea** (C) cyanobacteria (D) Protista

225. The best term for it, if it likes hot acidic water, is:
(A) halophile (B) methanogen (C) **thermoacidophile** (D) mesophile

226. Its RNA polymerase is similar to that of:
(A) viruses (B) eubacteria (C) **eukaryotes** (D) plants only

227. An example of the microbe could be:
(A) Escherichia coli (B) **Thermus aquaticus** (C) Nostoc (D) Bacillus

Unit 7: Protists and Fungi

Straight MCQs

1. The name "protist" comes from a Greek word meaning:
(A) small (B) **the very first** (C) single cell (D) water

2. Protists are eukaryotes. They differ from bacteria because they have:
(A) cell walls (B) **membrane-bound nuclei and organelles such as mitochondria and plastids** (C) flagella only (D) no DNA

3. The term "polyphyletic" refers to a group of organisms that:
(A) share a common ancestor (B) are all autotrophic (C) **do not share a common ancestor and evolved independently** (D) are all multicellular

4. Protists are mainly defined by:
(A) what they are (B) **what they are not, as they do not fit in plants, animals or fungi** (C) their size (D) their habitat only

5. The giant kelp, a brown alga, can be as long as:
(A) 6 metres (B) **60 metres** (C) 600 metres (D) 1 metre

6. Even multicellular protists lack:
(A) cell walls (B) nuclei (C) **specialized tissues** (D) mitochondria

7. Water molds obtain their food by:
(A) photosynthesis (B) ingestion (C) **absorption like fungi** (D) chemosynthesis

8. Protozoa and slime molds obtain their food by:
(A) photosynthesis (B) **ingesting food from other living things like animals** (C) absorption only (D) chemosynthesis

9. Most protists live in:
(A) deserts (B) **water, oceans or freshwater** (C) air (D) rocks

10. Which of the following is NOT a major group of protists?
(A) Protozoa (B) Algae (C) Oomycota (D) **Zygomycota**

11. The four major groups of protists are:
(A) **Protozoa, Algae, Myxomycota and Oomycota** (B) Protozoa, Algae, Zygomycota and Ascomycota (C) Algae, Fungi, Bacteria and Viruses (D) Protozoa, Plants, Fungi and Animals

12. The word "protozoa" is derived from Greek words meaning:
(A) first cells (B) **first animals** (C) small animals (D) one animal

13. Entamoeba histolytica and Plasmodium are examples of:
(A) free living protozoa (B) **parasitic protozoa** (C) algae (D) slime molds

14. In protozoans the food vacuole functions in:
(A) removal of water (B) **digestion of trapped food with enzymes** (C) movement (D) photosynthesis

15. Contractile vacuoles in protozoa:
(A) digest food (B) **pump out excess water to maintain internal balance** (C) store food (D) make ATP

16. Organs of locomotion in Amoeba are the:
(A) cilia (B) flagella (C) **pseudopodia** (D) fins

17. Paramecium moves by:
(A) pseudopodia (B) flagella (C) **cilia** (D) no movement

18. Trypanosoma moves by:
(A) pseudopodia (B) cilia (C) **flagella** (D) none

19. Plasmodium (malarial parasite) has:
(A) pseudopodia (B) cilia (C) flagella (D) **no specific locomotory organ**

20. Protozoa form resistant structures called cysts to:
(A) reproduce (B) **overcome unfavourable conditions** (C) feed (D) move

21. Amoeba proteus uses pseudopodia for:
(A) feeding only (B) movement only (C) **both movement and feeding** (D) reproduction

22. Protozoans that move using flagella are:
(A) ciliates (B) amoebas (C) **zooflagellates** (D) foraminifera

23. Giardia intestinalis infects the:
(A) liver (B) **small intestine causing giardiasis** (C) blood (D) lungs

24. Choanoflagellates are structurally similar to the:
(A) cells of Hydra (B) **collar cells of sponges** (C) cells of jellyfish (D) blood cells

25. Ciliates are named after a Latin word for:
(A) hair (B) thread (C) **eyelash** (D) whip

26. Examples of ciliates include:
(A) Amoeba and Entamoeba (B) **Paramecium, Stentor and Vorticella** (C) Euglena and Giardia (D) Plasmodium and Giardia

27. Foraminifera have shells made of:
(A) silica (B) **calcium** (C) cellulose (D) chitin

28. Actinopods have shells made of:
(A) calcium (B) **silica** (C) cellulose (D) chitin

29. Apicomplexans are:
(A) free-living amoebas (B) **parasitic protozoa with complex life cycles and host invasion structures** (C) algae (D) slime molds

30. Algae are responsible for about what percentage of photosynthesis on the planet?
(A) 10 to 20 (B) 30 to 40 (C) **50 to 60** (D) 90

31. The body of multicellular algae like seaweeds is called a:
(A) mycelium (B) **thallus** (C) plasmodium (D) hypha

32. Algae lack:
(A) chlorophyll (B) **roots, stems, leaves and vascular tissues** (C) cell walls (D) nuclei

33. Coenocytes are structures with:
(A) no nucleus (B) one nucleus (C) **many nuclei in a shared cytoplasm** (D) two cells

34. Almost all algae except red algae have flagellated motile cells at some stage. Red algae belong to the phylum:
(A) Chlorophyta (B) Phaeophyta (C) **Rhodophyta** (D) Euglenophyta

35. Algae differ from plants because algae:
(A) have chlorophyll (B) **have unicellular sex organs and unprotected zygotes, and do not form embryos** (C) have cell walls (D) perform photosynthesis

36. Approximately how many phyla of algae are discussed in the text?
(A) Three (B) Four (C) Five (D) **Six**

37. Euglena is an example of:
(A) diatoms (B) **euglenoids** (C) dinoflagellates (D) red algae

38. Euglena has:
(A) a cell wall of cellulose (B) **a pellicle, eyespot, contractile vacuole and two flagella (one long, one short)** (C) no flagella (D) a shell of silica

39. Euglena is a protist which:
(A) is only an autotroph (B) is only a heterotroph (C) **has chloroplasts but can also feed by ingestion or absorption** (D) is a parasite

40. Dinoflagellates are bounded by protective plates of:
(A) silica (B) **cellulose impregnated with silica** (C) chitin (D) protein

41. Most dinoflagellates have:
(A) no flagella (B) one flagellum (C) **two flagella** (D) many cilia

42. Bioluminescence in the sea is due to:
(A) diatoms (B) euglenoids (C) **dinoflagellates** (D) kelps

43. Red tides are caused by blooms of:
(A) diatoms (B) **dinoflagellates** (C) green algae (D) brown algae

44. Paralytic Shellfish Poisoning (PSP) is caused by toxins of the genus:
(A) Chlorella (B) **Alexandrium** (C) Laminaria (D) Volvox

45. Diatoms are the most numerous:
(A) multicellular algae (B) **unicellular algae in the oceans** (C) fungi (D) protozoans

46. The cell wall of a diatom is made of:
(A) cellulose (B) chitin (C) **silica in two halves like a box and lid** (D) protein

47. The silica shells of diatoms are called:
(A) tests (B) **frustules** (C) thalli (D) cysts

48. Fossil diatom deposits are used in:
(A) making sugar (B) **cosmetics, filters and nanotechnology (diatomaceous earth)** (C) making medicine for malaria (D) making agar

49. Brown algae can grow up to:
(A) 7.5 metres (B) 20 metres (C) **75 metres** (D) 750 metres

50. Giant brown algae are commonly known as:
(A) diatoms (B) **kelps** (C) agar (D) plankton

51. Laminaria is a:
(A) red alga (B) green alga (C) **brown alga** (D) diatom

52. Alginates obtained from brown algae are used as:
(A) antibiotics (B) **thickeners and stabilizers in food and pharmaceuticals** (C) fuel (D) fertilizer only

53. Red algae are mainly found in:
(A) cold polar water (B) freshwater (C) **warm seawater** (D) soil

54. Red algae are attached to rocks by a:
(A) rhizoid (B) **holdfast** (C) root (D) stalk

55. Agar, used in microbiology labs, is obtained from:
(A) brown algae (B) green algae (C) **red algae** (D) diatoms

56. Green algae are believed to be closely related to plants because they have:
(A) roots (B) **cellulose cell walls and chlorophyll a and b** (C) flowers (D) seeds

57. Which is a green alga?
(A) Laminaria (B) Euglena (C) **Spirogyra** (D) Diatom

58. Chlorella is used as a:
(A) dye (B) fuel only (C) **nutritious food source and in photosynthesis research** (D) poison

59. Which of these is a colonial green alga?
(A) Spirogyra (B) **Volvox** (C) Chlorella (D) Ulva

60. Ulva is commonly called:
(A) **sea lettuce** (B) kelp (C) diatom (D) red tide

61. The vegetative body of a plasmodial slime mold is the:
(A) thallus (B) mycelium (C) **plasmodium, a diploid multinucleate cytoplasmic mass** (D) hypha

62. Slime molds belong to the phylum:
(A) Oomycota (B) Zygomycota (C) **Myxomycota** (D) Rhodophyta

63. In slime molds spores are produced inside:
(A) asci (B) basidia (C) **sporangia by meiosis** (D) zoosporangia

64. Physarum is a:
(A) water mold (B) **plasmodial slime mold** (C) fungus (D) alga

65. Oomycota include:
(A) slime molds (B) **water molds, white rusts and downy mildews** (C) sac fungi (D) club fungi

66. The cell wall of Oomycota is made of:
(A) chitin (B) **cellulose** (C) protein (D) peptidoglycan

67. The hyphae of Oomycota are:
(A) septate (B) **aseptate and coenocytic** (C) absent (D) dikaryotic

68. Swimming spores of oomycetes are called:
(A) conidia (B) ascospores (C) **zoospores** (D) basidiospores

69. Zoospores are produced:
(A) sexually (B) **asexually in sporangia, and have a single whip-like flagellum** (C) in asci (D) in basidia

70. The female gametangium in Oomycota is the:
(A) antheridium (B) **oogonium** (C) ascus (D) sporangium

71. The male gametangium in Oomycota is the:
(A) **antheridium** (B) oogonium (C) ascus (D) zygote

72. The thick-walled sexual spore that gives the phylum its name is the:
(A) zoospore (B) conidium (C) **oospore** (D) zygospore

73. Phytophthora infestans caused the:
(A) Bengal famine (B) **Irish Potato Famine** (C) cholera epidemic (D) corn blight

74. Haustoria of Phytophthora:
(A) produce spores (B) **penetrate host leaves to obtain nourishment** (C) produce flagella (D) fix nitrogen

75. Entamoeba histolytica causes:
(A) malaria (B) sleeping sickness (C) **amoebic dysentery** (D) giardiasis

76. Acanthamoeba can cause:
(A) malaria (B) **keratitis of the eye, related to contact lens hygiene** (C) dysentery (D) sleeping sickness

77. Leishmaniasis in Pakistan is caused by Leishmania, transmitted by:
(A) mosquito (B) tsetse fly (C) **sandfly bites** (D) housefly

78. The study of fungi is called:
(A) phycology (B) **mycology** (C) virology (D) bacteriology

79. Fungi are:
(A) autotrophic (B) **heterotrophic and absorb nutrients by external digestion** (C) photosynthetic (D) chemosynthetic

80. Fungal cell walls contain:
(A) cellulose (B) peptidoglycan (C) **chitin** (D) lignin

81. The body of a fungus is called a:
(A) thallus only (B) **mycelium made of hyphae** (C) plasmodium (D) frond

82. Hyphae without cross walls are:
(A) septate (B) **non-septate (coenocytic)** (C) dikaryotic (D) haploid only

83. Which fungus has coenocytic hyphae?
(A) Penicillium (B) **Rhizopus** (C) Agaricus (D) Aspergillus

84. Which fungus has septate hyphae?
(A) Rhizopus (B) **Penicillium** (C) Mucor (D) Phytophthora

85. Fungi store carbohydrates as:
(A) starch (B) **glycogen** (C) cellulose (D) sucrose

86. Fungi are non-motile and lack:
(A) cell walls (B) nuclei (C) **flagella at any stage of the life cycle** (D) spores

87. Fungi were originally classified in kingdom:
(A) Animalia (B) Protista (C) **Plantae** (D) Monera

88. Which feature fungi share with plants?
(A) Chlorophyll (B) Flagella (C) **Cell wall and spores** (D) Chitin

89. Fungi differ from plants in being:
(A) non-motile (B) **saprotrophic or heterotrophic with chitin wall and no chlorophyll** (C) spore producing (D) having cell wall

90. The largest living organism on earth is a fungus named:
(A) Agaricus bisporus (B) Rhizopus nigricans (C) **Armillaria ostoyae** (D) Penicillium notatum

91. The fungal groups are classified mainly on the basis of:
(A) size (B) habitat (C) **methods of reproduction and types of sexual structures** (D) colour

92. Which group is known as conjugating fungi?
(A) Ascomycota (B) Basidiomycota (C) **Zygomycota** (D) Deuteromycota

93. Black bread mold is:
(A) Penicillium (B) **Rhizopus nigricans** (C) Agaricus (D) Saccharomyces

94. Zygomycota hyphae are:
(A) septate (B) **non-septate** (C) dikaryotic (D) absent

95. Sexual reproduction in Rhizopus takes place by conjugation between:
(A) male and female hyphae (B) **plus and minus mating strains** (C) identical hyphae (D) spores

96. The thick-walled resistant sexual structure of Rhizopus is the:
(A) oospore (B) ascospore (C) basidiospore (D) **zygospore**

97. Fusion of gametangia in Rhizopus forms a:
(A) haploid spore (B) **diploid zygote developing into a zygospore** (C) conidium (D) ascus

98. Asexual reproduction in Rhizopus is by:
(A) conidia (B) budding (C) **spores formed in sporangia** (D) fragmentation only

99. Sac fungi belong to:
(A) Zygomycota (B) **Ascomycota** (C) Basidiomycota (D) Deuteromycota

100. Sac fungi are named after their reproductive structure the:
(A) basidium (B) **ascus** (C) sporangium (D) zygospore

101. Each ascus usually contains:
(A) two ascospores (B) four ascospores (C) **eight haploid ascospores** (D) sixteen ascospores

102. Asexual spores of Ascomycota are:
(A) zoospores (B) **conidia borne on conidiophores** (C) basidiospores (D) zygospores

103. Yeasts reproduce asexually by:
(A) fission (B) conidia (C) **budding** (D) fragmentation

104. Which of the following is an Ascomycete?
(A) Agaricus (B) **Yeast, Neurospora, morels and truffles** (C) Rhizopus (D) Puccinia

105. The fruiting body of Ascomycetes is the:
(A) basidiocarp (B) **ascocarp** (C) sporangium (D) mushroom

106. A dikaryotic cell has:
(A) no nucleus (B) one nucleus (C) **two distinct nuclei in the same cell** (D) four

nuclei

107. Club fungi belong to:
(A) Zygomycota (B) Ascomycota (C) **Basidiomycota** (D) Deuteromycota

108. Mushrooms, rusts, smuts and puffballs belong to:
(A) Ascomycota (B) Zygomycota (C) **Basidiomycota** (D) Deuteromycota

109. Sexual spores of Basidiomycota are:
(A) ascospores (B) zygospores (C) oospores (D) **basidiospores borne on basidia**

110. The fruiting body of a mushroom is the:
(A) ascocarp (B) **basidiocarp** (C) sporangium (D) zygospore

111. The thin plates on the lower side of a mushroom cap are the:
(A) stalks (B) annulus (C) **gills** (D) buttons

112. Primary mycelium of Basidiomycota is:
(A) dikaryotic (B) diploid (C) **monokaryotic (n)** (D) polyploid

113. Secondary mycelium of mushroom is:
(A) monokaryotic (B) **dikaryotic (n+n)** (C) diploid (D) absent

114. Nuclear fusion in a mushroom occurs in the:
(A) stalk (B) mycelium (C) spores (D) **basidium on the gills**

115. A mushroom is formed from a compact mass called a:
(A) **button** (B) gill (C) cap (D) ascus

116. Imperfect fungi are placed in:
(A) Zygomycota (B) Ascomycota (C) Basidiomycota (D) **Deuteromycota**

117. Imperfect fungi are so called because:
(A) they are small (B) **sexual reproduction is not known in them** (C) they lack hyphae (D) they lack spores

118. Which is an imperfect fungus?
(A) Rhizopus (B) Agaricus (C) **Penicillium, Aspergillus, Alternaria and Fusarium** (D) Yeast

119. Genetic recombination in imperfect fungi occurs by:
(A) conjugation (B) meiosis (C) **parasexuality** (D) budding

120. Yeast produces ethyl alcohol and carbon dioxide by:
(A) photosynthesis (B) respiration (C) **fermentation of sugars** (D) hydrolysis

121. The yeast used for baking and brewing is:
(A) Candida albicans (B) **Saccharomyces cerevisiae** (C) Penicillium notatum (D) Aspergillus niger

122. In bread making, dough rises due to:
(A) alcohol (B) **carbon dioxide gas produced by yeast** (C) oxygen (D) water vapour

123. The hepatitis B vaccine is produced using:
(A) bacteria (B) **yeast** (C) viruses (D) algae

124. Yeast is a good model organism because of its:
(A) large size (B) **simple, well characterized genome and similarity to human genes** (C) multicellular body (D) chloroplasts

125. Penicillin is obtained from:
(A) Streptomyces griseus (B) **Penicillium chrysogenum** (C) Aspergillus fumigatus (D) Saccharopolyspora

126. Streptomycin is obtained from:
(A) **Streptomyces griseus** (B) Penicillium (C) Aspergillus (D) Yeast

127. Tetracycline is obtained from:
(A) Penicillium (B) **Streptomyces aureofaciens** (C) Aspergillus (D) Rhizopus

128. Erythromycin is obtained from:
(A) Penicillium (B) Streptomyces griseus (C) **Saccharopolyspora erythraea** (D) Aspergillus

129. Fumigatin is obtained from:
(A) Penicillium (B) **Aspergillus fumigatus** (C) Streptomyces (D) Saccharopolyspora

130. Mutualism is the association in which:
(A) one gains and one loses (B) **both partners get benefit** (C) neither benefits (D) one benefits and the other is unaffected

131. A lichen is an association between a fungus and:
(A) a bacterium only (B) a virus (C) **an alga or cyanobacterium** (D) a moss

132. In lichens the fungus is mostly:
(A) Zygomycota (B) **Ascomycota** (C) Oomycota (D) Myxomycota

133. In the lichen the photosynthetic cells are present in the:
(A) upper layer (B) **middle layer, intertwined with fungal hyphae** (C) lower layer (D) outside

134. Mycorrhiza is an association between fungus and:
(A) algae (B) **roots of higher plants** (C) leaves (D) bacteria

135. Mycorrhiza occurs in about what percentage of higher plant families?
(A) 25 (B) 50 (C) 75 (D) **95**

136. Mycorrhizal fungi help plants absorb mainly:
(A) nitrogen (B) **phosphorus, zinc and copper** (C) potassium only (D) water only

137. The fungus gets from mycorrhiza:
(A) minerals (B) **carbohydrates from the plant** (C) oxygen (D) water only

138. Fungi that penetrate the root cells forming coils and swellings are:
(A) ectomycorrhizae (B) **endomycorrhizae** (C) lichens (D) rhizoids

139. Fungi that form a protective sheath outside the root are:
(A) endomycorrhizae (B) **ectomycorrhizae** (C) lichens (D) rhizoids

140. Ectomycorrhizae are typically associated with:
(A) wheat (B) rice (C) **pines and firs** (D) maize

141. The most commonly cultivated edible mushroom genus is:
(A) Amanita (B) **Agaricus** (C) Penicillium (D) Rhizopus

142. The deadliest mushrooms belong to the genus:
(A) Agaricus (B) Morchella (C) **Amanita** (D) Aspergillus

143. The "death cap" is:
(A) Agaricus bisporus (B) Morchella esculenta (C) **Amanita phalloides** (D) Pleurotus

144. Morels and truffles belong to:
(A) Basidiomycota (B) Zygomycota (C) **Ascomycota** (D) Deuteromycota

145. Fungi act as decomposers and are important for:
(A) only cancer (B) **nutrient cycling** (C) photosynthesis (D) nitrogen fixation

146. Powdery mildew, chestnut blight and Dutch elm disease are caused by:
(A) basidiomycetes (B) **ascomycetes** (C) zygomycetes (D) oomycetes

147. Smuts and rusts of wheat and corn are caused by:
(A) ascomycetes (B) zygomycetes (C) **basidiomycetes** (D) oomycetes

148. Ringworm and athlete's foot are:
(A) systemic infections (B) **superficial skin infections by fungi** (C) viral infections (D) bacterial infections

149. Athlete's foot is caused by:
(A) Microsporum audouinii (B) **Tinea pedis** (C) Candida (D) Aspergillus

150. Oral thrush is caused by:
(A) Aspergillus (B) Histoplasma (C) **Candida (a yeast)** (D) Penicillium

151. Histoplasmosis is a serious infection of the:
(A) skin (B) brain (C) **lungs, caused by inhaling Histoplasma spores** (D) liver

152. Aflatoxin, a cancer causing mycotoxin, is produced by:
(A) Aspergillus fumigatus (B) **some strains of Aspergillus flavus** (C) Penicillium (D) Candida

153. Aflatoxin is found in improperly stored:
(A) milk (B) **peanuts and corn** (C) meat (D) fish

154. Ergotism is caused by ergot of:
(A) wheat (B) maize (C) **rye (Claviceps purpurea)** (D) rice

155. Pneumocystis pneumonia mainly affects people with:
(A) strong immunity (B) **weak immunity such as HIV/AIDS patients** (C) diabetes only (D) children only

156. Aspergillosis is seen in:
(A) fish (B) **birds, particularly parrots, and immunocompromised humans** (C) frogs (D) insects

157. Which activity can be used to study Rhizopus?
(A) **Growing it on moist stale bread** (B) Growing in sugar water (C) Growing in dry soil (D) Growing on glass

158. A saprotroph feeds on:
(A) living tissues (B) **non-living, rotten organic matter (detritus)** (C) sunlight (D) inorganic matter

159. Which of the following is NOT a similarity between fungi and animals?
(A) Heterotrophic nutrition (B) Storage of glycogen (C) Chitin (D) **Presence of chloroplast**

160. The ancestry of fungi is thought to be from:
(A) green algae (B) brown algae (C) **red algae** (D) diatoms

161. Fungi are thought to have originated about:
(A) 57 million years ago (B) 5.7 million years ago (C) **570 million years ago** (D) 5700 million years ago

162. In fungal mitosis the nuclear envelope:
(A) always breaks down (B) **does not break, and the spindle forms inside the nucleus** (C) is absent (D) is made of chitin

Scenario based MCQs

Scenario 1: A student keeps a slice of bread moist in a closed bag for a few days. A fuzzy white growth appears, later with tiny black dots at the tips of upright stalks. Under the microscope the threads have no cross walls.

163. The fungus is most probably:
(A) Penicillium (B) Agaricus (C) **Rhizopus** (D) Yeast

164. The black dots are:
(A) zygospores (B) **sporangia containing spores** (C) ascocarps (D) basidia

165. The hyphae without cross walls are called:
(A) septate (B) **coenocytic** (C) dikaryotic (D) diploid

166. The fungus belongs to:
(A) Ascomycota (B) **Zygomycota** (C) Basidiomycota (D) Deuteromycota

Scenario 2: A baker adds a small amount of Saccharomyces to flour, sugar and warm water. After one hour the dough has doubled and smells of alcohol.

167. The gas which makes the dough rise is:
(A) oxygen (B) **carbon dioxide** (C) nitrogen (D) hydrogen

168. This process is:
(A) photosynthesis (B) **alcoholic fermentation** (C) lactic fermentation (D) aerobic respiration only

169. The yeast reproduces asexually by:
(A) conidia (B) fission (C) **budding** (D) zoospores

170. Yeast is a member of:
(A) Zygomycota (B) **Ascomycota** (C) Basidiomycota (D) Oomycota

Scenario 3: A farmer sees potato leaves with brown scarred areas and white downy growth on the underside after a wet, cool spell.

171. The pathogen is:
(A) Rhizopus (B) **Phytophthora infestans** (C) Aspergillus (D) Penicillium

172. It belongs to:
(A) fungi (B) **Oomycota (water molds)** (C) Myxomycota (D) Ascomycota

173. Its cell wall is made of:
(A) chitin (B) **cellulose** (C) peptidoglycan (D) lignin

174. The structures used to absorb nutrients from the host cells are:
(A) rhizoids (B) **haustoria** (C) sporangia (D) conidia

Scenario 4: A hiker finds a mushroom on a forest floor. It has a stalk, a cap with gills, and a ring on the stalk.

175. The fruiting body is called a:
(A) ascocarp (B) **basidiocarp** (C) sporangium (D) zygospore

176. Spores are produced on the:
(A) cap surface (B) stalk (C) **gills, on club-shaped basidia** (D) ring

177. The mycelium inside the mushroom stalk is:
(A) monokaryotic (B) **dikaryotic (n+n)** (C) diploid (D) haploid

178. Nuclei fuse in the:
(A) mycelium (B) stalk (C) **basidium** (D) spore

Scenario 5: A rock in a forest has grey crusty patches. Under the microscope, a fungus and green photosynthetic cells are seen together.

179. The patches are:
(A) mosses (B) **lichens** (C) mycorrhiza (D) algae

180. The photosynthetic partner is:
(A) a bacterium only (B) **an alga or a cyanobacterium** (C) a fern (D) a virus

181. The fungus is mostly a member of:
(A) Zygomycota (B) **Ascomycota** (C) Oomycota (D) Myxomycota

182. The relationship was traditionally thought to be:
(A) parasitism (B) commensalism (C) **mutualism** (D) predation

Scenario 6: Fishermen on a coast find that shellfish are poisonous after a red coloured bloom in the sea.

183. The organisms in the bloom were likely:
(A) diatoms (B) green algae (C) **dinoflagellates** (D) kelp

184. The condition is called:
(A) dysentery (B) **paralytic shellfish poisoning** (C) malaria (D) giardiasis

185. The genus responsible is:
(A) Chlorella (B) **Alexandrium** (C) Volvox (D) Ulva

186. The same group can also produce light, known as:
(A) photosynthesis (B) **bioluminescence** (C) chemosynthesis (D) phototaxis

Unit 8: Plantae

Straight MCQs

1. The migration of plants from water to land started nearly:
(A) 40 million years ago (B) **400 million years ago** (C) 4 billion years ago (D) 4000 years ago

2. Plants are thought to have descended from an ancestral:
(A) cyanobacterium (B) archaeon (C) **freshwater green alga (charophycean)** (D) brown alga

3. Plants are protected from drying in air by a waxy covering called the:
(A) **cuticle formed of cutin** (B) cell wall of lignin (C) stomata (D) epidermis of cellulose

4. The plant body having roots, stems and leaves with vascular tissue consists of:
(A) xylem only (B) phloem only (C) **xylem and phloem** (D) tracheids only

5. The diploid generation which produces haploid spores by meiosis is the:
(A) gametophyte (B) **sporophyte** (C) zygote (D) protonema

6. The haploid generation which produces gametes by mitosis is the:
(A) sporophyte (B) **gametophyte** (C) zygote (D) embryo

7. Alternation of generations in plants is:
(A) isomorphic only (B) **heteromorphic, with distinct sporophyte and gametophyte** (C) absent (D) found only in algae

8. Plants produce gametes which are:
(A) isogametes (B) **oogamous (morphologically and physiologically different)** (C) identical (D) spores

9. The closest living relatives of land plants are:
(A) brown algae (B) red algae (C) **charophycean (green) algae** (D) diatoms

10. In the phylogenetic classification, Kingdom Plantae is divided into:
(A) Algae and Fungi (B) **Bryophytes and Tracheophytes** (C) Gymnosperms and Angiosperms (D) Vascular and algae

11. The non-vascular plants are:
(A) tracheophytes (B) **bryophytes** (C) pteridophytes (D) spermatophytes

12. Bryophytes include:
(A) ferns, horsetails and mosses (B) **liverworts, mosses and hornworts** (C) mosses and ferns (D) liverworts and gymnosperms

13. The vascular plants are:
(A) bryophytes (B) **tracheophytes** (C) charophytes (D) algae

14. Tracheophytes are named after the universal presence of:
(A) phloem fibres (B) companion cells (C) **tracheids in xylem** (D) stomata

15. Free-sporing vascular plants are collectively:
(A) gymnosperms (B) angiosperms (C) **pteridophytes** (D) bryophytes

16. Pteridophytes are a ... group while spermatophytes are a ... group:
(A) monophyletic; paraphyletic (B) **paraphyletic; monophyletic** (C) polyphyletic; paraphyletic (D) monophyletic; polyphyletic

17. Bryophytes lack true:
(A) cells (B) chlorophyll (C) **roots, stems and leaves** (D) spores

18. The dominant generation in bryophytes is the:
(A) sporophyte (B) **gametophyte** (C) zygote (D) embryo

19. Bryophyte sporophytes are:
(A) larger than gametophyte (B) independent (C) **small and depend on the gametophyte for food** (D) heterosporous

20. Bryophytes are:
(A) heterosporous (B) **homosporous** (C) seed-producing (D) vascular

21. Root-like structures in bryophytes are called:
(A) roots (B) **rhizoids** (C) rhizomes (D) fronds

22. The male sex organ in bryophytes is the:
(A) archegonium (B) **antheridium** (C) sporangium (D) ovule

23. The female sex organ in bryophytes is the:
(A) **archegonium** (B) antheridium (C) sporangium (D) strobilus

24. Bryophyte sperm needs a film of water to:
(A) germinate (B) **swim to the egg** (C) form spores (D) produce the embryo

25. Bryophytes are called amphibious plants of the plant kingdom because they:
(A) are aquatic only (B) are terrestrial only (C) **live on land but need water for fertilization** (D) lack tissues

26. Marchantia is a:
(A) moss (B) hornwort (C) **liverwort** (D) fern

27. Polytrichum belongs to:
(A) Hepaticopsida (B) **Bryopsida (mosses)** (C) Anthocerotopsida (D) Psilopsida

28. The three subdivisions of bryophytes are:
(A) Psilopsida, Lycopsida, Sphenopsida (B) **Hepaticopsida, Bryopsida and Anthocerotopsida** (C) Cycadopsida, Pinopsida, Gnetopsida (D) Monocots, dicots, ferns

29. The sterile layer of cells around sex organs of bryophytes is the:
(A) cuticle (B) **jacket layer** (C) paraphyses (D) rhizoid

30. Paraphyses in Polytrichum are:
(A) spores (B) gametes (C) **multicellular hair-like structures among sex organs** (D) rhizoids

31. When antheridia and archegonia are on separate plants, the condition is:
(A) monoecious (B) **dioecious** (C) bisexual (D) homosporous

32. Funaria is:
(A) dioecious (B) **monoecious** (C) heterosporous (D) a liverwort

33. The sporophyte of Polytrichum consists of foot, seta and:
(A) rhizoid (B) protonema (C) **capsule** (D) antheridium

34. The first cell of the sporophyte generation is the:
(A) spore (B) egg (C) **zygote** (D) protonema

35. The first cell of the gametophyte generation is the:
(A) zygote (B) **spore** (C) egg (D) embryo

36. Spore germination in moss gives rise to an algal-like structure called:
(A) thallus (B) rhizoid (C) **protonema** (D) strobilus

37. Peat moss is commercially important as a:
(A) fuel only (B) **soil conditioner that holds water** (C) food (D) medicine

38. Reindeer moss is actually a:
(A) true moss (B) fern (C) **lichen** (D) alga

39. The simplest of the vascular plants are:
(A) club mosses (B) horsetails (C) **whisk ferns (Psilopsida)** (D) ferns

40. Whisk ferns lack true roots but have underground stems called:
(A) fronds (B) **rhizomes** (C) stolons (D) tubers

41. A common example of a surviving whisk fern is:
(A) Rhynia (B) **Psilotum** (C) Selaginella (D) Equisetum

42. An extinct whisk fern is:
(A) Psilotum (B) **Rhynia** (C) Lycopodium (D) Adiantum

43. Club mosses belong to:
(A) Psilopsida (B) **Lycopsida** (C) Sphenopsida (D) Pteropsida

44. Leaves of club mosses are called:
(A) megaphylls (B) **microphylls with a single vascular strand** (C) fronds (D) needles

45. Sporangia of club mosses are borne in:
(A) sori (B) **strobili** (C) cones of pine (D) fruits

46. Examples of club mosses are:
(A) Psilotum and Rhynia (B) **Lycopodium and Selaginella** (C) Equisetum and Pinus (D) Adiantum and Pteris

47. Horsetails belong to:
(A) Psilopsida (B) Lycopsida (C) **Sphenopsida** (D) Pteropsida

48. Horsetails are also called arthrophytes because of their:
(A) whorled flowers (B) **slender, green, hollow jointed stems** (C) club-shaped strobili (D) coiled fronds

49. The genus of horsetail is:
(A) Psilotum (B) Lycopodium (C) **Equisetum** (D) Adiantum

50. Ferns belong to class:
(A) Psilopsida (B) Lycopsida (C) Sphenopsida (D) **Filicinae (Pteropsida)**

51. In ferns the sporophyte is:
(A) smaller than gametophyte (B) dependent (C) **large, conspicuous and independent** (D) absent

52. Spore bearing leaves of ferns are called:
(A) strobili (B) cones (C) **fronds** (D) thalli

53. Young fern fronds are coiled. This pattern of growth is called:
(A) dichotomous venation (B) **circinate vernation** (C) pinnate venation (D) alternate phyllotaxy

54. Adiantum is commonly known as:
(A) horsetail (B) **maidenhair fern** (C) club moss (D) whisk fern

55. The stem of Adiantum is:
(A) aerial and erect (B) **an underground horizontal rhizome** (C) a tree trunk (D) a stolon

56. The brownish scales on Adiantum rhizome are called:
(A) rachis (B) **ramenta** (C) indusium (D) annulus

57. Clusters of sporangia in ferns are called:
(A) strobili (B) cones (C) **sori** (D) fronds

58. The sorus in Adiantum is protected by a:
(A) true indusium (B) **false indusium (bent leaf margin)** (C) scale (D) ramenta

59. The part of a fern sporangium wall with thick-walled cells is the:
(A) stomium (B) **annulus** (C) capsule (D) stalk

60. The thin-walled cells where fern sporangium bursts form the:
(A) annulus (B) **stomium** (C) rachis (D) sorus

61. The gametophyte of Adiantum is called the:
(A) protonema (B) **prothallus (heart-shaped)** (C) strobilus (D) frond

62. The fern gametophyte is:
(A) diploid (B) **haploid** (C) triploid (D) absent

63. Fern antherozoids reach the archegonia by:
(A) wind (B) **chemotactic movement in water** (C) insects (D) pollen tube

64. Fern life cycle illustrates:
(A) isomorphic alternation of generations (B) **heteromorphic alternation of generations** (C) no alternation (D) sexual only

65. Spermatophytes are:
(A) seedless vascular plants (B) **seed-producing vascular plants** (C) non-vascular plants (D) algae

66. The two classes of spermatophytes are:
(A) Monocots and Dicots (B) **Gymnospermae and Angiospermae** (C) Ferns and mosses (D) Pteridophytes and bryophytes

67. All spermatophytes are:
(A) homosporous (B) **heterosporous** (C) non-vascular (D) seedless

68. The small male spores are called:
(A) megaspores (B) **microspores** (C) zoospores (D) akinetes

69. The ovule is another name for the:
(A) microsporangium (B) **megasporangium (with integuments)** (C) antheridium (D) pollen sac

70. The protective layers around a megasporangium are the:
(A) cuticle (B) **integuments** (C) testa only (D) carpels

71. The small opening in the ovule through which pollen tube enters is the:
(A) stigma (B) **micropyle** (C) style (D) hilum

72. In an ovule how many megaspores out of four are functional?
(A) Four (B) Three (C) Two (D) **One**

73. After fertilization the ovule becomes the:
(A) fruit (B) **seed** (C) embryo only (D) flower

74. The integuments form the:
(A) fruit wall (B) embryo (C) **seed coat** (D) endosperm

75. The name Gymnosperm means:
(A) enclosed seed (B) **naked seed** (C) flowering seed (D) fruit seed

76. Gymnosperms constitute about what fraction of the world's forests?
(A) One-tenth (B) **One-third** (C) One-half (D) Three-quarters

77. Gymnosperms lack:
(A) seeds (B) cones (C) **flowers and fruits** (D) xylem

78. Xylem of gymnosperms consists of tracheids and xylem parenchyma and generally lacks:
(A) tracheids (B) **vessels and fibres (except Gnetales)** (C) parenchyma (D) cambium

79. The phloem of gymnosperms lacks:
(A) sieve cells (B) **companion cells** (C) parenchyma (D) fibres

80. Xerophytic features of gymnosperm leaves include:
(A) large thin lamina (B) **thick cuticle, sunken stomata and wax** (C) no stomata (D) large air spaces

81. The two subclasses of gymnosperms are:
(A) Monocots and dicots (B) **Cycadophytes and Coniferophytes** (C) Gnetales and Ginkgoales (D) Pinus and Cycas

82. Which is a cycad?
(A) Pinus (B) Taxus (C) **Cycas** (D) Cedrus

83. Which is a conifer?
(A) Cycas (B) **Pinus** (C) Ginkgo only (D) Ephedra

84. Sago is obtained from:
(A) Pinus (B) **Cycas circinalis** (C) Cedrus (D) Taxus

85. Ephedrine from Ephedra is used for:
(A) heart diseases (B) **asthma and respiratory ailments** (C) malaria (D) cancer

86. Chilgoza is the edible seed of:
(A) Cedrus (B) **Pinus gerardiana** (C) Cycas (D) Taxus

87. Deodar is:
(A) Pinus (B) Picea (C) **Cedrus** (D) Taxus

88. Resins, turpentine and tar are obtained from:
(A) angiosperms (B) cycads (C) **conifers** (D) ferns

89. Pinus belongs to the order:
(A) Cycadales (B) Ginkgoales (C) **Coniferales** (D) Gnetales

90. The dominant generation in Pinus is:
(A) gametophyte (B) **sporophyte (diploid)** (C) haploid (D) zygote

91. The spore-producing structures in Pinus are the:
(A) flowers (B) fruits (C) **cones (strobili)** (D) sori

92. Male cones of pine are:
(A) large (6 to 12 inches) (B) **small (less than an inch) borne in clusters** (C) woody (D) found on lower branches

93. Female cones of pine are:
(A) small (B) **large, 6 to 12 inches, woody** (C) on top branches only (D) absent

94. Each microsporophyll bears how many microsporangia?
(A) One (B) **Two** (C) Four (D) Six

95. At the base of each megasporophyll how many ovules are present?
(A) One (B) **Two** (C) Four (D) Six

96. The pollen grains of Pinus have:
(A) no wings (B) **wings for wind dispersal** (C) flagella (D) thick spines only

97. Transfer of pollen to the female cone is:
(A) fertilization (B) germination (C) **pollination** (D) dehiscence

98. In gymnosperms each male gametophyte contributes only one sperm. This is:
(A) double fertilization (B) **single fertilization** (C) triple fusion (D) parthenogenesis

99. Female gametophyte of Pinus contains:
(A) antheridia (B) **archegonia** (C) synergids (D) antipodals

100. In Pinus the pollen tube enters the ovule through the:
(A) stigma (B) **micropyle** (C) style (D) chalaza

101. The word angiosperm means:
(A) naked seed (B) **enclosed seed** (C) flowering plant only (D) coat seed

102. The reproductive structure of angiosperms is the:
(A) cone (B) sorus (C) **flower** (D) strobilus

103. After fertilization the ovary develops into the:
(A) seed (B) **fruit** (C) endosperm (D) embryo

104. The outermost whorl of a flower is the:
(A) corolla (B) androecium (C) **calyx** (D) gynoecium

105. The petals together form the:
(A) calyx (B) **corolla** (C) androecium (D) gynoecium

106. The male reproductive whorl is the:
(A) calyx (B) corolla (C) **androecium** (D) gynoecium

107. The female reproductive whorl is the:
(A) calyx (B) corolla (C) androecium (D) **gynoecium**

108. The accessory whorls of a flower are:
(A) androecium and gynoecium (B) **calyx and corolla** (C) androecium and calyx (D) corolla and gynoecium

109. The necessary whorls of the flower are:
(A) **androecium and gynoecium** (B) calyx and corolla (C) calyx and androecium (D) corolla and gynoecium

110. Each stamen consists of a filament and a:
(A) stigma (B) style (C) **bilobed anther** (D) ovary

111. Each anther lobe contains how many pollen sacs (microsporangia)?
(A) Two (B) **Two in each lobe, four in total** (C) Six (D) Eight

112. The female part consists of ovary, style and:
(A) anther (B) **stigma** (C) filament (D) sepal

113. The stalk of a flower is called:
(A) thalamus (B) **pedicel** (C) filament (D) style

114. Pollen grains are formed from microspore mother cells by:
(A) mitosis (B) **meiosis** (C) budding (D) fission

115. A pollen grain contains the tube nucleus and the:
(A) polar nucleus (B) **generative nucleus which divides into two sperm nuclei** (C) egg (D) antipodal

116. The tube nucleus is responsible for forming the:
(A) sperm (B) **pollen tube** (C) embryo sac (D) endosperm

117. The functional megaspore in angiosperm undergoes how many mitotic divisions?
(A) One (B) Two (C) **Three, resulting in 8 nuclei** (D) Four

118. The embryo sac typically has how many nuclei?
(A) Four (B) Six (C) **Eight** (D) Sixteen

119. The egg is flanked by two:
(A) antipodals (B) polar nuclei (C) **synergids** (D) tube nuclei

120. The three nuclei at the end opposite the egg apparatus are the:
(A) synergids (B) **antipodals** (C) polar nuclei (D) sperms

121. The two nuclei in the centre of the embryo sac are the:
(A) synergids (B) antipodals (C) **polar nuclei** (D) egg nuclei

122. Double fertilization is found in:
(A) gymnosperms (B) ferns (C) mosses (D) **angiosperms**

123. In double fertilization one sperm fuses with the egg to form the:
(A) endosperm (B) **zygote (2n)** (C) seed coat (D) fruit

124. The other sperm fuses with the polar nuclei to form the:
(A) zygote (B) embryo (C) **triploid endosperm (3n)** (D) seed coat

125. The endosperm in angiosperms is:
(A) haploid (B) diploid (C) **triploid** (D) tetraploid

126. The integuments of the ovule develop into the:
(A) endosperm (B) fruit (C) **seed coat (testa and tegmen)** (D) embryo

127. The ovary wall develops into:
(A) seed coat (B) endosperm (C) **fruit wall** (D) embryo

128. The two subclasses of angiosperms are:
(A) gymnosperms and ferns (B) **dicotyledonae and monocotyledonae** (C) brassica and poaceae (D) herbs and shrubs

129. Dicot leaves have:
(A) parallel venation (B) **reticulate venation** (C) no veins (D) dichotomous venation

130. Monocot leaves have:
(A) reticulate venation (B) **parallel venation** (C) no veins (D) net venation

131. Vascular bundles are scattered in the:
(A) dicot stem (B) **monocot stem** (C) both (D) neither

132. Vascular cambium is present in:
(A) monocot stem (B) **dicot stem** (C) both (D) neither

133. A monocot has how many cotyledons?
(A) Two (B) **One** (C) Three (D) None

134. Monocots typically have a:
(A) taproot (B) **fibrous root system** (C) no root (D) aerial root

135. Dicot flowers are usually:
(A) trimerous (B) **tetra or pentamerous** (C) bimerous (D) hexamerous

136. Monocot flowers are usually:
(A) pentamerous (B) **trimerous (parts in threes)** (C) tetramerous (D) dimerous

137. Which is a monocot?
(A) Rose (B) Pea (C) **Lily** (D) Buttercup

138. Which is a dicot?
(A) Wheat (B) Rice (C) Orchid (D) **Rose**

139. Xylem patches in the dicot root are:
(A) more than 8 (B) **2 to 8** (C) exactly 10 (D) absent

140. Secondary growth occurs in:
(A) monocot roots (B) **dicot stems and roots** (C) both always (D) neither

141. The Brassicaceae was previously called:
(A) Gramineae (B) **Cruciferae** (C) Solanaceae (D) Leguminosae

142. Brassicaceae is also known as the:
(A) grass family (B) potato family (C) **mustard or cabbage family** (D) pea family

143. Brassicaceae flowers have:
(A) five petals (B) **four petals in a cross-like (cruciform) arrangement** (C) three petals (D) no petals

144. The characteristic fruit of Brassicaceae is the:
(A) berry (B) caryopsis (C) **silique** (D) drupe

145. Many members of Brassicaceae produce pungent:
(A) alkaloids (B) **glucosinolates** (C) terpenes (D) tannins

146. Which is a mustard used for oil extraction?
(A) Solanum tuberosum (B) **Brassica campestris** (C) Oryza sativa (D) Triticum

147. Raphanus sativus is:
(A) potato (B) tomato (C) **radish** (D) wheat

148. Capsella bursa-pastoris is a:
(A) common crop (B) **common weed of medicinal value** (C) tree (D) fern

149. Iberis amara (candytuft) and wallflower in this family are grown as:
(A) vegetables (B) **ornamentals** (C) fodder (D) timber

150. The Solanaceae is also called the:
(A) mustard family (B) grass family (C) **potato or nightshade family** (D) pea family

151. Solanaceae flowers are usually:
(A) trimerous (B) tetramerous (C) **pentamerous with five sepals and five united petals** (D) dimerous

152. The common fruit types of Solanaceae are:
(A) caryopsis (B) siliques (C) **berries and capsules** (D) nuts

153. Many Solanaceae contain:
(A) glucosinolates (B) **alkaloids such as nicotine** (C) cyclodextrin (D) resins

154. Nicotine is obtained from:
(A) potato (B) tomato (C) **Nicotiana tabacum** (D) brinjal

155. The scientific name of potato is:
(A) Lycopersicum esculentum (B) **Solanum tuberosum** (C) Capsicum annum (D) Brassica rapa

156. The scientific name of tomato is:
(A) Solanum tuberosum (B) **Lycopersicum esculentum** (C) Capsicum annum (D) Solanum melongena

157. Brinjal (eggplant) is:
(A) Solanum tuberosum (B) **Solanum melongena** (C) Capsicum (D) Nicotiana

158. Capsicum annuum is:
(A) brinjal (B) tomato (C) **chilli or bell pepper** (D) tobacco

159. Petunia is an ornamental member of:
(A) Brassicaceae (B) Poaceae (C) **Solanaceae** (D) Fabaceae

160. Poaceae was formerly called:
(A) Cruciferae (B) **Gramineae** (C) Solanaceae (D) Fabaceae

161. Poaceae is the most economically important:
(A) dicot family (B) gymnosperm family (C) **monocot family** (D) fern family

162. The fruit of grasses is a:
(A) berry (B) silique (C) **caryopsis (grain)** (D) capsule

163. Grasses are mostly:
(A) insect pollinated (B) **wind pollinated** (C) water pollinated (D) bird pollinated

164. Grass flowers lack:
(A) stamens (B) pistils (C) **showy petals** (D) ovary

165. Which gives sugar?
(A) Triticum (B) Avena (C) **Saccharum officinarum (sugarcane)** (D) Hordeum

166. Fibre for rope making is obtained from:
(A) Cymbopogon (B) Oryza (C) **Saccharum munja** (D) Hordeum

167. Lemongrass oil is obtained from:
(A) Saccharum (B) **Cymbopogon citratus** (C) Oryza (D) Triticum

168. Bamboo is a member of:
(A) Brassicaceae (B) Solanaceae (C) **Poaceae** (D) Fabaceae

169. Oats is scientifically:
(A) Triticum (B) **Avena sativa** (C) Hordeum vulgare (D) Oryza sativa

170. Rye belongs to:
(A) Brassicaceae (B) Solanaceae (C) **Poaceae** (D) Fabaceae

171. Rum is made from molasses of:
(A) wheat (B) rye (C) barley (D) **sugarcane**

172. Whisky is prepared from:
(A) potato (B) rice (C) **rye, barley and corn** (D) tomato

173. Cotton and paper are pure forms of:
(A) lignin (B) **cellulose** (C) chitin (D) starch

174. Alternation of generations includes a ... generation in angiosperms that is dominant:
(A) gametophyte (B) **sporophyte** (C) haploid (D) zygote

175. The ovule of angiosperms is homologous to the:
(A) cone scale of gymnosperms (B) **megasporangium (ovule) of gymnosperms** (C) pollen (D) anther

176. A flower is analogous to which structure of gymnosperms?
(A) Seed (B) **Cone** (C) Fruit (D) Leaf

177. Heterospory in seed plants gives rise to two spore types:
(A) zoospores and akinetes (B) **microspores and megaspores** (C) conidia and ascospores (D) oospores and zygospores

178. Pollen tube enables:
(A) sperm to swim in water (B) **water-independent fertilization on land** (C) germination of seed (D) spore release

Scenario based MCQs

Scenario 1: A student collects a small, green plant from a damp wall. It has no true roots or stems, bears leaf-like parts and slender stalks ending in capsules. She sprinkles water on a mature one and sees minute swimming cells.

179. The plant is a:
(A) fern (B) **moss (bryophyte)** (C) conifer (D) alga

180. The plant body she sees is the:
(A) sporophyte (B) **gametophyte** (C) embryo (D) zygote

181. The capsules on slender stalks are part of the:
(A) gametophyte (B) **sporophyte** (C) protonema (D) rhizoid

182. Swimming sperm need water because the plant lacks:
(A) chlorophyll (B) **pollen tubes and vascular tissues** (C) cells (D) nuclei

Scenario 2: In a shady garden, a student finds a plant with a heart-shaped green body no bigger than a coin growing on damp soil and a nearby plant with large pinnate leaves bearing brown dots on the underside.

183. The heart-shaped structure is the:
(A) sporophyte (B) **prothallus (gametophyte)** (C) rhizome (D) frond

184. The brown dots are:
(A) seeds (B) flowers (C) **sori, clusters of sporangia** (D) buds

185. The large leafy plant is the:
(A) gametophyte (B) **sporophyte** (C) embryo (D) spore

186. The plant is likely:
(A) Funaria (B) **Adiantum (a fern)** (C) Pinus (D) Lycopodium

Scenario 3: A forester finds a tree with needle-like leaves and woody cones. The seeds are on the surface of scales and no fruit is present.

187. The tree is a:
(A) angiosperm (B) **gymnosperm** (C) fern (D) moss

188. The seed-bearing structure is the:
(A) flower (B) **female cone** (C) fruit (D) pod

189. The pollen grains are carried by:
(A) insects (B) water (C) **wind** (D) birds

190. The male gametophyte contributes how many sperm?
(A) Two (B) **One, so fertilization is single** (C) Three (D) Four

Scenario 4: A farmer cultivates two crops: wheat and mustard. The wheat has parallel veined narrow leaves and fibrous roots. The mustard has netted veined leaves, a taproot and four petalled yellow flowers.

191. Wheat is a:
(A) dicot (B) **monocot** (C) gymnosperm (D) fern

192. Mustard is a:
(A) monocot (B) **dicot belonging to Brassicaceae** (C) gymnosperm (D) fern

193. The wheat belongs to the family:
(A) Brassicaceae (B) Solanaceae (C) **Poaceae** (D) Fabaceae

194. The wheat fruit is a:
(A) silique (B) berry (C) **caryopsis** (D) capsule

Scenario 5: A flower has a single seed in its ovary. A pollen grain landed on the stigma, formed a tube, and two sperm entered the ovule. One fused with the egg and the other with two polar nuclei.

195. The process is called:
(A) single fertilization (B) **double fertilization** (C) parthenogenesis (D) pollination only

196. The nucleus formed with polar nuclei and one sperm will form the:
(A) embryo (B) **endosperm (3n)** (C) seed coat (D) fruit wall

197. The zygote becomes the:
(A) endosperm (B) **embryo** (C) testa (D) pericarp

198. The ovary wall becomes the:
(A) seed (B) embryo (C) **fruit** (D) endosperm

Scenario 6: A student examines a potato plant and a tomato plant. Both have five sepals, five united petals, and berries or tubers. A crushed leaf has an unpleasant smell.

199. Both plants belong to:
(A) Brassicaceae (B) Poaceae (C) **Solanaceae** (D) Fabaceae

200. A poisonous compound in the family is:
(A) glucosinolate (B) **alkaloid such as nicotine and solanine** (C) starch (D) cellulose

201. Tobacco belongs to this family and is:
(A) **Nicotiana tabacum** (B) Brassica nigra (C) Oryza sativa (D) Zea mays

202. The edible fruit types of this family are mostly:
(A) siliques (B) caryopses (C) **berries** (D) pods

Unit 9: Diversity in Plant Functions

Straight MCQs

1. A nutrient is defined as any substance that:
(A) gives colour to the plant (B) **supplies essential elements required for growth and metabolic functions** (C) is made only by animals (D) is a hormone

2. Plant nutrients mainly consist of:
(A) organic compounds (B) **inorganic compounds** (C) proteins (D) vitamins

3. The number of elements found essential for plant growth is:
(A) nine (B) seven (C) **sixteen** (D) twenty

4. The number of macronutrients is:
(A) seven (B) **nine** (C) sixteen (D) six

5. Macronutrients are required in quantities greater than:
(A) 5 percent of dry weight (B) 0.5 percent (C) **0.05 percent of dry weight** (D)

0.005 percent

6. The number of micronutrients is:
(A) nine (B) **seven (as per the text list)** (C) sixteen (D) three

7. Which of the following is a macronutrient?
(A) Iron (B) Zinc (C) **Phosphorus** (D) Boron

8. Which of the following is a micronutrient?
(A) Potassium (B) Calcium (C) **Manganese** (D) Magnesium

9. Which pair are both micronutrients?
(A) Calcium and iron (B) **Boron and zinc** (C) Nitrogen and copper (D) Potassium and chlorine

10. Carbon and oxygen each constitute about what percentage of plant dry mass?
(A) 6 (B) 10 (C) **45** (D) 1.5

11. Hydrogen constitutes about what percentage of plant dry mass?
(A) 45 (B) **6** (C) 1.5 (D) 0.2

12. Nitrogen is a component of:
(A) cell wall only (B) **nucleic acids, proteins and chlorophyll** (C) starch (D) cellulose

13. Plants take up nitrogen as:
(A) N2 only (B) **nitrate and ammonium ions** (C) nitrite only (D) urea only

14. Chlorosis at the tips of older leaves is the deficiency symptom of:
(A) potassium (B) **nitrogen** (C) calcium (D) iron

15. Potassium deficiency causes:
(A) death of terminal buds (B) **mottling of older leaves with drying of leaf edges and weak stems** (C) chlorosis of young leaves (D) wilting

16. Potassium functions in:
(A) cell wall formation (B) **water balance, operation of stomata and as enzyme cofactor** (C) chlorophyll core (D) nitrogen fixation

17. Calcium is an important component of:
(A) chlorophyll (B) proteins (C) **middle lamella and cell walls** (D) ATP

18. Death of terminal buds and crinkling of young leaves is due to the deficiency of:
(A) nitrogen (B) **calcium** (C) magnesium (D) sulphur

19. Magnesium is a component of:
(A) cell wall (B) proteins (C) **chlorophyll** (D) ATP only

20. Interveinal chlorosis in older leaves is due to deficiency of:
(A) iron (B) nitrogen (C) **magnesium** (D) sulphur

21. Phosphorus is a component of:
(A) **nucleic acids, phospholipids and ATP** (B) proteins only (C) cellulose (D) chlorophyll

22. Purpling of veins with poor flowering and fruiting indicates deficiency of:
(A) nitrogen (B) potassium (C) **phosphorus** (D) sulphur

23. Sulphur is a component of:
(A) nucleic acids (B) chlorophyll (C) **proteins** (D) cellulose

24. General chlorosis in young leaves is the sign of deficiency of:
(A) nitrogen (B) **sulphur** (C) phosphorus (D) potassium

25. Iron is required in:
(A) cell division (B) **chlorophyll synthesis, respiration and nitrogen fixation** (C) water balance only (D) cell wall synthesis

26. Interveinal chlorosis in young leaves in basic soils is due to deficiency of:
(A) magnesium (B) nitrogen (C) **iron** (D) calcium

27. Boron is required for:
(A) chlorophyll core (B) **cell wall function and pollen tube growth** (C) nitrogen metabolism (D) photosynthesis only

28. Death of meristems and thick, leathery, discoloured leaves is caused by deficiency of:
(A) zinc (B) copper (C) **boron** (D) nickel

29. The most common micronutrient deficiency is of:
(A) iron (B) zinc (C) **boron** (D) copper

30. Zinc deficiency causes:
(A) death of meristems (B) **reduced internode length and crinkled leaves** (C) chlorosis of old leaves (D) wilting

31. Molybdenum and nickel are involved in:
(A) photosynthesis (B) respiration (C) **nitrogen metabolism** (D) cell wall synthesis

32. Manganese is required for:
(A) protein synthesis (B) **water splitting step of photosynthesis and activation of enzymes** (C) nitrogen metabolism (D) cell wall

33. Chlorine is involved in:
(A) nucleic acid synthesis (B) respiration (C) **photosynthesis (water splitting) and water balance** (D) enzymes only

34. Copper is a component of:
(A) chlorophyll (B) **many redox and lignin-biosynthetic enzymes** (C) cell wall (D) nucleic acid

35. Death of a part of the plant body is called:
(A) chlorosis (B) **necrosis** (C) etiolation (D) stunting

36. Yellowing of the green parts of plants due to lack of chlorophyll is:
(A) necrosis (B) **chlorosis** (C) etiolation (D) wilting

37. Stunted growth is due to deficiency of:
(A) only nitrogen (B) **phosphorus, sulphur and potassium** (C) only iron (D) only calcium

38. Cultivating different crops alternately on the same soil is called:
(A) mixed cropping (B) **crop rotation** (C) monocropping (D) vernalization

39. Growing plants in nutrient solution without soil is called:
(A) tissue culture (B) **hydroponics** (C) vernalization (D) grafting

40. Carnivorous plants are:
(A) non-photosynthetic (B) **photosynthetic autotrophs which trap insects** (C) heterotrophs only (D) parasites

41. Carnivorous plants use insects as a supplementary source of:
(A) carbon (B) **nitrogen** (C) phosphorus (D) calcium

42. Carnivorous plants usually grow in:
(A) nitrogen-rich soils (B) **nitrogen-deficient habitats like marshes** (C) deserts (D) oceans

43. Pitcher plant is:
(A) Dionaea muscipula (B) **Nepenthes** (C) Drosera (D) Utricularia

44. Venus flytrap is:
(A) Nepenthes (B) **Dionaea muscipula** (C) Drosera (D) Sarracenia

45. Sundew is:
(A) Nepenthes (B) Dionaea (C) **Drosera** (D) Pinguicula

46. Gaseous exchange in plants occurs mainly by:
(A) active transport (B) osmosis (C) **diffusion** (D) endocytosis

47. Gas exchange in woody stems takes place through:
(A) stomata only (B) **lenticels** (C) root hairs (D) hydathodes

48. In the daytime plants take in carbon dioxide because:
(A) respiration stops (B) **photosynthesis is faster than respiration** (C) stomata are closed (D) they do not respire

49. At dawn and dusk the net exchange of gases is zero. This is the:
(A) saturation point (B) **compensation point** (C) critical point (D) wilting point

50. At night plants:
(A) release oxygen (B) **absorb oxygen and release carbon dioxide** (C) absorb CO2 (D) do not respire

51. Mesophyll cells are:
(A) dead cells (B) thick-walled (C) **thin-walled living cells between the two epidermal layers** (D) found in roots

52. Dicot leaves have how many layers of mesophyll?
(A) One (B) **Two: palisade and spongy** (C) Three (D) None

53. Palisade mesophyll consists of:
(A) loosely arranged cells with large air spaces (B) **tightly packed elongated cells without spaces** (C) dead cells (D) guard cells

54. Spongy mesophyll is located:
(A) next to the upper epidermis (B) **next to the lower epidermis** (C) in the midrib (D) in the cuticle

55. Leaves with distinct palisade and spongy layers are:
(A) isobilateral (B) monofacial (C) **bifacial (dorsiventral)** (D) needle-like

56. Monocot leaves are:
(A) bifacial (B) dorsiventral (C) **isobilateral (monofacial) with only spongy mesophyll** (D) with only palisade

57. Stomata are formed by two:
(A) epidermal cells (B) **kidney or bean-shaped guard cells** (C) companion cells (D) sclerenchyma cells

58. In bifacial leaves more stomata are found in the:
(A) upper epidermis (B) **lower epidermis** (C) both equally (D) midrib

59. Isobilateral leaves have stomata:
(A) only on the lower surface (B) only on the upper surface (C) **evenly distributed on both surfaces** (D) none

60. Transpiration is the loss of water:
(A) as liquid from stems (B) **as vapour from aerial parts, primarily through stomata** (C) through roots (D) in the soil

61. The movement of water in and out of cells by osmosis. Water entering a cell is:
(A) exosmosis (B) **endosmosis** (C) plasmolysis (D) diffusion

62. Water leaving a cell is called:
(A) endosmosis (B) **exosmosis** (C) imbibition (D) guttation

63. Water potential is denoted by:
(A) psi s (B) psi p (C) **psi w** (D) omega

64. The water potential of pure water is:
(A) positive (B) negative (C) **zero** (D) infinity

65. The water potential of cells and solutions is:
(A) positive (B) **less than zero (negative)** (C) equal to pure water (D) infinite

66. The equation of water potential is:
(A) psi w = psi s - psi p (B) **psi w = psi s + psi p** (C) psi w = psi s x psi p (D) psi w = psi p - psi s

67. Solutes ... water potential:
(A) raise (B) **lower** (C) do not change (D) double

68. Solute potential is also called:
(A) pressure potential (B) **osmotic potential** (C) matric potential (D) turgor

69. Solute potential in distilled water is:
(A) negative (B) positive (C) **zero** (D) unknown

70. Pressure potential is:
(A) always negative (B) **an increase in water potential due to pressure greater than atmospheric** (C) zero in turgid cells (D) caused by solutes

71. Water moves from:
(A) lower to higher water potential (B) **higher to lower water potential** (C) negative to positive pressure (D) only soil to root

72. The order of water potential from soil to atmosphere is:
(A) atmosphere > leaf > stem > root > soil (B) **soil > root > stem > leaf > atmosphere** (C) root > soil > stem > leaf (D) leaf > soil > root

73. The Casparian strip is made of:
(A) cellulose (B) pectin (C) **suberin and lignin** (D) chitin

74. The Casparian strip is present in the:
(A) cortex (B) epidermis (C) **endodermis** (D) pericycle

75. The Casparian strip blocks the:
(A) symplast pathway (B) **apoplast pathway** (C) vacuolar pathway (D) xylem

76. The apoplast is the system of:
(A) cytoplasm (B) vacuoles (C) **adjacent cell walls** (D) plasmodesmata

77. The pathway through cytoplasmic connections (plasmodesmata) is the:
(A) apoplast pathway (B) **symplast pathway** (C) vacuolar pathway (D) xylem pathway

78. In the vacuolar pathway water moves:
(A) only through cell walls (B) only through plasmodesmata (C) **from vacuole to vacuole crossing membranes and tonoplast** (D) through xylem only

79. Water enters the root from the soil through:
(A) cortex (B) **root hairs by osmosis** (C) root cap (D) xylem

80. The correct path of water in the root is:
(A) xylem, cortex, endodermis, epidermis (B) **epidermis, cortex, endodermis, pericycle, xylem** (C) cortex, epidermis, xylem (D) pericycle, cortex, epidermis

81. Xylem conducts mainly:
(A) food (B) **water and minerals** (C) hormones only (D) gases

82. Phloem conducts:
(A) water only (B) **organic food from leaves upward and downward** (C) minerals only (D) gases

83. The four cell types of xylem are:
(A) sieve tubes, companion cells, fibres, parenchyma (B) **tracheids, vessel elements, xylem fibres and xylem parenchyma** (C) tracheids, sieve cells, fibres, parenchyma (D) vessels, companion cells, fibres, sclereids

84. The only living cells of xylem are:
(A) tracheids (B) vessels (C) fibres (D) **xylem parenchyma**

85. Tracheids are:
(A) living cells (B) **dead, elongated cells with tapering ends and lignified walls** (C) found only in angiosperms (D) sieve cells

86. Xylem vessels are found only in:
(A) gymnosperms (B) ferns (C) **angiosperms** (D) bryophytes

87. Xylem vessels are formed by:
(A) fusion of cells side to side (B) **end to end fusion of vessel elements** (C) division of tracheids (D) phloem

88. Xylem fibres mainly give:
(A) conduction (B) storage (C) **mechanical support** (D) photosynthesis

89. The phloem consists of:
(A) four living cell types (B) **three living cells (sieve tube elements, companion cells, parenchyma) and one dead cell (phloem fibre)** (C) all dead cells (D) only sieve tubes

90. Sieve tube elements lack:
(A) cytoplasm (B) cell walls (C) **nuclei at maturity** (D) plasma membrane

91. The perforated partition between two sieve tube elements is the:
(A) pit (B) **sieve plate** (C) septum (D) perforation plate of xylem

92. The activity of sieve tube elements is controlled by:
(A) xylem parenchyma (B) **adjacent companion cells** (C) phloem fibres (D) guard cells

93. Companion cells provide:
(A) support (B) **energy to sieve tube elements** (C) storage (D) gas exchange

94. Phloem fibres are:
(A) living storage cells (B) **thick-walled supporting cells** (C) conducting cells (D) companion cells

95. The upward movement of water in xylem is called:
(A) translocation (B) **ascent of sap** (C) guttation (D) imbibition

96. The most accepted theory of ascent of sap is the:
(A) root pressure theory (B) **TACT theory** (C) relay pump theory (D) capillarity theory

97. TACT stands for:
(A) Transport, Adhesion, Capillarity, Turgor (B) **Transpiration pull, Adhesion, Cohesion, Tension** (C) Turgor, Adhesion, Capillarity, Tension (D) Transpiration, Absorption, Cohesion, Turgor

98. The evaporation of water from leaves develops:
(A) root pressure (B) **transpiration pull** (C) turgor (D) adhesion

99. Attraction between water molecules and xylem walls is:
(A) cohesion (B) **adhesion** (C) tension (D) osmosis

100. Attraction among water molecules due to hydrogen bonds is:
(A) adhesion (B) **cohesion** (C) diffusion (D) imbibition

101. The force that keeps the water column in xylem continuous is:
(A) transpiration only (B) **cohesion and adhesion** (C) root pressure only (D) osmosis only

102. The bulk flow of water to the top of the plant is driven by:
(A) ATP (B) root pressure (C) **solar energy through evaporation** (D) gravity

103. Stomata are generally:
(A) open at night (B) **open in day and closed (incompletely) at night** (C) always open (D) always closed

104. The opening and closing of stomata depends on the:
(A) thickness of cuticle (B) **turgidity of guard cells** (C) cell wall of epidermis (D) vein size

105. Stomata open when guard cells are:
(A) flaccid (B) **turgid** (C) plasmolysed (D) dead

106. Guard cells are the only photosynthesizing cells of the:
(A) mesophyll (B) **leaf epidermis** (C) root (D) phloem

107. According to the starch sugar interconversion theory, in the morning sugar in guard cells:
(A) decreases (B) **increases, lowering water potential so water enters** (C) remains constant (D) is converted to cellulose

108. At night in guard cells glucose is converted to:
(A) cellulose (B) **starch** (C) malate (D) fructose

109. In K plus ion influx theory, low CO_2 level favours the:
(A) efflux of K plus (B) **influx of K plus ions into guard cells** (C) closure of stomata (D) formation of starch

110. K plus ions in guard cells combine with malate ions to form:
(A) malic acid (B) **potassium malate** (C) potassium chloride (D) starch

111. The movement of K plus into guard cells occurs by:
(A) diffusion (B) osmosis (C) **active transport** (D) facilitated diffusion

112. Blue light causes ionization of:
(A) oxalic acid (B) **malic acid** (C) citric acid (D) acetic acid

113. The movement of organic solutes through phloem is called:
(A) ascent of sap (B) transpiration (C) **translocation** (D) guttation

114. Translocation always occurs from a:
(A) sink to source (B) **source to sink** (C) root to shoot only (D) shoot to root only

115. A leaf is purely a:
(A) sink (B) **source** (C) both (D) neither

116. A fruit is particularly a:
(A) source (B) **sink** (C) both (D) neither

117. Roots and stems can act as:
(A) only source (B) only sink (C) **both source and sink** (D) neither

118. Phloem sap contains how much dry matter?
(A) 1 to 5 percent (B) **10 to 25 percent** (C) 50 percent (D) 90 percent

119. Of the dry matter in phloem sap, about 90 percent is:
(A) glucose (B) fructose (C) **sucrose** (D) starch

120. The theory explaining translocation is the:
(A) TACT theory (B) **pressure flow (mass flow) theory** (C) K plus theory (D) cohesion theory

121. According to pressure flow, sugar is loaded in sieve tubes at the source by:
(A) diffusion (B) osmosis (C) **active transport requiring ATP, with water entering by osmosis** (D) facilitated diffusion

122. At the sink, sugar is unloaded and water:
(A) enters sieve tube (B) **leaves the sieve tube by osmosis** (C) stays in sieve tube (D) is lost to the air

123. Homeostasis is the ability to:
(A) grow continuously (B) **maintain a steady state in a changing environment** (C) produce flowers (D) absorb nutrients

124. Maintenance of water and solute level in the body is called:
(A) thermoregulation (B) **osmotic adjustment (osmoregulation)** (C) photoperiodism (D) vernalization

125. A hypotonic medium has water potential:
(A) lower than cell sap (B) **higher than cell sap** (C) equal to cell sap (D) zero

126. In a hypotonic medium the plant cell becomes:
(A) flaccid (B) plasmolysed (C) **turgid** (D) shrunken

127. In a hypertonic medium water moves:
(A) into the cell (B) **out of the cell (exosmosis)** (C) no movement (D) into the vacuole only

128. In an isotonic medium:
(A) water enters the cell (B) water leaves the cell (C) **there is no net movement of water** (D) the cell bursts

129. Plants that grow where abundant water is available are:
(A) mesophytes (B) xerophytes (C) **hydrophytes** (D) halophytes

130. Hydrophytes are exposed to which kind of osmotic condition?
(A) Hypertonic (B) Isotonic (C) **Hypotonic** (D) None

131. Hydrophytes have stomata:
(A) on lower epidermis (B) sunken (C) **on upper epidermis, open day and night** (D) absent

132. Hydrophytes have a:
(A) very thick cuticle (B) **very thin cuticle or none** (C) waxy cuticle (D) thick cuticle

133. Wheat, rice and maize are examples of:
(A) hydrophytes (B) xerophytes (C) **mesophytes** (D) halophytes

134. Mesophytes face nearly:
(A) hypotonic condition (B) hypertonic condition (C) **isotonic condition** (D) saline condition

135. Mesophytes have stomata mainly on the:
(A) upper epidermis (B) **lower epidermis, open in day and closed at night** (C) both (D) none

136. Desert plants like cactus and Opuntia are:
(A) hydrophytes (B) mesophytes (C) **xerophytes** (D) halophytes

137. Xerophytes face which osmotic condition?
(A) Hypotonic (B) Isotonic (C) **Severely hypertonic** (D) None

138. Xerophytes show:
(A) high transpiration (B) medium transpiration (C) **very low rate of transpiration** (D) no transpiration at all

139. Xerophytes have stomata that are:
(A) on the upper epidermis (B) **sunken in depressions, closed in day and open at night** (C) open all day (D) absent

140. Succulent plants store:
(A) little water (B) no water (C) **a very high amount of water** (D) only starch

141. Plants in saline soils are:
(A) xerophytes (B) hydrophytes (C) mesophytes (D) **halophytes**

142. Saline soils create:
(A) physical drought (B) **physiological drought** (C) flooding (D) no problem

143. Halophytes cope with salinity by accumulating Na plus and Cl minus in:
(A) cytoplasm (B) nucleus (C) **vacuoles of leaf cells** (D) cell walls

144. Some halophytes make osmotic adjustment by accumulating:
(A) NaCl in cytoplasm (B) **compatible solutes like glycine betaine and sorbitol** (C) starch (D) water

145. Low temperature affects the cell membrane by making lipids:
(A) more fluid (B) **less fluid (crystallize)** (C) unsaturated (D) dissolve

146. To avoid crystallization of membrane lipids at low temperature, plants increase:
(A) saturated fatty acids (B) **unsaturated fatty acids** (C) cholesterol (D) waxes

147. Heat shock proteins help in:
(A) cell division (B) photosynthesis (C) **preventing denaturation of enzymes at high temperature** (D) flowering

148. In very hot areas plants develop a:
(A) thin cuticle (B) **shiny cuticle that reflects light** (C) no cuticle (D) thick bark only

149. At temperatures above 45 degrees plants:
(A) open stomata (B) **close their stomata to prevent water loss** (C) shed leaves (D) stop photosynthesis only

150. The pressure on cell walls due to water in a turgid cell is:
(A) osmotic pressure (B) **turgor pressure** (C) root pressure (D) atmospheric pressure

151. In herbaceous plants, support is mainly given by:
(A) sclerenchyma (B) wood (C) **turgidity of cells** (D) bark

152. Mechanical tissues are:
(A) parenchyma and meristems (B) **collenchyma and sclerenchyma** (C) xylem and phloem (D) epidermis and cortex

153. Collenchyma is:
(A) dead (B) **living with thickened corners, giving support to young plants** (C) lignified (D) found in wood

154. Collenchyma cells have cell wall thickened with:
(A) lignin (B) **cellulose and pectin at corners** (C) suberin (D) chitin

155. Sclerenchyma at maturity is:
(A) living (B) **dead due to heavily lignified secondary walls** (C) parenchymatous (D) meristematic

156. The two types of sclerenchyma are:
(A) tracheids and vessels (B) **fibres and sclereids** (C) fibres and tracheids (D) sclereids and vessels

157. Sclereids are common in:
(A) stems only (B) roots only (C) **fruit walls and seed coats** (D) leaves only

158. In dicot stems vascular bundles are arranged:
(A) scattered (B) **in a ring** (C) in a single row (D) absent

159. Growth is characterized by:
(A) reversible increase in size (B) **irreversible increase in size and mass** (C) decrease in mass (D) no change

160. Plants show growth throughout life. This is called:
(A) closed growth (B) **open growth** (C) limited growth (D) arrested growth

161. The region of dividing cells in plants is the:
(A) permanent tissue (B) **meristem** (C) epidermis (D) cortex

162. Meristematic cells are generally:
(A) large with big vacuoles (B) **small and cuboidal with large nuclei, small vacuoles and thin walls** (C) thick-walled (D) dead

163. The two major kinds of meristems are:
(A) primary and permanent (B) **apical and lateral** (C) apical and intercalary (D) lateral and permanent

164. Apical meristems are located at:
(A) lateral sides (B) nodes (C) **tips of roots and shoots** (D) bark

165. Apical meristems are also known as:
(A) secondary meristems (B) **primary meristems** (C) lateral meristems (D) tertiary meristems

166. Lateral meristems increase the:
(A) length (B) **thickness and diameter** (C) leaf size (D) flower number

167. Lateral meristems are also called:
(A) primary meristems (B) **secondary meristems** (C) apical meristems (D) permanent tissues

168. Vascular cambium and cork cambium are:
(A) apical meristems (B) **lateral meristems** (C) intercalary meristems (D) permanent tissues

169. Cork cambium is also called:
(A) vascular cambium (B) **phellogen** (C) pericycle (D) endodermis

170. Intercalary meristems are located:
(A) at the tips (B) **at the nodes in grasses** (C) in bark (D) in cambium

171. The increase in length of root and shoot is:
(A) secondary growth (B) **primary growth** (C) lateral growth (D) dormancy

172. The increase in thickness is:
(A) primary growth (B) **secondary growth** (C) apical growth (D) elongation only

173. Secondary growth is characteristic of:
(A) monocots (B) **dicots and gymnosperms** (C) ferns (D) mosses

174. Vascular cambium produces secondary xylem towards the:
(A) outer side (B) **inner side** (C) upper side (D) lower side

175. Vascular cambium produces secondary phloem towards the:
(A) inner side (B) **outer side** (C) upper side (D) none

176. In spring and summer the xylem cells are:
(A) small (B) **larger in size (early wood)** (C) dead (D) absent

177. In autumn and winter the xylem cells produced are:
(A) larger (B) **smaller (late wood)** (C) absent (D) tracheids only

178. Annual rings are formed due to:
(A) continuous growth (B) **differential growth of secondary xylem in different seasons** (C) phloem growth (D) cork growth

179. The age of a tree can be determined by counting:
(A) leaves (B) branches (C) **annual rings** (D) roots

180. Cork cambium adds cork towards the outer side and:
(A) secondary xylem inside (B) **secondary cortex inside** (C) phloem inside (D) pith inside

181. The wood is mainly:
(A) secondary phloem (B) **secondary xylem** (C) cork (D) cortex

182. The dark central region of wood is:
(A) sapwood (B) **heartwood** (C) bark (D) pith

183. The functional lighter outer wood is:
(A) heartwood (B) **sapwood** (C) bark (D) cork

184. Bark includes all tissues:
(A) inside the vascular cambium (B) **outside the vascular cambium** (C) only cork (D) only phloem

185. Interactions among different growing points are called:
(A) growth rates (B) **growth correlations** (C) tropisms (D) photoperiodism

186. The presence of an apical bud inhibiting the growth of lateral buds is:
(A) photoperiodism (B) **apical dominance** (C) vernalization (D) tropism

187. Apical dominance is caused by:
(A) cytokinin (B) gibberellin (C) **auxin** (D) ethylene

188. Cytokinin from lateral buds acts ... to auxin in apical dominance:
(A) synergistically (B) **antagonistically** (C) equally (D) independently

189. Plants with strong apical dominance are usually:
(A) bushy (B) **tall with few branches** (C) short (D) dwarf

190. The plant growth regulators number:
(A) three (B) four (C) **five** (D) six

191. Growth promoters are:
(A) auxin, ABA and ethylene (B) **auxins, gibberellins and cytokinins** (C) ABA and ethene only (D) cytokinins and ethylene

192. Growth inhibitors are:
(A) auxins and gibberellins (B) cytokinins and auxins (C) **abscisic acid and ethene** (D) gibberellins only

193. The first plant hormone ever discovered is:
(A) gibberellin (B) **auxin** (C) cytokinin (D) ethylene

194. Auxins are mainly synthesized in:
(A) roots (B) old leaves (C) **shoot tips, leaf primordia, young leaves and embryos** (D) flowers only

195. Auxins mainly promote:
(A) cell division (B) **cell elongation** (C) dormancy (D) ripening

196. Gibberellin GA3 is called:
(A) kinetin (B) **gibberellic acid** (C) zeatin (D) abscisic acid

197. Gibberellins are especially abundant in:
(A) old leaves (B) roots (C) **seeds and young shoots** (D) bark

198. Gibberellins control:
(A) root growth only (B) **stem elongation by stimulating cell division and elongation** (C) fruit ripening (D) dormancy

199. Cytokinins are named for their role in:
(A) cell elongation (B) **cell division (cytokinesis)** (C) dormancy (D) senescence

200. The most active naturally occurring cytokinin is:
(A) kinetin (B) **zeatin, isolated from corn** (C) GA3 (D) IAA

201. Cytokinins have a molecular structure similar to:
(A) guanine (B) thymine (C) **adenine** (D) cytosine

202. Abscisic acid is synthesized in:
(A) mitochondria (B) **plastids from carotenoids** (C) nucleus (D) vacuole

203. ABA's principal effect is:
(A) promotion of cell growth (B) **inhibition of cell growth, promotion of dormancy and closing stomata under water stress** (C) fruit ripening only (D) leaf expansion

204. Under water stress ABA causes:
(A) stomata to open (B) **stomata to close** (C) leaves to expand (D) roots to elongate

205. Ethylene is a:
(A) liquid hormone (B) **simple gaseous hydrocarbon** (C) protein (D) steroid

206. Ethylene stimulates:
(A) cell elongation (B) **fruit ripening and abscission of fruits and leaves** (C) stem elongation (D) cell division

207. The hormone which delays leaf senescence is:
(A) ethylene (B) ABA (C) **cytokinin (also auxin and gibberellin)** (D) none

208. A high cytokinin to auxin ratio promotes the formation of:
(A) roots (B) **shoots** (C) callus only (D) flowers

209. A low cytokinin to auxin ratio promotes:
(A) shoots (B) **roots** (C) leaves (D) buds

210. Movements of plant parts toward or away from a stimulus are called:
(A) taxes (B) nasties (C) **tropisms** (D) photoperiods

211. Movement in response to light is:
(A) geotropism (B) **phototropism** (C) thigmotropism (D) chemotropism

212. Shoots show:
(A) negative phototropism (B) **positive phototropism** (C) positive geotropism (D) thigmotropism

213. Roots show:
(A) positive phototropism (B) **negative phototropism and positive geotropism** (C) negative geotropism (D) positive thigmotropism

214. Shoots show:
(A) positive geotropism (B) **negative geotropism** (C) no geotropism (D) thigmotropism

215. Movement in response to touch is:
(A) phototropism (B) geotropism (C) **thigmotropism** (D) chemotropism

216. Climbing plants show:
(A) phototropism (B) geotropism (C) **thigmotropism** (D) chemotropism

217. Growth of fungal hyphae towards nutrients is an example of:
(A) phototropism (B) thigmotropism (C) geotropism (D) **chemotropism**

218. The total duration of light in a day is the:
(A) photoperiodism (B) **photoperiod** (C) critical period (D) phytochrome

219. The effect of photoperiod on flowering is:
(A) vernalization (B) **photoperiodism** (C) phototropism (D) thermoperiodism

220. Plants that flower when the photoperiod is less than a critical length are:
(A) long-day plants (B) **short-day plants** (C) day-neutral (D) dwarf plants

221. An example of a short-day plant is:
(A) spinach (B) wheat (C) **cocklebur or chrysanthemum** (D) tomato

222. An example of a long-day plant is:
(A) chrysanthemum (B) tobacco (C) **spinach or sugar beet** (D) cocklebur

223. An example of a day-neutral plant is:
(A) cocklebur (B) henbane (C) **tomato, bean or rose** (D) spinach

224. The actual stimulus for flowering is the uninterrupted:
(A) light period (B) **dark period** (C) red light (D) photoperiod

225. Short-day plants are actually:
(A) short-night plants (B) **long-night plants** (C) day-neutral plants (D) no-night plants

226. Long-day plants are actually:
(A) long-night plants (B) **short-night plants** (C) no-night plants (D) dark-loving plants

227. The critical photoperiod for cocklebur is:
(A) 11 hours (B) 14 hours (C) **15.5 hours** (D) 13 hours

228. The critical photoperiod for tobacco is:
(A) 11 hours (B) **14 hours** (C) 15.5 hours (D) 9 hours

229. The critical photoperiod for henbane is:
(A) **11 hours** (B) 14 hours (C) 15.5 hours (D) 8.5 hours

230. Interrupting the long night of a short-day plant with a brief light:
(A) promotes flowering (B) **prevents flowering** (C) has no effect (D) kills the plant

231. The wavelength of red light effective in preventing flowering of short day plants is:
(A) 730 nm (B) **660 nm** (C) 400 nm (D) 550 nm

232. The wavelength of far-red light is:
(A) 660 nm (B) **730 nm** (C) 450 nm (D) 550 nm

233. The photoreceptor pigment involved in photoperiodism is:
(A) chlorophyll (B) carotene (C) **phytochrome** (D) anthocyanin

234. Phytochromes are pigments which are:
(A) lipids (B) **proteins with an iron containing non-protein part** (C) carbohydrates (D) nucleic acids

235. The form of phytochrome which absorbs red light is:
(A) Pfr (B) **Pr (P660)** (C) P730 (D) P700

236. Pr on absorbing red light is converted into:
(A) P660 (B) **Pfr (P730)** (C) chlorophyll (D) florigen

237. Pfr on absorbing far-red light reverts to:
(A) Pfr (B) **Pr** (C) P700 (D) florigen

238. The conversion of Pfr to Pr occurs mainly:
(A) in the day (B) **at night** (C) at noon (D) in light only

239. A short-day plant requires a ... ratio of Pfr to Pr:
(A) high (B) **low** (C) equal (D) zero

240. A long-day plant requires a ... ratio of Pfr to Pr:
(A) low (B) **high** (C) zero (D) equal

241. The flowering hormone is called:
(A) vernalin (B) **florigen** (C) auxin (D) ABA

242. Florigen transforms:
(A) flower buds to fruits (B) **vegetative buds into floral buds** (C) seeds to seedlings (D) roots to shoots

243. Promotion of flowering by exposure to low temperature is:
(A) photoperiodism (B) phototropism (C) **vernalization** (D) thermonasty

244. The low temperature stimulus in vernalization is received by:
(A) leaves (B) roots (C) **shoot apex of a mature plant or the embryo** (D) flowers

245. The most effective temperature for vernalization is about:
(A) 0 degrees (B) **4 degrees Celsius** (C) 10 degrees (D) 15 degrees

246. Vernalization is required by:
(A) annual plants (B) **biennial plants** (C) all plants (D) aquatic plants only

247. Winter wheat is a:
(A) annual plant (B) **biennial plant** (C) perennial tree (D) day-neutral plant only

248. The hormone vernalin is actually:
(A) auxin (B) cytokinin (C) **gibberellin** (D) ethylene

249. Spring wheat sown in February or March is:
(A) a biennial plant (B) **an annual plant** (C) a perennial plant (D) a halophyte

250. Winter wheat sown in spring will flower if its seeds are exposed to:
(A) high temperature (B) **low temperature (4 degrees) for several weeks** (C) red light (D) gibberellin deficiency

Scenario based MCQs

Scenario 1: A farmer notices that the older leaves of his maize crop are turning yellow starting from the tips, and growth is poor. The soil has been used for maize for years.

251. The most likely deficient nutrient is:
(A) calcium (B) **nitrogen** (C) iron (D) boron

252. The yellowing is called:
(A) necrosis (B) **chlorosis** (C) etiolation (D) wilting

253. A good solution for the farmer is:
(A) continuous maize cropping (B) **crop rotation or adding fertilizers** (C) adding sand (D) stopping irrigation

254. Nitrogen is needed for synthesis of:
(A) cellulose (B) **proteins, nucleic acids and chlorophyll** (C) starch (D) wax

Scenario 2: A student places a plant cell in three solutions: A (pure water), B (a solution of same strength as cell sap), C (strong sucrose solution).

255. In A the cell will become:
(A) flaccid (B) **turgid, since water enters** (C) plasmolysed (D) burst

256. In B the cell:
(A) gains water (B) loses water (C) **has no net movement of water** (D) dies

257. In C the cell will:
(A) gain water (B) **lose water by exosmosis and become flaccid** (C) remain turgid (D) divide

258. Solution C is:
(A) hypotonic (B) isotonic (C) **hypertonic** (D) neutral

Scenario 3: A tall tree transports water from roots to leaves 30 metres above ground. On a hot sunny day stomata open widely.

259. The main force which pulls water up is:
(A) root pressure (B) **transpiration pull** (C) gravity (D) diffusion pressure

260. The continuity of the water column is due to:
(A) root hairs (B) **cohesion and adhesion** (C) active transport (D) osmosis only

261. The tissue that carries this water is:
(A) phloem (B) **xylem** (C) cambium (D) cortex

262. The cells forming pipelines only in angiosperms are:
(A) tracheids (B) **vessel elements** (C) fibres (D) companion cells

Scenario 4: A sugarcane leaf makes sucrose. The sucrose is loaded into the phloem and moved to the root where it is stored.

263. The leaf here acts as a:
(A) sink (B) **source** (C) valve (D) reservoir

264. The root acts as a:
(A) source (B) **sink** (C) valve (D) channel

265. Loading of sugar into sieve tubes is done by:
(A) xylem (B) **companion cells with ATP** (C) phloem fibres (D) guard cells

266. The process is explained by the:
(A) TACT theory (B) **pressure flow theory** (C) K plus theory (D) cohesion theory

Scenario 5: A tree trunk cut across shows alternating light and dark circular bands. A count shows 12 bands.

267. The bands are called:
(A) cork layers (B) **annual (growth) rings** (C) phloem rings (D) cambium rings

268. The age of the tree is about:
(A) 6 years (B) **12 years** (C) 24 years (D) 1 year

269. The light-coloured wide bands are formed in:
(A) winter (B) **spring and summer** (C) autumn only (D) dry season

270. The tissue producing secondary xylem is the:
(A) cork cambium (B) **vascular cambium** (C) apical meristem (D) intercalary meristem

Scenario 6: Cocklebur and spinach are grown in a greenhouse with an artificial day of 12 hours light and 12 hours dark. Cocklebur flowers but spinach does not. When the dark period for cocklebur is interrupted by a flash of red light, it fails to flower.

271. Cocklebur is a:
(A) long-day plant (B) **short-day plant** (C) day-neutral plant (D) biennial plant

272. Spinach is a:
(A) short-day plant (B) **long-day plant** (C) day-neutral plant (D) vernalization-requiring plant

273. The red flash prevented flowering by converting:
(A) Pfr to Pr (B) **Pr to Pfr** (C) chlorophyll to Pr (D) ABA to GA

274. Flowering could be restored by following the red flash with:
(A) blue light (B) green light (C) **far-red light** (D) infrared only

Scenario 7: A farmer sows winter wheat seeds in spring and the plants do not flower. Another farmer keeps the seeds at 4 degrees Celsius for several weeks before sowing and gets flowers.

275. This treatment is called:
(A) photoperiodism (B) **vernalization** (C) phototropism (D) scarification

276. The treatment is received by the:
(A) leaves (B) **shoot apex or embryo** (C) roots (D) flowers

277. The hormone actually involved is:
(A) auxin (B) **gibberellin** (C) cytokinin (D) ABA

278. Winter wheat is a:
(A) annual (B) **biennial** (C) perennial (D) day-neutral

Unit 10: Animalia

Straight MCQs

1. The name Animalia is derived from the Latin word "anima" meaning:
(A) movement (B) **breath or soul** (C) animal (D) life

2. Animals are:
(A) autotrophic with cell walls (B) **eukaryotic, multicellular, ingestive heterotrophs lacking cell walls** (C) prokaryotic and unicellular (D) photosynthetic

3. Which is NOT a criterion of animal classification?
(A) Presence or absence of tissues (B) Number of tissue layers (C) Body symmetry (D) **Type of nutrition of the cell wall**

4. The two sub-kingdoms based on organization of tissues are:
(A) Radiata and Bilateria (B) **Parazoa and Eumetazoa** (C) Protostomia and Deuterostomia (D) Diploblastic and triploblastic

5. Parazoa includes animals that:
(A) have true tissues (B) have organ systems (C) **lack tissue organization**

(sponges) (D) are bilaterally symmetrical

6. Diploblastic animals have:
(A) one germ layer (B) **two germ layers: ectoderm and endoderm** (C) three germ layers (D) four germ layers

7. The jelly-like layer between the two germ layers of diploblastic animals is the:
(A) mesoderm (B) **mesoglea** (C) coelom (D) mesentery

8. Triploblastic animals have:
(A) two germ layers (B) **ectoderm, mesoderm and endoderm** (C) one germ layer (D) mesoglea only

9. A diploblastic phylum is:
(A) Platyhelminthes (B) Annelida (C) **Cnidaria** (D) Mollusca

10. Radial symmetry is considered an adaptation to:
(A) motility (B) **a sessile life** (C) flight (D) burrowing

11. Bilateral symmetry is considered an adaptation to:
(A) sessile life (B) **motility** (C) floating (D) parasitism

12. All animals of grade Bilateria are:
(A) diploblastic (B) **triploblastic** (C) radially symmetrical (D) acoelomate

13. Echinoderm larvae show ... while the adults show ...:
(A) radial; bilateral (B) **bilateral; radial** (C) no symmetry; bilateral (D) radial; asymmetry

14. Animals with no body cavity are:
(A) pseudocoelomate (B) coelomate (C) **acoelomate** (D) enterocoelomate

15. A pseudocoelom is a body cavity formed between:
(A) ectoderm and mesoderm (B) **mesoderm and endoderm** (C) ectoderm and endoderm (D) mesoderm only

16. A true coelom is completely lined by:
(A) ectoderm (B) endoderm (C) **mesoderm** (D) mesoglea

17. Platyhelminthes are:
(A) coelomate (B) pseudocoelomate (C) **acoelomate** (D) diploblastic

18. Nematodes are:
(A) acoelomate (B) **pseudocoelomate** (C) coelomate (D) diploblastic

19. In protostomes the blastopore develops into the:
(A) anus (B) **mouth** (C) coelom (D) notochord

20. In deuterostomes the blastopore develops into the:
(A) mouth (B) **anus** (C) coelom (D) gill slit

21. Deuterostomes include:
(A) molluscs and annelids (B) arthropods and annelids (C) **echinoderms and chordates** (D) flatworms and roundworms

22. Invertebrates account for about what percent of known animal species?
(A) 50 (B) 75 (C) **95** (D) 99.9

23. The number of major invertebrate phyla described is:
(A) five (B) six (C) seven (D) **eight**

24. Sponges belong to phylum:
(A) Cnidaria (B) **Porifera** (C) Platyhelminthes (D) Mollusca

25. Porifera means:
(A) stinging cell (B) **pore bearer** (C) flat worm (D) soft body

26. The outer dermal layer of a sponge is the:
(A) choanoderm (B) **pinacoderm (pinacocytes)** (C) mesenchyme (D) spongocoel

27. The inner layer of sponge made of flagellated collar cells is the:
(A) pinacoderm (B) **choanoderm (choanocytes)** (C) mesenchyme (D) osculum

28. The middle layer of sponges, with amoeboid cells, is the:
(A) choanoderm (B) pinacoderm (C) **mesenchyme** (D) mesoglea

29. The pores in the body of a sponge are called:
(A) oscula (B) **ostia** (C) stomata (D) spiracles

30. The large opening through which water leaves the sponge is the:
(A) ostium (B) **osculum** (C) stoma (D) mouth

31. The central cavity in the sponge is the:
(A) gastrovascular cavity (B) coelom (C) **spongocoel** (D) pseudocoel

32. The skeleton of a sponge consists of:
(A) bones (B) cartilage (C) **spicules (calcareous or siliceous) or spongin fibres** (D) chitin

33. Asexual reproduction in sponges is by:
(A) binary fission only (B) **budding and gemmules** (C) fragmentation of eggs (D) spores

34. Sponges are believed to have evolved from:
(A) cnidarians (B) **choanoflagellates** (C) flatworms (D) ciliates

35. Spongilla and Sycon are:
(A) cnidarians (B) **sponges** (C) flatworms (D) molluscs

36. Dried sponges are used for:
(A) food (B) **bathing, washing and absorbing fluids in surgery** (C) making pearls (D) making silk

37. Cnidaria means:
(A) pore bearer (B) **stinging celled** (C) soft bodied (D) segmented

38. The stinging cells of cnidarians are called:
(A) choanocytes (B) **cnidocytes with nematocysts** (C) pinacocytes (D) amoebocytes

39. Cnidarians are:
(A) triploblastic with coelom (B) **diploblastic with a gastrovascular cavity having one opening** (C) acoelomate triploblastic (D) pseudocoelomate

40. The nervous system of cnidarians is in the form of a:
(A) brain (B) nerve cord (C) **nerve net** (D) ganglion

41. Cnidarians exhibit:
(A) bilateral symmetry (B) **radial or biradial symmetry** (C) asymmetry (D) no symmetry

42. Which is a freshwater cnidarian?
(A) Obelia (B) Jellyfish (C) **Hydra** (D) Sea anemone

43. A colonial cnidarian is:
(A) Hydra (B) **Obelia** (C) Planaria (D) Sycon

44. The feeding zooids of cnidarian colonies are the:
(A) medusae (B) **polyps** (C) blastostyles (D) gemmules

45. The reproductive zooids are the:
(A) polyps (B) **medusae** (C) hydranths (D) gemmules

46. Division of labour among zooids of a colony is called:
(A) metamorphosis (B) **polymorphism** (C) regeneration (D) metagenesis

47. Coral reefs are built of:
(A) silica (B) **calcium carbonate** (C) chitin (D) calcium phosphate

48. Obelia colony has three types of zooids, which are:
(A) polyps, medusae and spicules (B) **hydranth, blastostyle and medusae** (C) nematocytes only (D) gemmules, medusa, polyp

49. Planaria belongs to:
(A) Aschelminthes (B) **Platyhelminthes** (C) Annelida (D) Cnidaria

50. Flatworms are:
(A) **dorsiventrally flattened, triploblastic, bilaterally symmetrical and acoelomate** (B) cylindrical and pseudocoelomate (C) radial and diploblastic (D) segmented and coelomate

51. Free-living flatworms like Planaria move by:
(A) flagella (B) pseudopodia (C) **cilia on the undersides** (D) tube feet

52. Asexual reproduction in flatworms is by:
(A) budding (B) **fission** (C) spores (D) gemmules

53. Most flatworms are:
(A) dioecious (B) **monoecious** (C) asexual (D) parthenogenetic only

54. The liver fluke is:
(A) Taenia (B) Dugesia (C) **Fasciola** (D) Ascaris

55. Tapeworm is:
(A) Fasciola (B) **Taenia** (C) Dugesia (D) Planaria

56. The head of the tapeworm which attaches to the host intestine is the:
(A) proglottid (B) **scolex** (C) pharynx (D) sucker disc

57. The body segments of tapeworm are called:
(A) somites (B) scolices (C) **proglottids** (D) zooids

58. Aschelminthes are commonly called:
(A) flatworms (B) **roundworms (nematodes)** (C) segmented worms (D) acorn worms

59. The body of roundworm is:
(A) flat (B) **cylindrical and tapering at both ends** (C) segmented (D) spherical

60. The body cavity of nematodes is a:
(A) true coelom (B) **pseudocoelom** (C) haemocoel (D) gastrovascular cavity

61. Most nematodes are:
(A) monoecious (B) **dioecious** (C) asexual (D) hermaphrodite

62. The muscular layer in nematodes is divided into:
(A) two bands (B) **four longitudinal quadrants** (C) circular rings (D) plates

63. Ascaris lumbricoides is the intestinal parasite of:
(A) cattle (B) **man** (C) fish (D) birds

64. Pinworms (Enterobius vermicularis) cause:
(A) anaemia (B) **insomnia and loss of appetite** (C) night blindness (D) fever only

65. Mollusca means:
(A) soft bodied (B) hard bodied (C) **soft bodied animals** (D) segmented

66. Molluscs are:
(A) segmented animals (B) **soft, unsegmented, coelomate, triploblastic and bilaterally symmetrical** (C) diploblastic (D) acoelomate

67. The body of molluscs is divided into:
(A) head, thorax, abdomen (B) **head, ventral muscular foot and dorsal visceral hump** (C) proboscis, collar, trunk (D) head and trunk

68. The envelope that secretes the shell in molluscs is the:
(A) coelom (B) foot (C) **mantle** (D) radula

69. The tongue-like rasping structure in molluscs is the:
(A) gill (B) foot (C) mantle (D) **radula**

70. The larval stage of molluscs is:
(A) nauplius (B) **trochophore** (C) bipinnaria (D) tadpole

71. A pearl is formed by:
(A) snail (B) slug (C) **pearl oyster** (D) octopus

72. The shell of freshwater mussels is used in:
(A) making pearls (B) **button industry** (C) glue (D) dye

73. Teredo, the shipworm, damages:
(A) cotton (B) **wooden parts of ships** (C) crops (D) metal parts

74. Annelids are:
(A) unsegmented worms (B) **metamerically segmented worms with a true coelom** (C) pseudocoelomate (D) acoelomate

75. Earthworm is an example of:
(A) Mollusca (B) Aschelminthes (C) **Annelida** (D) Platyhelminthes

76. The scientific name of earthworm is:
(A) Hirudo (B) Nereis (C) **Pheretima** (D) Ascaris

77. Leech is:
(A) Pheretima (B) Nereis (C) **Hirudo** (D) Taenia

78. The annelid circulatory system is:
(A) open (B) **closed** (C) absent (D) lacunar

79. The coelom of annelids acts as a:
(A) skeleton of chitin (B) **hydrostatic skeleton** (C) respiratory organ (D) digestive organ

80. Earthworm and leech are:
(A) dioecious (B) **hermaphrodite** (C) asexual (D) parthenogenetic only

81. Nereis has:
(A) united sexes (B) **separate sexes** (C) no sex (D) one sex

82. Arthropoda means:
(A) soft bodied (B) spiny skinned (C) **animals with jointed legs** (D) segmented worms

83. The body of arthropods is covered by:
(A) cellulose (B) cutin (C) **chitin** (D) keratin

84. The coelom in arthropods is reduced and called:
(A) pseudocoelom (B) **haemocoel** (C) spongocoel (D) mesocoel

85. The skeleton of arthropods is:
(A) endoskeleton (B) **exoskeleton formed mainly of chitin** (C) spicules (D) hydrostatic

86. The sexes in arthropods are:
(A) united (B) **separate** (C) absent (D) hermaphrodite

87. Development in arthropods takes place through:
(A) direct development only (B) **metamorphosis** (C) budding (D) trochophore larva

88. Cyclops carries the larva of:
(A) tapeworm (B) Ascaris (C) **guinea worm** (D) liver fluke

89. The honey bee produces:
(A) silk (B) **honey and wax** (C) lac (D) pearls

90. Silk is produced by:
(A) honey bee (B) spider (C) **silkworm** (D) lac insect

91. Which insect is used in laboratories for genetic research?
(A) Honey bee (B) **Fruit fly (Drosophila)** (C) Silkworm (D) Housefly

92. Malaria is spread by:
(A) houseflies (B) **mosquitoes** (C) fleas (D) lice

93. Echinodermata means:
(A) soft bodied (B) **spiny skinned animals** (C) jointed legs (D) segmented worms

94. Echinoderms are exclusively:
(A) freshwater (B) terrestrial (C) **marine** (D) parasitic

95. Adult echinoderms show:
(A) bilateral symmetry (B) **radial symmetry** (C) asymmetry (D) no symmetry

96. The locomotory organs of echinoderms are:
(A) flagella (B) cilia (C) **tube feet** (D) parapodia

97. The water vascular system of echinoderms is used in:
(A) circulation (B) **locomotion, attachment, gas exchange and feeding** (C) excretion only (D) reproduction

98. The sieve-like plate connecting the water vascular system to outside is the:
(A) osculum (B) **madreporite** (C) ampulla (D) ostium

99. In echinoderms the mouth is on the:
(A) aboral side (B) **oral side, and the anus is on the aboral side** (C) lateral side (D) posterior end only

100. Bipinnaria and brachiolaria are larvae of:
(A) molluscs (B) annelids (C) **echinoderms (starfish)** (D) arthropods

101. Echinoderms are closest to:
(A) arthropods (B) molluscs (C) **chordates** (D) annelids

102. Which is an echinoderm?
(A) Octopus (B) Jellyfish (C) **Starfish, sea urchin, sea cucumber** (D) Sea anemone

103. The power of regenerating lost arms by starfish is called:
(A) metamorphosis (B) **autotomy and regeneration** (C) budding (D) polymorphism

104. Hemichordates are known as:
(A) flatworms (B) **acorn worms** (C) sea cucumbers (D) lancelets

105. Hemichordates are also called:
(A) protochordates (B) **prochordates** (C) urochordates (D) cephalochordates

106. The body of hemichordates has three regions:
(A) head, thorax, abdomen (B) **proboscis, collar and trunk** (C) head, collar, trunk (D) scolex, neck, strobila

107. Balanoglossus and Saccoglossus belong to:
(A) Echinodermata (B) **Hemichordata** (C) Chordata (D) Annelida

108. The characteristic features of chordates are:
(A) notochord, ventral solid nerve cord, gill slits, post-anal tail (B) **notochord, dorsal hollow nerve cord, gill slits and post-anal tail** (C) notochord, gills, tail, ventral nerve cord (D) no notochord, dorsal nerve cord

109. The notochord is a:
(A) hollow rod (B) **solid unjointed rod in the mid-dorsal line between gut and nerve cord** (C) jointed rod (D) bony box

110. The nerve cord in chordates is:
(A) solid and ventral (B) **single, tubular, non-ganglionated and dorsal** (C) ganglionated and ventral (D) branched

111. In humans the post-anal tail regresses into the:
(A) skull (B) **tailbone (coccyx)** (C) pelvis (D) ribs

112. Phylum Chordata is divided into:
(A) Agnatha and Gnathostomata (B) **Protochordata (Acrania) and Craniata** (C) Cephalochordata and Urochordata only (D) Tetrapoda and Pisces

113. The two subphyla of Protochordata are:
(A) Vertebrata and Agnatha (B) **Urochordata and Cephalochordata** (C) Chondrichthyes and Osteichthyes (D) Myxini and Cephalaspidomorphi

114. Urochordates are known as:
(A) lancelets (B) **tunicates** (C) hagfish (D) lampreys

115. An example of Urochordata is:
(A) Amphioxus (B) **Ascidia** (C) Hagfish (D) Lamprey

116. In urochordates the notochord is present in the:
(A) adult (B) **larval tail, and disappears in the adult** (C) head (D) body trunk

117. Amphioxus belongs to:
(A) Urochordata (B) **Cephalochordata** (C) Agnatha (D) Gnathostomata

118. In cephalochordates the notochord extends:
(A) in the head only (B) in the tail only (C) **the entire length of the body** (D) nowhere

119. Craniata have one subphylum:
(A) Cephalochordata (B) Urochordata (C) **Vertebrata** (D) Hemichordata

120. The two superclasses of Vertebrata are:
(A) Tetrapoda and Pisces (B) **Agnatha and Gnathostomata** (C) Amniota and Anamniota (D) Craniata and Acrania

121. Agnatha are:
(A) jawed fishes (B) **jawless fishes** (C) amphibians (D) tetrapods

122. Examples of Agnatha are:
(A) Shark and ray (B) Rohu and carp (C) **Hagfish and lamprey** (D) Frog and toad

123. Jaws are believed to have evolved from:
(A) the skull (B) **the first pair of gill arches** (C) the vertebral column (D) the ribs

124. Gnathostomata are divided into how many classes?
(A) Four (B) Five (C) **Six** (D) Seven

125. Cartilaginous fishes belong to class:
(A) Osteichthyes (B) **Chondrichthyes** (C) Agnatha (D) Amphibia

126. An example of Chondrichthyes is:
(A) Rohu (B) Sea horse (C) **Dogfish shark, skate, ray** (D) Latimeria

127. Chondrichthyes have the mouth:
(A) terminal (B) **ventral** (C) dorsal (D) absent

128. Bony fishes belong to class:
(A) Chondrichthyes (B) **Osteichthyes** (C) Amphibia (D) Agnatha

129. The respiration in bony fishes is by gills covered by:
(A) spiracle (B) **operculum** (C) scales (D) skin

130. Labeo rohita (Rohu) is a:
(A) cartilaginous fish (B) **bony fish** (C) jawless fish (D) amphibian

131. Latimeria is a:
(A) ray-finned fish (B) **lobe-finned fish, a living fossil** (C) cartilaginous fish (D) jawless fish

132. Amphibians evolved from:
(A) cartilaginous fishes (B) jawless fishes (C) ray-finned fishes (D) **lobe-finned bony fishes with lungs**

133. The first tetrapods were:
(A) reptiles (B) **amphibians** (C) birds (D) mammals

134. The body of amphibians is divided into:
(A) head, neck, trunk, tail (B) **head and trunk only** (C) head, thorax, abdomen (D) cephalothorax and abdomen

135. The heart of amphibians is:
(A) two chambered (B) **three chambered** (C) four chambered (D) incompletely four chambered

136. Respiration in adult amphibians is by:
(A) gills only (B) **lungs and skin** (C) spiracles (D) trachea

137. Amphibians are:
(A) endothermic (B) **poikilothermic (ectotherms)** (C) homeothermic (D) amniotes

138. Amphibians are:
(A) amniotes (B) **anamniotes (without amnion)** (C) viviparous (D) homeotherms

139. Caecilians are:
(A) frogs (B) toads (C) **limbless amphibians** (D) salamanders

140. Which is an amphibian?
(A) Lizard (B) Crocodile (C) **Frog, toad or salamander** (D) Snake

141. Amphibians are not a very successful group because they depend on water for:
(A) food only (B) **habitat, reproduction and development** (C) air (D) light

142. Skin of reptiles is:
(A) smooth and moist (B) glandular (C) **rough, cornified and dry** (D) covered with feathers

143. The heart of most reptiles is:
(A) two chambered (B) three chambered (C) **incompletely four chambered** (D) completely four chambered

144. Which reptile has a completely four-chambered heart?
(A) Lizard (B) Snake (C) Tortoise (D) **Crocodile**

145. Reptiles are:
(A) endothermic (B) **ectothermic (poikilothermic)** (C) homeothermic (D) aquatic only

146. The three extra-embryonic membranes of reptiles are:
(A) yolk sac, placenta, amnion (B) **amnion, allantois and chorion** (C) amnion, yolk sac, placenta (D) chorion, placenta, yolk sac

147. The fertilization in reptiles is:
(A) external (B) **internal** (C) absent (D) parthenogenetic

148. Reptiles lay eggs which are covered by:
(A) gel (B) feathers (C) **leathery or limy shell** (D) scales

149. Birds have the forelimbs modified into:
(A) fins (B) **wings** (C) flippers (D) claws

150. Birds have:
(A) teeth (B) **a horny beak and no teeth** (C) heavy bones (D) no feathers

151. The skeleton of birds is light due to:
(A) cartilage (B) **air spaces** (C) absence of bones (D) soft bones

152. The heart of birds is:
(A) two chambered (B) three chambered (C) **four chambered with two atria and two ventricles** (D) incompletely four chambered

153. In birds only the ... aortic arch is present:
(A) left (B) **right** (C) both (D) neither

154. Birds are:
(A) ectothermic (B) **endothermic (warm blooded)** (C) poikilothermic (D) amphibious

155. The voice box of birds is the:
(A) larynx (B) **syrinx** (C) epiglottis (D) pharynx

156. The muscular structure used for crushing food in birds is the:
(A) crop (B) **gizzard** (C) proventriculus (D) cloaca

157. The main nitrogenous waste of birds is:
(A) urea (B) ammonia (C) **uric acid** (D) creatinine

158. Birds lack:
(A) kidneys (B) **a urinary bladder** (C) lungs (D) heart

159. Running birds that lost the power of flight include:
(A) Parrot and pigeon (B) **Ostrich and kiwi** (C) Eagle and hawk (D) Duck and swan

160. Respiration in birds is by:
(A) gills (B) skin (C) **lungs only, supplemented by air sacs** (D) spiracles

161. Reptiles, birds and mammals are collectively called:
(A) anamniotes (B) **amniotes** (C) tetrapods only (D) ectotherms

162. The amnion is:
(A) a hard shell (B) **a sac filled with fluid providing a private pond for the embryo** (C) the placenta (D) a yolk sac

163. Mammals are characterized by:
(A) feathers (B) **mammary glands and hair** (C) scales (D) nucleated RBCs

164. Mammalian skin is:
(A) dry without glands (B) **glandular with hair** (C) covered with scales (D) covered with feathers

165. The three ear ossicles of mammals are:
(A) columella, incus, stapes (B) **malleus, incus and stapes** (C) malleus, hammer, stapes (D) incus, anvil, columella

166. The skull of mammals has:
(A) one occipital condyle (B) **two occipital condyles** (C) no condyle (D) three condyles

167. The aortic arch in mammals is:
(A) right only (B) **left only** (C) both (D) absent

168. Mammalian RBCs are:
(A) nucleated (B) **non-nucleated** (C) absent (D) oval and nucleated

169. The voice apparatus of mammals consists of:
(A) syrinx (B) **larynx and epiglottis** (C) trachea only (D) pharynx

170. The three subclasses of mammals are:
(A) Prototheria, Eutheria, Aves (B) **Prototheria, Metatheria and Eutheria** (C) Monotremata, Aves, Reptilia (D) Metatheria, Aves, Eutheria

171. Egg laying mammals belong to subclass:
(A) Metatheria (B) Eutheria (C) **Prototheria** (D) Aves

172. Duckbill platypus and spiny anteater are:
(A) marsupials (B) placentals (C) **monotremes** (D) reptiles

173. Monotremes are found in:
(A) Africa (B) America (C) **Australia** (D) Asia

174. Pouched mammals belong to:
(A) Prototheria (B) **Metatheria** (C) Eutheria (D) Aves

175. Kangaroo, koala and opossum are:
(A) monotremes (B) **marsupials** (C) placentals (D) reptiles

176. The pouch of marsupials is called the:
(A) cloaca (B) **marsupium** (C) placenta (D) uterus

177. Young of marsupials are born:
(A) fully developed (B) **immature and develop in the pouch** (C) as eggs (D) in water

178. Placental mammals are the subclass:
(A) Prototheria (B) Metatheria (C) **Eutheria** (D) Aves

179. In Eutheria the young develop:
(A) in the pouch (B) in eggs (C) **inside the mother's body, depending on placenta** (D) outside the body

180. Placenta is an organ of exchange between:
(A) mother and egg (B) **maternal blood and fetal blood** (C) fetal and fetal (D) mother and environment

181. In pangolin hair is modified into:
(A) spines (B) **scales** (C) feathers (D) horns

182. In porcupine hair is modified into:
(A) scales (B) **spines** (C) feathers (D) horns

183. Bat is:
(A) a bird (B) a reptile (C) **a flying placental mammal** (D) a marsupial

184. Whale and dolphin are:
(A) fishes (B) **placental mammals** (C) marsupials (D) monotremes

185. The reptilian features of monotremes include:
(A) mammary glands (B) hair (C) **laying of eggs and cloaca** (D) placenta

186. The mammalian features of monotremes include:
(A) egg laying (B) cloaca (C) **mammary glands and hair** (D) shelled eggs

187. In the animal phylogenetic tree, the earliest branch is:
(A) Cnidaria (B) **Porifera** (C) Platyhelminthes (D) Nematoda

188. Which of these has a gastrovascular cavity?
(A) Sponges (B) Earthworms (C) Roundworms (D) **Hydra and flatworms**

189. A landsnail, a clam and an octopus share:
(A) gills (B) embryonic torsion (C) **a mantle** (D) a radula in all

190. Which phylum has segmented bodies with a true coelom and closed circulation?
(A) Mollusca (B) **Annelida** (C) Nematoda (D) Cnidaria

191. In arthropods the open circulatory system has:
(A) a closed vascular system (B) **haemocoel connected with the blood vascular system** (C) no blood (D) lymph only

192. Insects are successful because of:
(A) soft body (B) **flight, chitinous exoskeleton and tracheal system** (C) absence of segmentation (D) radial symmetry

Scenario based MCQs

Scenario 1: A student examines a marine animal. It has a body with a central disc and five arms. It is attached to rocks by tube feet. Water enters through a sieve-like plate on the upper surface.

193. The animal belongs to:
(A) Mollusca (B) **Echinodermata** (C) Cnidaria (D) Annelida

194. The sieve-like plate is the:
(A) osculum (B) **madreporite** (C) radula (D) ostium

195. The adult shows:
(A) bilateral symmetry (B) **radial symmetry** (C) no symmetry (D) biradial only

196. It is the closest relative of the phylum:
(A) Mollusca (B) **Chordata** (C) Annelida (D) Platyhelminthes

Scenario 2: A biologist dissects an earthworm and finds a body divided into many similar rings, a true body cavity, a closed blood system and a ventral nerve cord.

197. The phylum is:
(A) Platyhelminthes (B) Nematoda (C) **Annelida** (D) Mollusca

198. The segmentation seen is called:
(A) polymorphism (B) **metamerism** (C) metamorphosis (D) regeneration

199. The cavity separating gut from body wall is a:
(A) pseudocoelom (B) haemocoel (C) **true coelom** (D) gastrovascular cavity

200. The body cavity acts as a:
(A) respiratory organ (B) **hydrostatic skeleton** (C) digestive tract (D) gonad

Scenario 3: A vet examines three animals. Animal X lays eggs and has fur and mammary glands. Animal Y carries its young in a pouch. Animal Z gives birth to young nourished via placenta.

201. Animal X belongs to:
(A) Metatheria (B) Eutheria (C) **Prototheria** (D) Aves

202. Animal X could be:
(A) kangaroo (B) **duckbill platypus** (C) horse (D) whale

203. Animal Y could be:
(A) platypus (B) **koala or kangaroo** (C) cat (D) echidna

204. Animal Z belongs to subclass:
(A) Prototheria (B) Metatheria (C) **Eutheria** (D) Aves

Scenario 4: A zoologist records the following about a vertebrate: three-chambered heart, moist glandular skin, larva breathes by gills and adult by lungs, eggs laid in water.

205. The vertebrate is a:
(A) reptile (B) fish (C) **amphibian** (D) bird

206. The body temperature is:
(A) constant (B) **variable (poikilothermic)** (C) high (D) endothermic

207. The development takes place through:
(A) trochophore (B) **metamorphosis** (C) direct development (D) budding

208. The animal is an:
(A) amniote (B) **anamniote** (C) endotherm (D) marsupial

Scenario 5: A student examines a freshwater polyp with tentacles. Touching them with a needle causes stinging threads to be fired.

209. The organism is probably:
(A) Planaria (B) **Hydra** (C) Ascaris (D) Spongilla

210. The stinging organelles are:
(A) radulae (B) **nematocysts** (C) spicules (D) ostia

211. The body wall has how many germ layers?
(A) One (B) **Two** (C) Three (D) Four

212. The digestive cavity is the:
(A) spongocoel (B) **gastrovascular cavity with one opening** (C) coelom (D) pseudocoel

Scenario 6: A child has insomnia and itching around the anus at night. A doctor finds small white thread-like worms in the stool.

213. The parasite is probably:
(A) tapeworm (B) liver fluke (C) **pinworm (Enterobius vermicularis)** (D) leech

214. The worm belongs to phylum:
(A) Platyhelminthes (B) Annelida (C) **Aschelminthes (Nematoda)** (D) Mollusca

215. The body cavity of this worm is:
(A) coelom (B) **pseudocoelom** (C) absent (D) haemocoel

216. The sexes of these worms are:
(A) united (B) **separate (dioecious)** (C) absent (D) hermaphrodite

Unit 11: Reproduction

Straight MCQs

1. Reproduction is essential for the survival of the:
(A) individual (B) **species** (C) organ (D) cell only

2. The human reproductive system becomes functional at:
(A) birth (B) **puberty, when turned on by sex hormones** (C) adulthood only (D) old age

3. The male gonads are the:
(A) ovaries (B) **testes** (C) epididymis (D) prostate

4. The testes are situated outside the abdomen in a skin pouch called the:
(A) perineum (B) **scrotum** (C) pelvis (D) penis

5. The testes are located outside the body because spermatogenesis is most efficient at:
(A) 37 degrees (B) **about 35 degrees, two degrees below body temperature** (C) 40 degrees (D) 30 degrees

6. Each testis is divided into about how many lobules?
(A) 25 to 30 (B) 100 to 150 (C) **250 to 300** (D) 500 to 600

7. Each lobule contains how many seminiferous tubules?
(A) One (B) **One to four** (C) Ten (D) Twenty

8. Spermatogenesis takes place in:
(A) epididymis (B) **seminiferous tubules (germinal epithelium)** (C) vas deferens (D) prostate

9. The tubular network where sperms mature after leaving seminiferous tubules is the:
(A) epididymis (B) **rete testis** (C) vas deferens (D) urethra

10. Sperms leave the testis through:
(A) vas deferens (B) **efferent ductules** (C) urethra (D) ejaculatory duct

11. Epididymis functions in:
(A) spermatogenesis (B) **transport and storage of sperms** (C) secretion of semen (D) hormone production

12. The duct from the epididymis is the:
(A) urethra (B) **vas deferens** (C) ejaculatory duct (D) rete testis

13. The vas deferens joins the duct of the seminal vesicle to form the:
(A) urethra (B) **ejaculatory duct** (C) epididymis (D) rete testis

14. The ejaculatory duct enters the:
(A) bladder (B) **prostate gland and then opens into the urethra** (C) seminal vesicle (D) penis

15. The urethra is also called the urinogenital duct because it carries:
(A) only sperms (B) only urine (C) **both urine and semen** (D) blood

16. The accessory glands of the male reproductive system are:
(A) testes, epididymis, vas deferens (B) **seminal vesicles, prostate gland and bulbourethral glands** (C) Leydig and Sertoli cells (D) ovary, uterus

17. The bulbourethral gland is also called:
(A) Bartholin's gland (B) **Cowper's gland** (C) Leydig's gland (D) Sertoli's gland

18. The prostate gland encircles the:
(A) ureter (B) **urethra just below the bladder** (C) vas deferens (D) penis

19. The copulatory organ of male is the:
(A) scrotum (B) **penis** (C) prostate (D) testis

20. Semen is a mixture of sperms and:
(A) urine (B) **secretions of accessory glands** (C) blood (D) mucus only

21. The normal sperm count in semen is about:
(A) 2 to 15 million per ml (B) **20 to 150 million per ml** (C) 200 to 500 million per ml (D) 1000 million per ml

22. A healthy adult male makes about how many sperms every day?
(A) 4 million (B) 40 million (C) **400 million** (D) 4 billion

23. Spermatogonia divide by mitosis to form:
(A) secondary spermatocytes (B) spermatids (C) **primary spermatocytes** (D) sperms

24. A primary spermatocyte divides by meiosis I to form:
(A) spermatids (B) **two secondary spermatocytes** (C) four sperms (D) spermatogonia

25. Each secondary spermatocyte after meiosis II produces:
(A) one sperm (B) **two spermatids** (C) four sperms (D) two sperms directly

26. The transformation of spermatids into sperms is called:
(A) spermatogenesis (B) **spermiogenesis (differentiation)** (C) oogenesis (D) gametogenesis

27. A mature human sperm consists of:
(A) head and tail only (B) **head, neck, midpiece and tail** (C) head, trunk and tail (D) nucleus and acrosome only

28. The midpiece of the sperm contains many:
(A) ribosomes (B) **mitochondria** (C) lysosomes (D) Golgi bodies

29. The cap-like structure at the head of sperm is the:
(A) centrosome (B) **acrosome** (C) nucleus (D) tail

30. The acrosome contains:
(A) DNA (B) mitochondria (C) **digestive enzymes to penetrate the egg** (D) ATP only

31. The cells in seminiferous tubules that provide nutrients to developing sperms are:
(A) Leydig cells (B) **Sertoli cells** (C) spermatogonia (D) Graafian cells

32. The interstitial cells which secrete testosterone are:
(A) Sertoli cells (B) **Leydig cells** (C) spermatocytes (D) spermatogonia

33. LH acts on the:
(A) Sertoli cells (B) **Leydig cells to secrete testosterone** (C) spermatids (D) epididymis

34. FSH acts on the:
(A) Leydig cells (B) **Sertoli cells to facilitate spermatogenesis** (C) epididymis (D) prostate

35. GnRH is secreted by the:
(A) anterior pituitary (B) **hypothalamus** (C) testes (D) adrenal gland

36. GnRH stimulates the anterior pituitary to release:
(A) testosterone and inhibin (B) **FSH and LH** (C) oxytocin and ADH (D) insulin

37. Testosterone is responsible for:
(A) milk production (B) **secondary sexual characteristics and stimulation of spermatogenesis** (C) ovulation (D) menstruation

38. Which is a secondary sexual characteristic in males?
(A) Larger testes (B) Sperm production (C) **Deepening of voice and growth of facial hair** (D) Penis formation

39. Inhibin is produced by:
(A) Leydig cells (B) **Sertoli cells** (C) anterior pituitary (D) hypothalamus

40. Inhibin inhibits the release of:
(A) LH only (B) **GnRH and FSH** (C) testosterone (D) estrogen

41. High levels of testosterone inhibit:
(A) only FSH (B) **GnRH, FSH and LH by negative feedback** (C) spermatogenesis (D) inhibin only

42. Sertoli cells cease inhibin release if the sperm count falls to:
(A) 2 million per ml (B) 200 million per ml (C) **20 million per ml** (D) 150 million per ml

43. The female gonads are the:
(A) testes (B) **ovaries** (C) oviducts (D) uterus

44. The female reproductive system consists of ovaries, oviducts, uterus and:
(A) prostate (B) **vagina** (C) epididymis (D) scrotum

45. Each ovary contains many tiny sac-like structures called:
(A) seminiferous tubules (B) **ovarian follicles** (C) alveoli (D) lobules

46. The immature egg inside a follicle is the:
(A) ovum (B) **oocyte** (C) zygote (D) polar body

47. Release of an oocyte from the ovary is called:
(A) fertilization (B) menstruation (C) **ovulation** (D) implantation

48. After ovulation the ruptured follicle becomes the:
(A) corpus callosum (B) **corpus luteum** (C) corpus albicans (D) Graafian follicle

49. The oviducts are also known as:
(A) uterine tubes only (B) **Fallopian tubes** (C) ureters (D) vasa deferentia

50. Fertilization generally occurs in the:
(A) ovary (B) uterus (C) vagina (D) **oviduct (fallopian tube)**

51. The finger-like projections at the oviduct opening near the ovary are the:
(A) cilia (B) **fimbriae** (C) villi (D) follicles

52. The uterus is shaped like:
(A) a cylinder (B) **an inverted pear** (C) a sphere (D) a cone

53. The three portions of the uterus are:
(A) head, body, tail (B) **fundus, body and cervix** (C) fundus, neck, tail (D) perimetrium, myometrium, endometrium

54. The outermost layer of uterine wall is the:
(A) endometrium (B) myometrium (C) **perimetrium** (D) cervix

55. The thick muscular middle layer of uterus is the:
(A) perimetrium (B) **myometrium** (C) endometrium (D) cervix

56. The inner spongy lining of the uterus is the:
(A) perimetrium (B) myometrium (C) **endometrium** (D) cervix

57. The embryo implants in the:
(A) myometrium (B) perimetrium (C) **endometrium** (D) cervix

58. The narrow entrance of the uterus from the vagina is the:
(A) fundus (B) body (C) **cervix** (D) perimetrium

59. The vagina is a thin-walled tube about:
(A) 2 to 3 cm long (B) 18 to 20 cm long (C) **8 to 10 cm long** (D) 30 cm long

60. Oogenesis begins:
(A) at puberty (B) at birth (C) **in the foetus** (D) at menarche

61. Oogonia multiply by:
(A) meiosis (B) **mitosis** (C) fission (D) budding

62. Primary oocytes arrest in:
(A) metaphase I (B) **prophase I** (C) anaphase I (D) telophase I

63. At ovulation the oocyte is arrested in:
(A) prophase I (B) **metaphase II (secondary oocyte)** (C) anaphase II (D) interphase

64. Meiosis II of the secondary oocyte is completed only if:
(A) ovulation occurs (B) **a sperm penetrates** (C) the corpus luteum forms (D) menstruation starts

65. The smaller cell formed during meiosis I of oogenesis is the:
(A) secondary oocyte (B) **first polar body** (C) ovum (D) oogonium

66. Polar bodies degenerate because they lack:
(A) DNA (B) nucleus (C) **nutrient-containing cytoplasm** (D) chromosomes

67. One primary oocyte results in:
(A) four ova (B) two ova (C) **one ovum and polar bodies** (D) four sperms

68. One primary spermatocyte results in:
(A) one sperm (B) two sperms (C) **four sperms** (D) eight sperms

69. The sequence of all reproductive events in females is called the:
(A) gestation (B) **menstrual (reproductive) cycle** (C) lactation (D) puberty

70. The two phases of the female reproductive cycle are:
(A) proliferative and secretory (B) **ovarian cycle and uterine cycle** (C) follicular and luteal (D) menarche and menopause

71. The menstrual cycle is divided into three phases:
(A) follicular, luteal, ovulation (B) **menstrual, proliferative and secretory** (C) menstrual, ovulation, menopause (D) proliferative, secretory, luteal only

72. The menstrual phase lasts about:
(A) days 6 to 14 (B) days 15 to 28 (C) days 29 to 35 (D) **days 1 to 5, with bleeding for 3 to 5 days**

73. During menstruation the uterus sheds:
(A) the entire uterus (B) **all but the deepest part of the endometrium** (C) the myometrium (D) the cervix

74. The proliferative (pre-ovulatory) phase lasts from:
(A) day 1 to 5 (B) **day 6 to 14** (C) day 15 to 28 (D) day 28 to 35

75. In the proliferative phase the endometrium is rebuilt under the influence of:
(A) progesterone (B) **estrogen** (C) LH (D) testosterone

76. The hormone that rises early in the cycle and stimulates follicle growth is:
(A) LH (B) progesterone (C) **FSH** (D) estrogen

77. The mature follicle is also called:
(A) corpus luteum (B) **Graafian follicle** (C) primordial follicle (D) atretic follicle

78. Follicles which stop growing and disintegrate undergo:
(A) ovulation (B) **follicular atresia** (C) luteolysis (D) menstruation

79. Estrogen from the follicle makes the cervical mucus:
(A) thick and sticky (B) **thin and crystalline allowing passage of sperms** (C) acidic (D) absent

80. Estrogen has negative feedback upon:
(A) LH (B) **FSH** (C) progesterone (D) inhibin

81. The surge of ... at day 14 triggers ovulation:
(A) FSH (B) progesterone (C) **LH** (D) estrogen

82. LH also converts the ruptured follicle into:
(A) corpus albicans (B) **corpus luteum** (C) Graafian follicle (D) primordial follicle

83. The secretory (post-ovulatory) phase lasts:
(A) day 1 to 5 (B) day 6 to 14 (C) **day 15 to 28** (D) day 29 to 35

84. In the secretory phase the corpus luteum secretes:
(A) FSH (B) LH (C) **progesterone (and estrogen)** (D) testosterone

85. Progesterone in the secretory phase causes the uterine glands to secrete:
(A) mucus (B) **nutritious glycogen** (C) blood (D) enzymes

86. If fertilization does not occur, the corpus luteum degenerates and:
(A) the cycle stops (B) **hormone levels fall and menstruation begins** (C) ovulation occurs again (D) a new follicle is formed at once

87. The first menstruation is called:
(A) menopause (B) **menarche** (C) menstruation (D) ovulation

88. The cessation of menstrual cycle around 50 years is called:
(A) menarche (B) **menopause** (C) puberty (D) gestation

89. In a normal 28 day cycle, ovulation occurs on about day:
(A) 5 (B) 10 (C) **14** (D) 21

90. If the first day of menstruation is 1 March, the most likely date of ovulation is:
(A) 5 March (B) **14 March** (C) 20 March (D) 28 March

91. The zygote differs from an ovum in having:
(A) a larger size (B) haploid number of chromosomes (C) more than one cell (D) **diploid number of chromosomes**

92. Ovulation takes less than:
(A) one hour (B) one second (C) **five minutes** (D) one day

93. Which statement is correct about the male and female reproductive systems?
(A) They are identical (B) **They are quite different in the two sexes unlike other organ systems** (C) They function from birth (D) They produce the same gamete

94. The main function of the male reproductive system is:
(A) nourishing the embryo (B) **production and maintenance of sperms** (C) production of ova (D) menstruation

95. Which of the following is NOT a function of the female reproductive system?
(A) Production of eggs (B) Nourishment of the foetus (C) Production of female sex hormones (D) **Production of sperms**

96. Androgens in the testes are secreted by:
(A) Sertoli cells (B) **Leydig cells** (C) accessory ducts (D) bulbourethral glands

97. A primary organ of the female reproductive system is the:
(A) vagina (B) uterus (C) **ovary** (D) cervix

98. Sperms are stored prior to ejaculation in the:
(A) **epididymis** (B) seminal vesicle (C) urethra (D) prostate gland

99. The follicular phase of the ovarian cycle corresponds to the uterine:
(A) menstrual phase (B) **proliferative phase** (C) secretory phase (D) luteal phase

100. The luteal phase of the ovarian cycle corresponds to the uterine:
(A) proliferative phase (B) menstrual phase (C) **secretory phase** (D) ovulation

101. Immediately after ovulation the mammalian egg is surrounded by:
(A) chorion (B) **zona pellucida and corona radiata** (C) amnion (D) vitelline membrane only

102. The hormone level that is the lowest at the beginning of the menstrual phase are:
(A) gonadotropins (B) **ovarian hormones** (C) LH and FSH (D) progesterone

103. Which of the following is correct about timing in a normal cycle?
(A) Release of egg on day 5 (B) **Regeneration of endometrium on days 5 to 10** (C) Secretion of nutrients by endometrium on days 11 to 18 (D) Rise in progesterone on days 1 to 15

104. In vitro fertilization is fertilization carried out:
(A) inside the uterus (B) inside the oviduct (C) **outside the body in a laboratory dish** (D) in the vagina

Scenario based MCQs

Scenario 1: A young man has a low sperm count of 8 million per ml. The doctor measures hormones and finds that his FSH is low.

105. FSH acts on the:
(A) Leydig cells (B) **Sertoli cells to promote spermatogenesis** (C) epididymis (D) prostate

106. Sperm production occurs in the:
(A) epididymis (B) **seminiferous tubules** (C) vas deferens (D) prostate

107. If testosterone is high, the hypothalamus will:
(A) increase GnRH (B) **decrease GnRH by negative feedback** (C) not respond (D) secrete inhibin

108. Testosterone is made by the:
(A) Sertoli cells (B) **Leydig (interstitial) cells** (C) spermatogonia (D) epididymis

Scenario 2: A woman has a regular 28 day cycle. On day 12 a scan shows a large follicle. On day 14 there is a sudden surge of a pituitary hormone. On day 20 blood tests show a high level of progesterone.

109. The large follicle is the:
(A) corpus luteum (B) **Graafian follicle** (C) atretic follicle (D) primordial follicle

110. The hormone surge on day 14 is of:
(A) FSH (B) progesterone (C) **LH** (D) estrogen

111. The progesterone on day 20 is from the:
(A) ovarian follicle (B) **corpus luteum** (C) pituitary (D) adrenal

112. On day 20 the woman is in the:
(A) menstrual phase (B) proliferative phase (C) **secretory phase** (D) follicular phase

Scenario 3: In a woman's ovary after ovulation, the ruptured follicle degenerates immediately without forming a corpus luteum.

113. The likely result is a lack of:
(A) FSH (B) **progesterone, so the endometrium would not be maintained** (C) LH (D) ovulation in the next cycle only

114. Menstruation would:
(A) never occur (B) **occur early because of fall in hormones** (C) be delayed by 3 months (D) be unaffected

115. Pregnancy would be:
(A) established (B) **unlikely, as the endometrium cannot be maintained** (C) certain (D) unaffected

116. The endometrium during the secretory phase secretes:
(A) mucus (B) **glycogen for the embryo** (C) blood (D) enzymes

Scenario 4: A couple discuss the passage of sperm through the male tract after it is made.

117. The correct order of passage is:
(A) epididymis, seminiferous tubule, vas deferens, urethra (B) **seminiferous tubule, rete testis, efferent ductules, epididymis, vas deferens, ejaculatory duct, urethra** (C) urethra, vas deferens, epididymis (D) rete testis, seminiferous tubule, epididymis

118. The sperm finally joins the oocyte in the:
(A) vagina (B) uterus (C) **oviduct** (D) ovary

119. The sperm would pass through the female tract in the order:
(A) vagina, oviduct, cervix, uterus (B) **vagina, cervix, uterus, oviduct** (C) cervix, vagina, uterus (D) uterus, cervix, oviduct

120. The sperm head enzyme helping penetration is in the:
(A) midpiece (B) tail (C) **acrosome** (D) neck

Unit 12: Inheritance

Straight MCQs

1. The similar characteristics passing from parents to offspring are collectively called:
(A) variation (B) **heredity** (C) mutation (D) evolution

2. The differences among offspring and between offspring and parents are called:
(A) heredity (B) **variations** (C) genes (D) alleles

3. The science dealing with heredity and variation is:
(A) ecology (B) **genetics** (C) embryology (D) cytology

4. A gene is best defined as:
(A) a whole chromosome (B) **a sequence of nucleotides in DNA that codes for a polypeptide** (C) a protein (D) an RNA only

5. The basic unit of heredity is the:
(A) nucleotide (B) **gene** (C) chromosome (D) allele only

6. Three bases (codon) code for one:
(A) nucleotide (B) **amino acid** (C) protein (D) gene

7. The strand of a gene that determines the type of protein is called the:
(A) coding strand (B) **template strand** (C) sense strand of mRNA (D) ribosomal strand

8. Genetics originated in the year 1900 with the work of:
(A) Darwin (B) **Gregor Johann Mendel** (C) Watson (D) Morgan

9. Mendel worked on:
(A) fruit flies (B) **pea plant** (C) bean plant (D) maize

10. Mendel is called the father of:
(A) cytology (B) embryology (C) **genetics** (D) ecology

11. When both alleles of a gene pair are the same, the organism is:
(A) heterozygous (B) **homozygous** (C) hemizygous (D) hybrid

12. An organism with two different alleles for a gene pair is:
(A) homozygous (B) **heterozygous** (C) hemizygous (D) pure

13. The F1 of a cross between RR and rr is:
(A) RR (B) rr (C) **Rr** (D) RR and rr

14. The phenotypic ratio in F2 of a monohybrid cross is:
(A) 1:2:1 (B) **3:1** (C) 9:3:3:1 (D) 1:1

15. The genotypic ratio in F2 of a monohybrid cross is:
(A) 3:1 (B) **1:2:1** (C) 9:3:3:1 (D) 1:1:1:1

16. The law of segregation states that:
(A) alleles of different genes assort independently (B) **the two alleles for a trait separate at meiosis so each gamete receives only one** (C) alleles blend (D) all alleles are dominant

17. A cross between two individuals differing in two traits is a:
(A) monohybrid cross (B) **dihybrid cross** (C) test cross (D) back cross

18. The phenotypic ratio in F2 of a dihybrid cross is:
(A) 3:1 (B) 1:2:1 (C) **9:3:3:1** (D) 1:1:1:1

19. In a dihybrid cross between RRYY and rryy the F1 is:
(A) RRYY (B) RrYy (C) rryy (D) **RrYy, all round yellow**

20. The F1 dihybrid RrYy produces how many types of gametes?
(A) Two (B) Three (C) **Four** (D) Eight

21. The number of boxes in the Punnett square of a dihybrid F2 is:
(A) 4 (B) 8 (C) **16** (D) 32

22. Round green and wrinkled yellow are called:
(A) parental types (B) **recombinant types** (C) dominant types (D) lethal types

23. The law of independent assortment states that:
(A) alleles segregate only (B) **each pair of alleles assorts independently of other pairs during gamete formation** (C) genes are always linked (D) alleles are lost

24. Independent assortment of genes is due to:
(A) crossing over (B) **random orientation of homologous chromosomes at metaphase I** (C) mutation (D) replication

25. In humans, the number of possible combinations of chromosomes in gametes is about:
(A) 23 thousand (B) 46 thousand (C) **2 raised to 23, about eight million** (D) 2 raised to 46

26. The Punnett square was devised by:
(A) Mendel (B) **R. C. Punnett** (C) Morgan (D) Correns

27. The limitation of independent assortment is that genes on the same chromosome:
(A) assort independently (B) **do not assort independently** (C) are lost (D) mutate

28. A source of variation other than independent assortment is:
(A) replication only (B) **mutation and crossing over** (C) mitosis (D) binary fission

29. Which does NOT promote genetic variation?
(A) Random assortment of chromosomes (B) Random fusion of gametes (C) Crossing over (D) **Mitotic division**

30. The probability of an event is:
(A) a divided by n squared (B) **number of favourable cases divided by the total number of possible cases** (C) n divided by a (D) a times n

31. The probability of obtaining a head on tossing a coin is:
(A) 1 (B) **1/2** (C) 1/4 (D) 0

32. The probability of dominant phenotype in F2 of monohybrid cross is:
(A) 1/4 (B) 1/2 (C) **3/4** (D) 1

33. The probability of recessive phenotype in F2 is:
(A) **1/4** (B) 1/2 (C) 3/4 (D) 1

34. The combined probability of two independent events is calculated by the:
(A) sum rule (B) **product rule** (C) division rule (D) subtraction rule

35. The probability of round yellow phenotype in F2 of a dihybrid cross is:
(A) 3/16 (B) 1/16 (C) **9/16** (D) 3/4

36. If both parents are Rr heterozygous, the probability of homozygous recessive offspring is:
(A) 1/2 (B) **1/4** (C) 3/4 (D) 1/8

37. Exceptions to Mendel's laws are called:
(A) Mendelian inheritance (B) **non-Mendelian inheritance** (C) blending inheritance (D) mutations

38. Which is an exception to Mendelian inheritance?
(A) Complete dominance (B) **Incomplete dominance, co-dominance and multiple alleles** (C) Segregation (D) Independent assortment

39. In incomplete dominance the heterozygote shows:
(A) dominant phenotype (B) recessive phenotype (C) **an intermediate phenotype** (D) both phenotypes distinctly

40. Incomplete dominance was first reported by Carl Correns in:
(A) pea (B) **four o'clock plant (Mirabilis jalapa)** (C) maize (D) Drosophila

41. When red and white four o'clock plants are crossed, F1 plants have:
(A) red flowers (B) white flowers (C) **pink flowers** (D) red and white

42. The F2 ratio in incomplete dominance of four o'clock is:
(A) 3:1 (B) **1:2:1 (red:pink:white)** (C) 9:3:3:1 (D) 1:1

43. In co-dominance both alleles:
(A) blend (B) **express independently in the heterozygote** (C) are recessive (D) are suppressed

44. An example of co-dominance in humans is:
(A) height (B) skin colour (C) **MN blood group and AB blood group** (D) haemophilia

45. A person with LMLN genotype has:
(A) only M molecules (B) only N molecules (C) **both M and N molecules on the red blood cells** (D) no molecules

46. If a man of M blood group marries a woman of N blood group, all their children will have:
(A) M blood group (B) N blood group (C) O blood group (D) **MN blood group**

47. Alleles are:
(A) different genes at different loci (B) **alternative forms of a gene at the same locus** (C) chromosomes (D) proteins

48. A gene having more than two allelic forms shows:
(A) polygenic inheritance (B) epistasis (C) **multiple alleles** (D) linkage

49. Multiple alleles are produced by:
(A) crossing over (B) **gene mutation** (C) replication (D) translation

50. A diploid individual can carry at most how many alleles of a gene?
(A) One (B) **Two** (C) Three (D) Four

51. The best example of multiple alleles in humans is:
(A) skin colour (B) **ABO blood groups** (C) height (D) eye colour

52. The International Society of Blood Transfusion recognizes up to how many major blood group systems? (as per text)
(A) 4 (B) 8 (C) **30 to 33** (D) 100

53. Blood group systems are characterized by the presence or absence of:
(A) antibodies (B) **antigens on red blood cell surface** (C) enzymes (D) hormones

54. The two most significant blood group systems are:
(A) MNS and Kell (B) **ABO and Rh** (C) Duffy and Kidd (D) Lutheran and Kell

55. The ABO blood group system was discovered in 1901 by:
(A) Mendel (B) Morgan (C) **Karl Landsteiner** (D) Correns

56. The ABO system is based on how many antigens?
(A) One (B) **Two (A and B)** (C) Three (D) Four

57. A blood group with both A and B antigens is:
(A) A (B) B (C) **AB** (D) O

58. A blood group with neither A nor B antigens is:
(A) A (B) B (C) AB (D) **O**

59. The number of alleles controlling ABO blood groups is:
(A) two (B) **three (IA, IB and i)** (C) four (D) five

60. Alleles IA and IB are:
(A) recessive to i (B) **co-dominant to each other and dominant over i** (C) both recessive (D) incompletely dominant

61. Genotype IAi produces blood group:
(A) B (B) AB (C) O (D) **A**

62. Genotype IBi produces blood group:
(A) A (B) **B** (C) AB (D) O

63. Genotype ii produces blood group:
(A) A (B) B (C) AB (D) **O**

64. Genotype IAIB produces blood group:
(A) A (B) B (C) **AB** (D) O

65. Blood group A has ... antibodies in plasma:
(A) anti-A (B) **anti-B** (C) both anti-A and anti-B (D) none

66. Blood group B has ... antibodies in plasma:
(A) **anti-A** (B) anti-B (C) both (D) none

67. Blood group AB has ... antibodies:
(A) anti-A (B) anti-B (C) both (D) **no anti-A or anti-B**

68. Blood group O has ... antibodies:
(A) anti-A only (B) anti-B only (C) **both anti-A and anti-B** (D) none

69. Antibodies of the ABO system are produced:
(A) only after exposure to antigen (B) **without any stimulus from embryonic life** (C) only in adults (D) only after transfusion

70. Persons with blood group A can receive blood from:
(A) B and O (B) AB only (C) **A and O** (D) A and B

71. Persons with blood group B can receive blood from:
(A) A and O (B) **B and O** (C) AB and O (D) A and B

72. AB blood group can receive blood from:
(A) AB only (B) O only (C) **A, B, AB and O** (D) A and B only

73. The blood group O can receive blood only from:
(A) A (B) B (C) AB (D) **O**

74. The universal donor in ABO system is:
(A) AB (B) A (C) **O** (D) B

75. The universal recipient in ABO system is:
(A) O (B) A (C) B (D) **AB**

76. The actual universal donor is:
(A) O positive (B) **O negative** (C) AB negative (D) AB positive

77. The actual universal recipient is:
(A) O negative (B) AB negative (C) **AB positive** (D) O positive

78. The recessive allele i is more frequent in the population because:
(A) it is dominant (B) **heterozygous carriers cross to produce O group offspring, so the allele persists** (C) it mutates more (D) it is on Y chromosome

79. The Bombay phenotype is due to the absence of the:
(A) **H antigen precursor because of hh genotype** (B) A antigen (C) Rh factor (D) B antigen

80. The H substance is a precursor of:
(A) Rh antigen (B) **A and B antigens** (C) M and N antigens (D) D antigen

81. The Rh blood group was first discovered in:
(A) dogs (B) **Rhesus monkey** (C) chimpanzee (D) mouse

82. The Rh factor is also called the:
(A) A antigen (B) **D antigen** (C) C antigen (D) E antigen

83. A person who has Rh antigen is:
(A) Rh negative (B) **Rh positive** (C) universal donor (D) type O

84. Genotypes DD and Dd are:
(A) Rh negative (B) **Rh positive** (C) universal (D) incompatible

85. Genotype dd is:
(A) Rh positive (B) **Rh negative** (C) heterozygous (D) absent

86. Anti-Rh antibodies in Rh-negative persons are produced:
(A) from birth (B) **only on exposure to Rh antigen** (C) in all persons (D) only in males

87. Once stimulated, the production of anti-Rh antibodies:
(A) stops in one year (B) **continues throughout life** (C) stops after delivery (D) is temporary

88. Erythroblastosis foetalis occurs when:
(A) Rh-positive mother has Rh-negative child (B) **Rh-negative mother carries an Rh-positive foetus** (C) both are Rh negative (D) both are Rh positive

89. In erythroblastosis foetalis the mother's anti-Rh antibodies cross the:
(A) skin (B) **placenta and cause haemolysis of foetal RBCs** (C) uterus (D) cervix

90. Haemolytic disease of the newborn causes the foetus to become:
(A) polycythaemic (B) **anaemic and jaundiced** (C) diabetic (D) cyanotic only

91. Yellowing of skin due to accumulation of bilirubin is:
(A) anaemia (B) **jaundice** (C) cyanosis (D) oedema

92. An erythroblast is a:
(A) white blood cell (B) **nucleated immature red blood cell** (C) platelet (D) antibody

93. The first child of an Rh negative mother with an Rh positive foetus is usually:
(A) severely affected (B) **safe, since antibodies are not yet formed** (C) aborted always (D) Rh negative

94. Erythroblastosis foetalis is prevented by giving the mother:
(A) antibiotics (B) iron (C) **Rh immunoglobulin (RhoGAM)** (D) insulin

95. RhoGAM is given to the Rh-negative mother at:
(A) 5 weeks and 10 weeks (B) **28 weeks and within 72 hours after delivery of an Rh-positive baby** (C) 12 weeks only (D) after 5 years

96. Alternatives to blood transfusion include:
(A) plasma only (B) **volume expanders, haematopoietic growth factors and erythropoietin** (C) antibiotics (D) vitamins

97. Erythropoietin is produced by:
(A) liver (B) **kidneys** (C) spleen (D) bone marrow

98. Erythropoietin stimulates the production of:
(A) white blood cells (B) platelets (C) **red blood cells** (D) plasma

99. Traits showing continuous variation are controlled by:
(A) single genes (B) **polygenes** (C) multiple alleles (D) sex chromosomes

100. Polygenic traits include:
(A) blood groups (B) **height, weight and skin colour** (C) haemophilia (D) MN blood group

101. Polygenes show ... effect:
(A) dominant (B) **additive** (C) recessive (D) epistatic

102. Wheat grain colour is controlled by how many gene pairs?
(A) One (B) Two (C) **Three** (D) Four

103. In wheat the number of phenotypes in the F2 is:
(A) 3 (B) 5 (C) **7** (D) 9

104. The F2 ratio of wheat grain colour from dark red x white is:
(A) 9:3:3:1 (B) **1:6:15:20:15:6:1** (C) 1:2:1 (D) 3:1

105. The F1 grain colour in wheat dark red x white is:
(A) dark red (B) white (C) **light red (intermediate)** (D) pink only

106. A wheat grain of genotype AaBbCc is:
(A) white (B) pink (C) **light red** (D) dark red

107. A wheat grain with genotype AABBCC is:
(A) white (B) pink (C) **dark red** (D) light red

108. Human skin colour is regulated by at least how many gene pairs?
(A) One (B) Two (C) **Three** (D) Four

109. Skin pigmentation depends upon:
(A) haemoglobin (B) carotene (C) **melanin** (D) keratin

110. The genotype AaBbCc in skin colour is characteristic of a:
(A) very dark person (B) very light person (C) **mulatto (intermediate)** (D) albino

111. Epistasis is the phenomenon in which:
(A) two alleles of same gene interact (B) **a gene at one locus masks or suppresses the effect of a gene at another locus** (C) genes are linked (D) genes mutate

112. The gene that masks the other gene is called:
(A) hypostatic (B) **epistatic** (C) dominant (D) polygenic

113. The gene which is suppressed is:
(A) epistatic (B) **hypostatic** (C) dominant (D) lethal

114. Dominance involves:
(A) two different loci (B) **a single pair of alleles at one locus** (C) three loci (D) sex chromosomes

115. Epistasis involves:
(A) a single pair of alleles (B) **two pairs of alleles at different loci** (C) no genes (D) only sex genes

116. Epistasis shows ... variation while polygenic inheritance shows ... variation:
(A) continuous; discontinuous (B) **discontinuous; continuous** (C) continuous; continuous (D) discontinuous; discontinuous

117. Coat colour in Labrador retriever is an example of:
(A) polygenic inheritance (B) multiple alleles (C) **epistasis** (D) co-dominance

118. In Labradors the allele for black is:
(A) recessive to chocolate (B) **dominant to chocolate** (C) co-dominant (D) lethal

119. A yellow Labrador must have genotype:
(A) EE (B) Ee (C) **ee** (D) BB

120. Crossing BbEe x BbEe in Labradors gives the ratio of black:chocolate:yellow as:
(A) 9:3:3:1 (B) 12:3:1 (C) **9:3:4** (D) 3:1

121. Foxglove flower colour shows:
(A) recessive epistasis (B) **dominant epistasis with a 12:3:1 ratio** (C) incomplete dominance (D) polygenic inheritance

122. Genes located on the same chromosome that tend to be inherited together are:
(A) alleles (B) **linked genes** (C) polygenes (D) multiple alleles

123. The phenomenon of linked genes staying together is called:
(A) crossing over (B) **gene linkage** (C) segregation (D) mutation

124. Linkage on the sex chromosome is called:
(A) autosomal linkage (B) **sex linkage** (C) complete linkage (D) incomplete

linkage

125. The number of linkage groups in an organism equals its:
(A) diploid number (B) **haploid number of chromosomes** (C) gene number (D) triploid number

126. In a test cross of a dihybrid the ratio 1:1:1:1 indicates:
(A) complete linkage (B) incomplete linkage (C) **no linkage (independent assortment)** (D) epistasis

127. If only parental types are produced in a test cross, the linkage is:
(A) incomplete (B) absent (C) **complete** (D) variable

128. The linkage in Drosophila was shown by:
(A) Mendel (B) **T. H. Morgan** (C) Correns (D) Punnett

129. Morgan worked with:
(A) pea (B) **fruit fly Drosophila melanogaster** (C) mouse (D) maize

130. The dihybrid ratio in complete linkage in Morgan's experiment became:
(A) 9:3:3:1 (B) 1:1:1:1 (C) **3:1** (D) 1:2:1

131. The recombination of linked genes occurs due to:
(A) mutation (B) **crossing over** (C) replication (D) translation

132. Crossing over takes place in:
(A) prophase II (B) **prophase I of meiosis** (C) metaphase (D) mitosis

133. Crossing over modifies:
(A) the gamete number (B) **the progeny by producing recombinants** (C) the chromosome number (D) the sex

134. One map unit equals:
(A) 10 percent crossing over (B) **1 percent crossing over (recombination)** (C) 0.1 percent (D) 100 percent

135. The frequency of crossing over is governed mainly by the:
(A) size of chromosome (B) **distance between genes** (C) number of genes (D) temperature

136. Drosophila has how many chromosomes?
(A) 4 (B) **8** (C) 16 (D) 46

137. Chromosomes other than the sex chromosomes are:
(A) mesosomes (B) **autosomes** (C) polysomes (D) lysosomes

138. Humans have how many pairs of autosomes?
(A) 23 (B) 21 (C) **22** (D) 24

139. In humans, the sex chromosomes of a female are:
(A) XY (B) **XX** (C) XO (D) YY

140. In humans, the sex chromosomes of male are:
(A) XX (B) **XY** (C) XO (D) YY

141. The human male is:
(A) homogametic (B) **heterogametic** (C) hemizygous only (D) asexual

142. The human female is:
(A) **homogametic, producing only X-bearing eggs** (B) heterogametic (C) XY (D) hemizygous

143. The sex of the child is determined by the:
(A) egg (B) **sperm** (C) mother (D) environment

144. A sperm with X chromosome fertilizing an egg produces:
(A) a boy (B) **a girl** (C) no child (D) a twin

145. The sex ratio of human offspring is:
(A) 2:1 (B) **1:1** (C) 3:1 (D) 1:2

146. The probability of a boy in the fifth pregnancy after four daughters is:
(A) 1/16 (B) 1/32 (C) **1/2** (D) 1

147. The gene SRY is located on the:
(A) X chromosome (B) **Y chromosome** (C) chromosome 21 (D) chromosome 1

148. SRY stands for:
(A) Sex-Related Yeast (B) **Sex-determining Region Y** (C) Sperm Region Y (D) Sex Reversal Yield

149. The arrangement of chromosomes in a cell is called:
(A) genome (B) **karyotype** (C) genotype (D) phenotype

150. Traits controlled by genes on sex chromosomes are:
(A) autosomal (B) **sex-linked** (C) polygenic (D) epistatic

151. Genes found on both X and Y chromosomes are called:
(A) X-linked (B) Y-linked (C) **X-Y linked (pseudo-autosomal)** (D) holandric

152. Wild type refers to:
(A) mutant organisms (B) **organisms with normal characteristics** (C) hybrid organisms (D) recessive organisms

153. Morgan crossed a white-eyed male Drosophila to a red-eyed female. The F1 flies were:
(A) all white eyed (B) **all red eyed** (C) half white (D) all male

154. In F2 of Morgan's cross, all white-eyed flies were:
(A) female (B) **male** (C) both sexes equally (D) absent

155. Morgan concluded that the gene for eye colour is located on the:
(A) Y chromosome (B) autosome (C) **X chromosome** (D) both

156. In Drosophila a white-eyed female genotype is:
(A) XRXR (B) XRXr (C) **XrXr** (D) XrY

157. A white-eyed male fly has genotype:
(A) XRY (B) **XrY** (C) XrXr (D) XRXr

158. Examples of X-linked recessive traits in humans are:
(A) Down syndrome (B) Sickle cell (C) **haemophilia and colour blindness** (D) Albinism

159. An X-linked dominant disease is:
(A) haemophilia (B) colour blindness (C) **hypophosphatemic (vitamin D resistant) rickets** (D) Down syndrome

160. A carrier woman of an X-linked recessive disease:
(A) shows the disease (B) **does not show the disease but passes it to 50 percent of offspring** (C) never passes it (D) has no X chromosome

161. All daughters of an affected father with an X-linked recessive trait will be:
(A) affected (B) **carriers** (C) normal (D) dead

162. No sons of an affected father inherit his X-linked trait because:
(A) sons receive his X (B) **sons receive his Y chromosome, not the X** (C) sons have two X (D) the trait is lethal

163. Y-linked traits are also called:
(A) autosomal traits (B) **holandric traits** (C) hemizygous recessive (D) polygenic traits

164. Y-linked traits pass:
(A) father to daughter (B) mother to son (C) **father to son** (D) mother to daughter

165. An example of a Y-linked character in humans is:
(A) haemophilia (B) colour blindness (C) **hypertrichosis (hairy pinna)** (D) sickle cell

166. Haemophilia is a disease in which:
(A) blood clots too fast (B) **blood fails to clot properly** (C) RBCs are destroyed (D) WBCs increase

167. The haemophilia types A and B are:
(A) autosomal recessive (B) **X-linked recessive** (C) Y-linked (D) dominant

168. Haemophilia C is:
(A) X-linked recessive (B) **autosomal recessive** (C) dominant (D) Y-linked

169. Haemophilia A is due to the deficiency of clotting factor:
(A) IX (B) XI (C) **VIII** (D) I

170. Haemophilia B is due to the deficiency of factor:
(A) VIII (B) **IX** (C) XI (D) I

171. The percentage of haemophilia A cases is about:
(A) 20 (B) 40 (C) **80** (D) 100

172. Haemophilia B represents about:
(A) 80 percent (B) **20 percent** (C) 50 percent (D) 1 percent

173. The number of known clotting factors is:
(A) 7 (B) 10 (C) **13** (D) 15

174. Factor I is also called:
(A) thrombin (B) **fibrinogen** (C) prothrombin (D) fibrin

175. The final step of the clotting cascade converts fibrinogen into:
(A) thrombin (B) **fibrin** (C) prothrombin (D) platelets

176. The haemophilia A treatment using a genetically engineered factor VIII is:
(A) nonacog alfa (B) **octocog alfa** (C) desmopressin (D) insulin

177. Mild haemophilia A can be treated with:
(A) nonacog alfa (B) **desmopressin** (C) insulin (D) aspirin

178. A woman can suffer from haemophilia only when she is:
(A) heterozygous (B) **homozygous recessive** (C) XY (D) XO

179. Haemophilia affects:
(A) women more than men (B) **men more than women** (C) both equally (D) only women

180. The normal colour vision is based on how many kinds of cones?
(A) Two (B) **Three** (C) Four (D) Five

181. The genes for red and green opsins are on the:
(A) autosome (B) **X chromosome** (C) Y chromosome (D) chromosome 7

182. The gene for blue opsin is on:
(A) X chromosome (B) Y chromosome (C) **autosome 7** (D) chromosome 21

183. A person who can perceive only two primary colours is a:
(A) monochromat (B) **dichromat** (C) trichromat (D) normal person

184. A person who can see only one colour is a:
(A) dichromat (B) **monochromat** (C) trichromat (D) normal

185. Red-green colour blindness is more common in:
(A) women (B) **men** (C) both equally (D) children only

186. A carrier woman marrying a normal man will have colour blind sons in what proportion?
(A) None (B) All (C) **50 percent of the sons** (D) 25 percent of the daughters

187. Pedigree analysis is used to study inheritance in:
(A) Drosophila (B) pea plants (C) **humans** (D) bacteria

188. In a pedigree, a square represents a:
(A) female (B) **male** (C) carrier (D) dead individual

189. In a pedigree, a circle represents a:
(A) **female** (B) male (C) carrier (D) twin

190. Amniocentesis involves the extraction of:
(A) chorionic villi (B) blood of mother (C) **about 20 ml of amniotic fluid** (D) placental tissue

191. In amniocentesis the foetal cells are:
(A) destroyed (B) **cultured, stained and examined for chromosome abnormalities** (C) injected (D) counted only

192. Down syndrome is detected in amniocentesis as:
(A) monosomy 21 (B) **trisomy 21** (C) trisomy 18 (D) XXY

193. Chorionic villus sampling takes a sample from the:
(A) amniotic fluid (B) **placenta** (C) umbilical cord (D) mother's blood

194. Chorionic villi are derived from the:
(A) mother (B) **foetus and have the same genotype as the foetus** (C) father (D) uterus

195. Chorionic villus sampling can be done:
(A) after birth (B) **earlier than amniocentesis through the cervix or abdominal wall** (C) only at 9 months (D) only through blood

196. When a Rh-negative woman marries a Rh-positive DD man, all offspring are:
(A) dd (B) **Dd and Rh positive** (C) DD (D) Rh negative

197. A cross between an albino man and a woman with albino father, as albinism is recessive, gives:
(A) all normal (B) all albino (C) **1 normal : 1 albino** (D) 3 normal : 1 albino

198. A man of blood group B and woman of group A can have children of:
(A) A or B only (B) AB only (C) AB or O only (D) **A, B, AB or O**

199. The Rh system is encoded by three tightly linked genes at:
(A) one locus (B) **two loci in total, three genes C, D, E** (C) four loci (D) five loci

200. Multiple alleles can provide many phenotypes because:
(A) they are on different chromosomes (B) **many combinations of the alleles are possible in diploid individuals** (C) they mutate rapidly (D) they are on the Y chromosome

Scenario based MCQs

Scenario 1: A garden has red and white flowered four o'clock plants. A student crosses a red plant with a white plant. All the F1 plants have pink flowers. She then crosses two pink plants.

201. This is an example of:
(A) complete dominance (B) **incomplete dominance** (C) epistasis (D) linkage

202. The F2 phenotypic ratio would be:
(A) 3:1 (B) 9:3:3:1 (C) **1 red : 2 pink : 1 white** (D) 1:1

203. A cross between a pink and a white plant gives:
(A) all pink (B) all white (C) **1 pink : 1 white** (D) 3 pink : 1 white

204. The pink flower plants are:
(A) homozygous (B) **heterozygous** (C) hemizygous (D) haploid

Scenario 2: A man with blood group A and a woman with blood group B have four children, each with a different ABO group. Their first child is group O and the second is group AB.

205. The genotype of the father is:
(A) IAIA (B) **IAi** (C) IAIB (D) ii

206. The genotype of the mother is:
(A) IBIB (B) IAIB (C) **IBi** (D) ii

207. The group O child has genotype:
(A) IAi (B) IBi (C) IAIB (D) **ii**

208. The ABO system exemplifies:
(A) incomplete dominance only (B) **multiple alleles with co-dominance** (C) polygenic inheritance (D) linkage

Scenario 3: A woman with Rh-negative blood marries a man with Rh-positive blood. Their first baby is born healthy. During the second pregnancy the baby shows severe anaemia and jaundice.

209. The condition in the second baby is:
(A) thalassaemia (B) **erythroblastosis foetalis** (C) sickle cell anaemia (D) haemophilia

210. The anti-Rh antibodies were produced in the mother because of exposure to:
(A) A antigen (B) **Rh antigen from the first baby's blood at delivery** (C) B antigen (D) antibiotics

211. The yellowing of baby's skin is due to accumulation of:
(A) haemoglobin (B) **bilirubin** (C) melanin (D) carotene

212. The condition could have been prevented by giving the mother:
(A) vitamin K (B) iron tablets (C) **Rh immunoglobulin (RhoGAM)** (D) blood transfusion

Scenario 4: A boy has haemophilia although both his parents have normal blood clotting. His mother's father was a haemophiliac.

213. The mother of the boy is:
(A) normal homozygous (B) **a carrier (XHXh)** (C) haemophilic (D) XY

214. The father of the boy has genotype:
(A) XhY (B) **XHY** (C) XHXH (D) XhXh

215. The gene for haemophilia came to the boy from his:
(A) father (B) **mother** (C) both parents (D) grandfather's Y chromosome

216. This type of inheritance is described as:
(A) Y-linked (B) **X-linked recessive criss-cross inheritance** (C) autosomal dominant (D) polygenic

Scenario 5: In Drosophila, a cross between red-eyed females (homozygous) and white-eyed males gives all red-eyed F1. When F1 flies are interbred, F2 has 3 red : 1 white, but all white-eyed flies are male.

217. The gene for eye colour is on the:
(A) Y chromosome (B) autosome (C) **X chromosome** (D) mitochondria

218. The F1 females are:
(A) XRXR (B) **XRXr** (C) XrXr (D) XRY

219. The white-eyed F2 male has genotype:
(A) XRY (B) **XrY** (C) XrXr (D) XRXr

220. This experiment was carried out by:
(A) Mendel (B) Correns (C) **T. H. Morgan** (D) Landsteiner

Scenario 6: A student crosses a Labrador with black coat (BbEe) with another BbEe. The puppies were black, chocolate and yellow.

221. This is an example of:
(A) incomplete dominance (B) **epistasis** (C) co-dominance (D) linkage

222. The expected ratio of black : chocolate : yellow is:
(A) 9:3:3:1 (B) 12:3:1 (C) **9:3:4** (D) 3:1

223. Yellow puppies have genotype:
(A) E_ (B) B_E_ (C) **ee** (D) bbEE only

224. The gene which masks the black/chocolate gene is:
(A) B (B) b (C) **ee (the yellow gene)** (D) none

Scenario 7: A pregnant woman aged 42 years is advised to have a test to detect chromosomal abnormalities in her foetus. A needle is inserted through the abdominal wall under ultrasound and a sample is drawn.

225. The test is:
(A) chorionic villus sampling (B) **amniocentesis** (C) blood grouping (D) biopsy of mother

226. About how much fluid is withdrawn?
(A) 2 ml (B) 200 ml (C) **20 ml** (D) 2 litres

227. The foetal cells are:
(A) frozen at once (B) **cultured, stained and examined under the microscope** (C) injected back (D) discarded

228. A disorder detected could be:
(A) haemophilia only (B) **Down syndrome (trisomy 21)** (C) malaria (D) diabetes

Unit 13: Chromosome and DNA

Straight MCQs

1. Chromosomes are thick thread-like structures which appear in the nucleus during:
(A) interphase (B) **cell division** (C) growth (D) only meiosis

2. In an interphase cell the chromosomes appear as a fine network called:
(A) chromatid (B) **chromatin** (C) nucleolus (D) spindle

3. A chromosome consists of two strands called:
(A) centromeres (B) **chromatids** (C) telomeres (D) nucleosomes

4. The two chromatids are attached at the:
(A) telomere (B) satellite (C) **centromere (primary constriction)** (D) nucleolus

5. The secondary constriction which gives rise to the nucleolus is the:
(A) centromere (B) telomere (C) **nucleolar organizer** (D) satellite

6. The knob-like terminal region beyond the secondary constriction is the:
(A) telomere (B) centromere (C) **satellite** (D) kinetochore

7. The terminal ends of chromosomes are called:
(A) satellites (B) centromeres (C) **telomeres** (D) chromomeres

8. Telomeres prevent:
(A) DNA replication (B) **two chromosomes from attaching to each other at their ends** (C) transcription (D) crossing over

9. A chromosome with the centromere at the centre is:
(A) submetacentric (B) acrocentric (C) telocentric (D) **metacentric**

10. A chromosome with the centromere slightly away from the centre is:
(A) metacentric (B) **submetacentric** (C) acrocentric (D) telocentric

11. A chromosome with the centromere near one end is:
(A) metacentric (B) submetacentric (C) **acrocentric** (D) telocentric

12. A chromosome with the centromere at one end is:
(A) metacentric (B) acrocentric (C) submetacentric (D) **telocentric**

13. The chromosome is chemically made up of about:
(A) 60 percent DNA and 40 percent protein (B) **40 percent DNA and 60 percent protein** (C) 50 percent DNA and 50 percent RNA (D) 100 percent DNA

14. DNA in chromosomes is complexed with basic proteins called:
(A) albumins (B) globulins (C) **histones** (D) keratins

15. Histones are rich in the basic amino acids:
(A) glycine and alanine (B) **arginine and lysine** (C) valine and leucine (D) proline and serine

16. A human chromosome contains DNA about:
(A) 5 mm long (B) **5 cm long with about 140 million nucleotides** (C) 5 m long (D) 5 micrometres long

17. A nucleosome consists of DNA wrapped around:
(A) four histones (B) six histones (C) **a core of eight histone molecules** (D) ten histones

18. Approximately every how many nucleotides of DNA wrap around a histone core?
(A) 20 (B) 100 (C) **200** (D) 2000

19. The DNA wraps around the histone core:
(A) once (B) **twice** (C) three times (D) four times

20. Histone H1 acts as:
(A) the core (B) **a linker which seals the DNA around the histone core** (C) an enzyme (D) a repressor

21. The nucleosome string is about how thick?
(A) 2 nm (B) **10 nm** (C) 30 nm (D) 300 nm

22. The chromatin fibre is about how thick?
(A) 10 nm (B) **30 nm** (C) 300 nm (D) 700 nm

23. The supercoil has a diameter of:
(A) 10 nm (B) 30 nm (C) **300 nm** (D) 700 nm

24. The chromatid is about how thick?
(A) 30 nm (B) 300 nm (C) **700 nm** (D) 1400 nm

25. A chromosome (two chromatids) is about:
(A) 700 nm (B) **1400 nm** (C) 300 nm (D) 30 nm

26. The correct sequence of chromosome organization from DNA is:
(A) chromatin fibre, nucleosome, supercoil, chromatid (B) **nucleosome, chromatin fibre, supercoil, chromatid** (C) supercoil, nucleosome, chromatid (D) chromatid, supercoil, nucleosome

27. Highly condensed and unexpressed chromatin is:
(A) euchromatin (B) **heterochromatin** (C) satellite (D) nucleolus

28. Non-condensed chromatin in which genes are expressed is:
(A) heterochromatin (B) **euchromatin** (C) satellite (D) telomere

29. The question whether DNA or protein carries heredity was addressed by:
(A) only Mendel (B) **a series of investigators from the late 1920s over 30 years** (C) only Watson and Crick (D) only Darwin

30. Griffith worked with:
(A) E. coli (B) **Streptococcus pneumoniae and mice** (C) Drosophila (D) bacteriophage T2

31. The S-type bacteria have a:
(A) no capsule and are rough (B) **polysaccharide capsule and form smooth colonies** (C) protein capsule (D) cell wall of cellulose

32. The R-type bacteria are:
(A) virulent (B) **non-virulent and rough colonies without capsule** (C) capsulated (D) dead

33. When Griffith injected mice with live S-type, the mice:
(A) lived (B) **died** (C) showed no effect (D) became immune

34. When injected with heat-killed S-type plus live R-type, the mice:
(A) lived (B) **died, and live S-type bacteria were found in the blood** (C) had no effect (D) became stronger

35. The transfer of genetic material from one organism to another changing the genetic make-up of the recipient is called:
(A) conjugation (B) transduction (C) **transformation** (D) mutation

36. The transforming principle was identified as DNA in 1944 by:
(A) Hershey and Chase (B) **Avery, MacLeod and McCarty** (C) Meselson and Stahl (D) Watson and Crick

37. In Avery's experiment the extract treated with DNase:
(A) still caused transformation (B) **did not cause transformation** (C) killed the mice (D) produced S cells

38. In Avery's experiment the extract treated with protease:
(A) lost transformation ability (B) **still caused transformation, so protein is not the active factor** (C) killed the mice (D) became inactive

39. In Avery's experiment RNase treatment:
(A) stopped transformation (B) **did not stop transformation, so RNA is not the active factor** (C) killed the bacteria (D) made R-type virulent

40. The Hershey and Chase experiment was carried out in:
(A) 1928 (B) 1944 (C) **1952** (D) 1958

41. Hershey and Chase worked on:
(A) Streptococcus (B) **bacteriophages and E. coli** (C) Drosophila (D) yeast

42. They labelled phage DNA with:
(A) 35S (B) **32P** (C) 15N (D) 14C

43. They labelled phage protein with:
(A) 32P (B) **35S** (C) 15N (D) 18O

44. In the bacterial cells after infection they found:
(A) 35S (B) **32P** (C) both (D) neither

45. In the medium after centrifugation they found:
(A) 32P (B) **35S (phage protein coat)** (C) both (D) neither

46. Hershey and Chase proved that the hereditary material of phage is:
(A) protein (B) **DNA** (C) RNA (D) lipid

47. If you want to label amino acids but not DNA, you use the isotope:
(A) 32P (B) **35S** (C) 14N (D) 18F

48. DNA replication occurs only once during the:
(A) G1 phase (B) **S phase** (C) G2 phase (D) M phase

49. The DNA molecule which is replicated is called the:
(A) daughter DNA (B) **parent DNA** (C) template RNA (D) primer

50. The three models of DNA replication are:
(A) semiconservative, dispersive, discontinuous (B) **semi-conservative, conservative and dispersive** (C) conservative, discontinuous, continuous (D) dispersive, continuous, semi-dispersive

51. In the semi-conservative model each daughter DNA consists of:
(A) two old strands (B) two new strands (C) **one parental and one new strand** (D) fragments of old and new

52. In the conservative model one daughter DNA has:
(A) one old, one new strand (B) **both parental strands, and the other has both new strands** (C) dispersed fragments (D) none

53. In the dispersive model the parental DNA:
(A) remains intact (B) **is dispersed into fragments which combine with new nucleotides** (C) is destroyed (D) forms one daughter only

54. Meselson and Stahl did their experiment in:
(A) 1928 (B) 1952 (C) **1958** (D) 1962

55. Meselson and Stahl used the heavy isotope of:
(A) phosphorus (B) sulphur (C) **nitrogen (15N)** (D) carbon

56. They separated the DNA by:
(A) electrophoresis (B) chromatography (C) **cesium chloride density gradient ultracentrifugation** (D) filtration

57. After one generation in 14N medium the DNA appeared:
(A) heaviest (B) lightest (C) **intermediate (hybrid)** (D) as two bands

58. After two generations the DNA showed:
(A) one intermediate band (B) only a light band (C) only a heavy band (D) **two bands, one light and one intermediate**

59. Meselson and Stahl proved that DNA replication is:
(A) conservative (B) dispersive (C) **semi-conservative** (D) random

60. The point where replication begins is the:
(A) promoter (B) terminator (C) **origin of replication** (D) operator

61. In prokaryotes the number of origins of replication is:
(A) many (B) none (C) **one** (D) two

62. Eukaryotic DNA has:
(A) only one origin (B) **more than one origin of replication** (C) none (D) two only

63. The enzyme that opens the DNA duplex by breaking base pairs is:
(A) DNA gyrase (B) primase (C) **DNA helicase** (D) ligase

64. The enzyme that reduces the tension created during unwinding is:
(A) helicase (B) **DNA gyrase** (C) ligase (D) primase

65. The proteins that prevent single strands from re-pairing are:
(A) histones (B) **single-strand binding (SSB) proteins** (C) repressors (D) sigma factors

66. The Y-shaped region on each side of the replication bubble is the:
(A) origin (B) **replication fork** (C) promoter (D) operon

67. The enzyme which synthesizes RNA primers is:
(A) DNA polymerase (B) helicase (C) ligase (D) **primase**

68. The complex of primase and helicase is called the:
(A) spliceosome (B) nucleosome (C) **primosome** (D) ribosome

69. The enzyme which synthesizes the daughter strand is:
(A) DNA ligase (B) **DNA polymerase** (C) RNA polymerase (D) helicase

70. DNA polymerase adds nucleotides to the:
(A) 5 prime end of the primer (B) **3 prime end of the primer** (C) middle of template (D) phosphate group

71. Synthesis of DNA is in the direction:
(A) 3 prime to 5 prime (B) **5 prime to 3 prime** (C) both directions (D) random

72. DNA polymerase III:
(A) repairs DNA (B) removes primers (C) **is the main enzyme of replication** (D) joins fragments

73. DNA polymerase II is involved in:
(A) main replication (B) **repair of DNA damages** (C) primer synthesis (D) unwinding

74. DNA polymerase I:
(A) is the main replicating enzyme (B) **removes RNA primers and fills the gaps with DNA nucleotides** (C) makes primers (D) joins Okazaki fragments

75. The continuously synthesized daughter strand is the:
(A) lagging strand (B) **leading strand** (C) template (D) primer

76. The discontinuously synthesized daughter strand is the:
(A) leading strand (B) **lagging strand** (C) parent strand (D) sense strand

77. The short fragments of the lagging strand are called:
(A) Meselson fragments (B) **Okazaki fragments** (C) Griffith fragments (D) exons

78. The enzyme that joins Okazaki fragments is:
(A) DNA polymerase (B) helicase (C) **DNA ligase** (D) primase

79. The ability of DNA polymerase to remove a wrongly added nucleotide is called:
(A) splicing (B) **proofreading** (C) capping (D) translocation

80. Which enzyme could be missing if replication gives DNA with many short fragments joined to the normal strand?
(A) DNA polymerase (B) **DNA ligase** (C) Primase (D) Helicase

81. Errors in DNA replication result in:
(A) stability (B) **mutations and genetic variation** (C) no change (D) protein loss

82. The idea that DNA makes protein via RNA is the:
(A) genetic code (B) **central dogma** (C) proofreading (D) lac operon

83. Gene expression includes:
(A) replication and repair (B) **transcription and translation** (C) mutation and recombination (D) splicing only

84. Transcription is the synthesis of:
(A) protein from RNA (B) DNA from RNA (C) **RNA from a DNA template** (D) DNA from DNA

85. Transcription requires only one enzyme which is:
(A) DNA polymerase (B) **RNA polymerase** (C) helicase (D) ligase

86. The three phases of transcription are:
(A) replication, translation, termination (B) **initiation, elongation and termination** (C) activation, initiation, elongation (D) transcription, splicing, capping

87. The region of a gene where RNA polymerase binds is the:
(A) operator (B) terminator (C) **promoter** (D) exon

88. The prokaryotic promoter sequences are:
(A) TATA and CAAT boxes (B) **TATAAT (minus 10) and TTGACA (minus 35)** (C) GC box only (D) AUG

89. Eukaryotic promoter contains:
(A) TATAAT and TTGACA (B) **TATA box, CAAT box and GC-rich box** (C) only terminator (D) operator

90. The TATA box is located at about:
(A) minus 10 (B) minus 35 (C) **minus 25** (D) minus 80

91. The CAAT box is located at about:
(A) minus 25 (B) **minus 80** (C) minus 10 (D) minus 35

92. Prokaryotic RNA polymerase core enzyme has how many subunits?
(A) Two (B) Three (C) **Four subunits (two alpha and two beta types)** (D) Six

93. The factor needed for RNA polymerase to bind the promoter is the:
(A) rho factor (B) **sigma factor** (C) release factor (D) initiation factor

94. The core enzyme plus sigma factor is called the:
(A) spliceosome (B) **holoenzyme** (C) apoenzyme (D) primosome

95. Eukaryotic RNA polymerase I synthesizes:
(A) mRNA (B) tRNA (C) **rRNA** (D) snRNA

96. Eukaryotic RNA polymerase II synthesizes:
(A) rRNA (B) tRNA (C) **mRNA** (D) DNA

97. RNA polymerase III synthesizes:
(A) rRNA (B) mRNA (C) **tRNA** (D) DNA

98. RNA polymerase does not require a:
(A) promoter (B) template (C) **primer** (D) nucleotides

99. The strand of the gene which is used as a template is also called:
(A) sense strand (B) coding strand (C) **antisense strand** (D) leading strand

100. The strand having the same sequence as mRNA is the:
(A) template strand (B) antisense strand (C) **coding (sense) strand** (D) lagging strand

101. The movement of the RNA polymerase is in the direction:
(A) 3 prime to 5 prime of RNA (B) **5 prime to 3 prime of RNA** (C) random (D) both

102. The terminator region consists of GC base pairs followed by:
(A) GC pairs (B) **AT base pairs, forming a GC hairpin and poly U tail** (C) TATA (D) CAAT

103. The GC hairpin in transcription termination causes:
(A) start of transcription (B) **RNA polymerase to stop synthesis of RNA** (C) splicing (D) capping

104. Eukaryotic newly synthesized mRNA is called:
(A) mature mRNA (B) **pre-mRNA or primary transcript** (C) tRNA (D) rRNA

105. In prokaryotes mRNA:
(A) is processed in the nucleus (B) **undergoes translation as soon as it is formed** (C) has introns (D) has a cap

106. The non-coding regions of eukaryotic genes are:
(A) exons (B) **introns** (C) promoters (D) operators

107. The coding regions are called:
(A) introns (B) **exons** (C) promoters (D) terminators

108. The 5 prime cap on mRNA is:
(A) poly A (B) **7-methylguanosine triphosphate (7-methyl GTP)** (C) a tRNA (D) a sigma factor

109. The poly-A tail of mRNA is added at the:
(A) 5 prime end (B) **3 prime end, with 30 to 500 adenine nucleotides** (C) middle (D) introns

110. The cap and tail protect mRNA from:
(A) splicing (B) **degradation by phosphatases and nucleases** (C) translation (D) transcription

111. The removal of introns from mRNA is called:
(A) capping (B) **RNA splicing** (C) tailing (D) replication

112. Splicing is catalysed by:
(A) ribosomes (B) primosomes (C) **spliceosomes (RNA-protein complex)** (D) nucleosomes

113. The exons are joined together by:
(A) DNA ligase (B) **RNA ligase** (C) DNA polymerase (D) RNA polymerase

114. The length of mRNA shortens as it enters the cytoplasm due to:
(A) degradation (B) **removal of introns by splicing** (C) loss of cap (D) loss of poly A

115. The relationship between amino acid sequence and nucleotide sequence is called the:
(A) central dogma (B) **genetic code** (C) codon degeneracy (D) transcription

116. A triplet of bases specifying an amino acid is a:
(A) anticodon (B) **codon** (C) gene (D) exon

117. The total number of codons is:
(A) 20 (B) 61 (C) 16 (D) **64**

118. The number of codons which do not encode any amino acid:
(A) one (B) two (C) **three (UAA, UAG, UGA)** (D) four

119. The stop codons are also called:
(A) sense codons (B) **nonsense codons** (C) start codons (D) degenerate codons

120. The start codon is:
(A) UAA (B) UGA (C) **AUG which codes for methionine** (D) UAG

121. The characteristic of genetic code in which an amino acid is encoded by more than one codon is:
(A) universality (B) non-overlapping (C) **degeneracy** (D) punctuation

122. Leucine and serine are each encoded by:
(A) two codons (B) four codons (C) **six codons** (D) one codon

123. The amino acids encoded by a single codon are:
(A) leucine and serine (B) **methionine and tryptophan** (C) glycine and alanine (D) proline and valine

124. The genetic code is universal, meaning it is:
(A) **the same in almost all organisms** (B) different in each organism (C) found only in humans (D) only in bacteria

125. An exception to universality is found in the genetic code of:
(A) nuclear DNA (B) **mitochondrial DNA** (C) rRNA (D) plasmids

126. In mitochondria UGA codes for:
(A) stop (B) **tryptophan** (C) methionine (D) arginine

127. The genetic code is read without gaps between codons. This is:
(A) overlapping (B) **comma-less (no punctuation)** (C) degenerate (D) universal

128. Non-overlapping code means:
(A) codons overlap (B) **each base belongs to only one codon** (C) codons are in pairs (D) no codons

129. The minimum number of tRNA types needed in a cell for a triplet code (excluding stop codons) is:
(A) 20 (B) 64 (C) **61** (D) 3

130. Translation is the synthesis of:
(A) RNA (B) DNA (C) **polypeptide from mRNA** (D) lipids

131. The four phases of translation are:
(A) initiation, elongation, termination, splicing (B) **activation of amino acids, formation of initiation complex, elongation and termination** (C) replication, transcription, translation, repair (D) capping, splicing, tailing, translation

132. Amino acids bind to tRNA with the help of:
(A) peptidyl transferase (B) **aminoacyl-tRNA synthetase** (C) RNA polymerase (D) ligase

133. Amino acids are attached to tRNA at its:
(A) anticodon (B) D loop (C) **3 prime CCA end** (D) 5 prime end

134. Activation of amino acids requires:
(A) GTP (B) **ATP** (C) NADPH (D) CTP

135. The first tRNA in prokaryotes carries:
(A) methionine (B) **N-formylmethionine** (C) alanine (D) glycine

136. In eukaryotes the initiating amino acid is:
(A) N-formylmethionine (B) **methionine (unmodified)** (C) valine (D) serine

137. The initiation complex is formed by:
(A) large subunit, tRNA and DNA (B) **small ribosomal subunit, mRNA and first aminoacyl-tRNA, then large subunit** (C) only mRNA (D) ribosome and DNA

138. The P site of the ribosome is the:
(A) aminoacyl site (B) exit site (C) **peptidyl site** (D) promoter site

139. The A site of the ribosome is the:
(A) **aminoacyl site where new tRNAs bind** (B) peptidyl site (C) exit site (D) promoter

140. The E site of the ribosome is the:
(A) aminoacyl site (B) peptidyl site (C) **exit site where empty tRNAs leave** (D) entry site

141. Peptide bonds between amino acids are formed by:
(A) aminoacyl synthetase (B) **peptidyl transferase** (C) RNA polymerase (D) DNA ligase

142. The movement of the ribosome along mRNA by one codon is:
(A) activation (B) **translocation** (C) transcription (D) initiation

143. The ribosome moves along mRNA in the direction:
(A) 3 prime to 5 prime (B) **5 prime to 3 prime** (C) both (D) random

144. Translation terminates when which is exposed at the A site?
(A) A start codon (B) A sense codon (C) **A stop codon** (D) An anticodon

145. Stop codons are recognized by:
(A) tRNAs (B) initiation factors (C) **release factors** (D) rRNA

146. The polypeptide after synthesis enters the Golgi complex for:
(A) synthesis (B) replication (C) **further modification** (D) degradation only

147. A cell can secrete proteins as:
(A) only DNA (B) **digestive enzymes, hormones, albumins, fibrinogen and antibodies** (C) only RNA (D) only lipids

148. Ribosomes in eukaryotes are:
(A) 70S (B) **80S with 60S and 40S subunits** (C) 70S with 50S and 30S (D) 60S

149. Prokaryotic translation uses how many release factors?
(A) One (B) **Two** (C) Three (D) Four

150. Eukaryotic translation uses:
(A) two release factors (B) **a single release factor** (C) no release factor (D) three release factors

151. Regulation of gene expression is important because it:
(A) stops all genes (B) **allows the cell to express proteins when needed and is the basis of differentiation** (C) changes the DNA sequence (D) repairs DNA

152. The mature human body has about how many different cell types?
(A) 20 (B) 100 (C) **200** (D) 2000

153. Different cell types differ because of:
(A) different genes present (B) **differential gene expression** (C) different DNA content (D) different chromosomes

154. In negative control, gene expression is:
(A) switched on by a protein (B) **turned off by a repressor protein** (C) stopped by a mutation (D) increased

155. In positive control, gene expression is:
(A) blocked by a repressor (B) **turned on by an activator protein** (C) random (D) absent

156. A repressor binds to the:
(A) promoter (B) **operator region** (C) terminator (D) structural genes

157. The lac operon is a classic example of gene regulation in:
(A) yeast (B) **bacteria** (C) humans (D) viruses

158. The lac operon consists of a regulatory gene and how many structural genes?
(A) Two (B) **Three (z, y and a)** (C) Four (D) Five

159. The i gene produces the:
(A) permease (B) beta-galactosidase (C) **repressor protein** (D) transacetylase

160. The z gene codes for:
(A) permease (B) transacetylase (C) **beta-galactosidase** (D) repressor

161. Beta-galactosidase hydrolyses:
(A) glucose (B) **lactose** (C) maltose (D) sucrose

162. When lactose is absent, the repressor:
(A) does not bind (B) **binds the operator and prevents transcription of structural genes** (C) activates the operon (D) is destroyed

163. When lactose is present, the repressor:
(A) binds to the operator (B) **is inactivated by the inducer (lactose), so transcription occurs** (C) makes more enzymes (D) is destroyed

164. The inducer of the lac operon is:
(A) glucose (B) **lactose (allolactose)** (C) galactose (D) maltose

165. A mutation is a change in:
(A) the protein (B) **the DNA sequence or chromosome structure or number** (C) the RNA only (D) the cell wall

166. Agents which cause mutations are called:
(A) mutants (B) **mutagens** (C) mutators (D) carcinogens only

167. The organism in which a mutation occurs is called a:
(A) mutagen (B) **mutant** (C) variant (D) clone

168. A physical mutagen is:
(A) colchicine (B) mustard gas (C) **UV rays, X-rays and gamma rays** (D) acridine orange

169. A chemical mutagen is:
(A) gamma rays (B) X-rays (C) **colchicine, mustard gas and nitrous acid** (D) UV rays

170. Mutations which occur naturally are called:
(A) induced mutations (B) **spontaneous (natural) mutations** (C) chromosomal mutations (D) point mutations

171. Mutations produced artificially are:
(A) natural (B) **induced mutations** (C) spontaneous (D) harmless

172. A change in a single or a few nucleotides is a:
(A) chromosomal mutation (B) **point (gene) mutation** (C) aneuploidy (D) translocation

173. A change in the structure or number of chromosomes is:
(A) a point mutation (B) **a chromosomal mutation (aberration)** (C) a gene mutation (D) silent mutation

174. Replacement of one base by another is:
(A) insertion (B) deletion (C) **base substitution** (D) frameshift

175. Addition or removal of one or more nucleotides causes a:
(A) substitution (B) **frameshift mutation** (C) silent mutation (D) translocation

176. A frameshift mutation results in:
(A) no change (B) **a completely new codon sequence and a non-functional protein** (C) a normal protein (D) a change in one amino acid

177. Most mutations are:
(A) beneficial (B) neutral (C) **harmful** (D) lethal always

178. Mutations are considered the driving force of:
(A) cell division (B) **evolution** (C) respiration (D) photosynthesis

179. Harmful mutations are removed from the gene pool by:
(A) mutation (B) **natural selection** (C) migration (D) gene flow

180. Examples of harmful mutations include:
(A) beautiful flowers (B) **cancer, microcephaly, Down syndrome and sickle cell anaemia** (C) antibiotic production (D) nitrogen fixation

181. Down syndrome is characterized by:
(A) 2n minus 1 (B) **2n plus 1 with trisomy 21** (C) XXY (D) XO

182. The total chromosome number in a Down syndrome child is:
(A) 45 (B) 46 (C) **47** (D) 48

183. Down syndrome results from:
(A) mutation in a single gene (B) **non-disjunction of chromosome 21 during maternal meiosis** (C) radiation only (D) virus infection

184. A symptom of Down syndrome is:
(A) tall height (B) **a single crease in the palm and a flattened nose** (C) webbed neck (D) enlarged breasts

185. Klinefelter's syndrome has the chromosome constitution:
(A) 44 + XO (B) **44 + XXY** (C) 44 + XYY (D) 44 + XXX

186. Klinefelter's patients are:
(A) females (B) **males with some feminine characters and small testes** (C) normal males (D) sterile females

187. Klinefelter's syndrome can be treated with:
(A) estrogen (B) **testosterone at puberty, but it does not help infertility** (C) insulin (D) growth hormone

188. Turner syndrome has the chromosome constitution:
(A) 44 + XXY (B) **44 + XO (45 chromosomes)** (C) 44 + XXX (D) 44 + XYY

189. Turner syndrome patients are:
(A) males (B) **females with short height, webbed neck and infertility** (C) normal females (D) fertile females

190. Growth hormone and estrogen therapy are used for:
(A) Down syndrome (B) Klinefelter's syndrome (C) **Turner's syndrome** (D) sickle cell anaemia

191. Sickle cell anaemia is due to replacement of glutamic acid by:
(A) leucine (B) **valine at position 6 of the beta chain** (C) alanine (D) lysine

192. Sickle cell anaemia is caused by:
(A) a dominant gene (B) **a recessive gene, inherited from both parents** (C) a Y-linked gene (D) a chromosomal mutation

193. Treatment of sickle cell anaemia includes:
(A) insulin (B) **blood transfusions, pain relief, fluids, and bone marrow or stem cell transplant** (C) antibiotics only (D) surgery only

194. Phenylketonuria (PKU) is the inability to break down:
(A) tyrosine (B) glucose (C) **phenylalanine** (D) lactose

195. In PKU the defective enzyme is:
(A) tyrosinase (B) **phenylalanine hydroxylase** (C) amylase (D) lactase

196. PKU is inherited as:
(A) autosomal dominant (B) X-linked recessive (C) **autosomal recessive** (D) Y-linked

197. The treatment of PKU is a diet extremely low in:
(A) glucose (B) **phenylalanine** (C) fat (D) tyrosine

198. The special infant formula for PKU is:
(A) Lactogen (B) Nan (C) **Lofenalac** (D) Cerelac

199. Chromosomes are made of:
(A) DNA and pectin (B) RNA and DNA (C) **DNA and histone proteins** (D) DNA only

200. The anticodon of a tRNA is:
(A) identical to the codon (B) **complementary to the corresponding codon of mRNA** (C) complementary to rRNA (D) the amino acid binding part

Scenario based MCQs

Scenario 1: A scientist injects mice with (i) live S-type bacteria, (ii) live R-type bacteria, (iii) heat-killed S-type bacteria, and (iv) a mixture of live R-type and heat-killed S-type.

201. Mice which die are those injected with:
(A) (ii) and (iii) only (B) **(i) and (iv)** (C) (iii) only (D) (ii) only

202. In the mixture (iv) live S-type bacteria are found in the dead mice because of:
(A) mutation (B) **transformation of R-type by a substance from dead S-type** (C) conjugation (D) transduction

203. The substance responsible was later identified to be:
(A) protein (B) polysaccharide (C) RNA (D) **DNA**

204. The scientist who identified it was:
(A) Hershey (B) **Avery, MacLeod and McCarty** (C) Meselson (D) Watson

Scenario 2: Bacteria are grown for several generations in a medium with heavy nitrogen (15N). They are then shifted to normal nitrogen (14N) medium. DNA is extracted after one and two generations and centrifuged in cesium chloride.

205. After one generation the DNA band is:
(A) at the top (B) at the bottom (C) **in the middle (hybrid)** (D) absent

206. After two generations, the bands are:
(A) one at the bottom (B) one at the middle (C) **one at the top and one in the middle** (D) all at the bottom

207. This result supports:
(A) conservative replication (B) dispersive replication (C) **semi-conservative replication** (D) no replication

208. The experiment was done by:
(A) Hershey and Chase (B) **Meselson and Stahl** (C) Avery and MacLeod (D) Watson and Crick

Scenario 3: At a replication fork, one new strand is made continuously while the other is made in short pieces which are later joined.

209. The continuous strand is the:
(A) lagging strand (B) **leading strand** (C) template (D) primer

210. The short pieces are called:
(A) exons (B) **Okazaki fragments** (C) introns (D) primers

211. The enzyme that joins the pieces is:
(A) helicase (B) polymerase III (C) **ligase** (D) gyrase

212. The enzyme that provides the starting short RNA is:
(A) polymerase (B) ligase (C) **primase** (D) gyrase

Scenario 4: A gene in a eukaryotic cell is transcribed. The primary transcript has 3000 nucleotides but the mature mRNA that enters the cytoplasm has only 1500 nucleotides. A cap and a poly-A tail are added.

213. The shortening is due to removal of:
(A) exons (B) **introns by splicing** (C) the cap (D) the tail

214. The process occurs in the:
(A) cytoplasm (B) ribosome (C) **nucleus** (D) Golgi

215. The cap and tail protect mRNA from:
(A) translation (B) **degradation by nucleases and phosphatases** (C) transcription (D) replication

216. The splicing enzyme complex is the:
(A) primosome (B) nucleosome (C) **spliceosome** (D) ribosome

Scenario 5: An mRNA has the sequence 5 prime AUG AGC GCA UAA 3 prime and is being translated at a ribosome.

217. The start codon is:
(A) AGC (B) **AUG, coding for methionine** (C) GCA (D) UAA

218. The stop codon is:
(A) AUG (B) AGC (C) GCA (D) **UAA**

219. The number of amino acids in the polypeptide formed is:
(A) 4 (B) **3** (C) 2 (D) 12

220. The tRNA anticodon for the codon AGC would be:
(A) AGC (B) **UCG** (C) TCG (D) GCT

Scenario 6: A child is born with 47 chromosomes. He has a flat nose, a single crease in his palms and learning difficulty.

221. The syndrome is:
(A) Turner's (B) Klinefelter's (C) **Down syndrome** (D) PKU

222. The chromosomal constitution is:
(A) monosomy 21 (B) **trisomy 21** (C) XXY (D) XO

223. The cause is:
(A) a point mutation (B) **non-disjunction of chromosome 21 in maternal meiosis** (C) a frameshift (D) a deletion

224. A suitable test during pregnancy to detect it is:
(A) blood grouping (B) **amniocentesis** (C) urine test (D) X-ray

Scenario 7: In E. coli grown in a medium containing glucose only, the enzymes for lactose breakdown are not made. When lactose is the only sugar, the enzymes are made.

225. This regulation is described by:
(A) the Calvin cycle (B) **the lac operon** (C) the Krebs cycle (D) the central dogma only

226. In the absence of lactose the repressor binds to the:
(A) promoter (B) **operator** (C) structural gene (D) terminator

227. In the presence of lactose the repressor is:
(A) activated (B) **inactivated by binding the inducer** (C) synthesized more (D) attached to RNA polymerase

228. The enzymes produced include:
(A) amylase (B) **beta-galactosidase, permease and transacetylase** (C) lipase (D) protease

Unit 14: Evolution

Straight MCQs

1. The age of the earth is about:
(A) 4.5 million years (B) **4.5 billion years** (C) 14 billion years (D) 45 billion years

2. The oldest known fossils are about:
(A) 3.7 million years old (B) **3.7 billion years old** (C) 600 million years old (D) 4.5 billion years old

3. The word evolution means:
(A) creation (B) extinction (C) **change over a period of time** (D) growth of an individual

4. The earliest photosynthetic autotrophs used which compound as a source of hydrogen?
(A) Water (B) **Hydrogen sulfide** (C) Methane (D) Ammonia

5. Oxygen-evolving photosynthesis began with organisms similar to:
(A) archaea (B) **cyanobacteria** (C) protozoa (D) algae

6. For more than a billion years the world was ruled by:
(A) eukaryotes (B) **prokaryotes** (C) plants (D) animals

7. The endosymbiosis theory was proposed by:
(A) Darwin (B) Lamarck (C) **Lynn Margulis** (D) Wallace

8. According to endosymbiosis, mitochondria evolved from:
(A) a photosynthetic bacterium (B) **an aerobic bacterium engulfed by a large anaerobic prokaryote** (C) a spirochete (D) a virus

9. Chloroplasts are thought to be derived from:
(A) aerobic bacteria (B) **photosynthetic bacteria ingested by an early eukaryote** (C) archaea (D) viruses

10. Flagella may have been derived from ingestion of prokaryotes similar to:
(A) cyanobacteria (B) **spirochetes** (C) archaea (D) Rhizobium

11. Which feature supports the endosymbiont origin of mitochondria and chloroplasts?
(A) They have 80S ribosomes (B) They lack DNA (C) **They have their own DNA and bacteria-like ribosomes** (D) They are larger than bacteria

12. Mitochondria and chloroplasts are similar to bacteria in:
(A) having a nucleus (B) **size and having their own DNA and 70S ribosomes** (C) having cell walls of cellulose (D) having histones

13. The first life forms on earth were:
(A) autotrophs (B) **heterotrophs** (C) photoautotrophs (D) chemoautotrophs only

14. The first theory of evolution was put forward by:
(A) Darwin (B) **J. B. Lamarck** (C) Wallace (D) Mendel

15. Lamarck presented his ideas in 1809 in the book:
(A) Origin of Species (B) **Philosophie Zoologique** (C) Principles of Geology (D) Descent of Man

16. Lamarck's mechanism was based on:
(A) natural selection and mutation (B) **use and disuse of organs and inheritance of acquired characters** (C) survival of the fittest (D) overproduction

17. According to Lamarck, organs which are used more become:
(A) weaker (B) **stronger and more developed** (C) vestigial (D) unchanged

18. Lamarck explained the loss of legs in snakes by:
(A) use of legs (B) **disuse of legs due to creeping habit** (C) natural selection (D) mutation

19. Webbed feet of aquatic birds are explained by Lamarck as due to:
(A) disuse (B) **constant spreading of toes to swim** (C) mutation (D) natural selection

20. Characters acquired in a lifetime and passed to offspring are called:
(A) inherited characters (B) **acquired characters** (C) mutations (D) genetic traits

21. Lamarck explained the long neck of giraffe by:
(A) natural selection of long necked ones (B) **stretching of necks over many generations by short necked ancestors** (C) sudden mutation (D) human selection

22. A drawback of Lamarckism is that:
(A) it has experimental proof (B) **somatic changes are not heritable** (C) use and disuse can change genotype (D) organs change by the wish of the organism

23. Acquired traits are non-genetic and:
(A) inherited (B) **cannot be inherited** (C) change the genotype (D) are always harmful

24. Charles Darwin was born in:
(A) Scotland (B) **England** (C) Germany (D) France

25. Darwin sailed as a naturalist in 1831 on the ship:
(A) HMS Victory (B) **HMS Beagle** (C) HMS Endeavour (D) Mayflower

26. Darwin was ... years old when he joined the voyage:
(A) 32 (B) 42 (C) **22** (D) 12

27. The Beagle spent almost two months at the:
(A) Hawaiian islands (B) **Galapagos Islands** (C) Falkland islands (D) Canary islands

28. The Galapagos Islands are about how far west of Ecuador?
(A) 96 km (B) **965 km** (C) 9650 km (D) 500 km

29. In the Galapagos, Darwin collected how many types of finches?
(A) 4 (B) 8 (C) **14** (D) 40

30. Darwin's finches differed mainly in:
(A) colour (B) **beak size and shape according to their food** (C) wings (D) legs

31. The Galapagos organisms resembled those of:
(A) Europe (B) Africa (C) **South American mainland** (D) Australia

32. Darwin's observations about distribution of species among islands suggested:
(A) special creation (B) **new species arise by gradual accumulation of adaptations in separated habitats** (C) spontaneous generation (D) inheritance of acquired characters

33. Darwin wrote a 35-page sketch of his theory in:
(A) 1831 (B) 1836 (C) **1842** (D) 1859

34. The book Principles of Geology was written by:
(A) Hutton (B) **Charles Lyell** (C) Malthus (D) Wallace

35. The theory of uniformitarianism was proposed by:
(A) Lyell (B) **James Hutton** (C) Malthus (D) Lamarck

36. Lyell's work suggested that the earth is:
(A) young (B) **much older than generally believed** (C) 6000 years old (D) unchanging

37. Malthus wrote:
(A) Origin of Species (B) Principles of Geology (C) **An Essay on the Principle of Population** (D) Philosophie Zoologique

38. Malthus noted that human population increases:
(A) arithmetically (B) **exponentially (1, 2, 4, 8, 16)** (C) slowly (D) not at all

39. Malthus noted that food supply increases:
(A) exponentially (B) **arithmetically (1, 2, 3, 4, 5)** (C) rapidly (D) geometrically

40. Malthus's idea led Darwin to the concept of:
(A) mutation (B) **struggle for existence** (C) use and disuse (D) continental drift

41. The naturalist who independently proposed natural selection in 1858 was:
(A) Lyell (B) Hooker (C) **Alfred Russel Wallace** (D) Malthus

42. Wallace was travelling in:
(A) Africa (B) South America (C) **the Malay Archipelago** (D) Australia

43. The papers of Darwin and Wallace were presented to the:
(A) Royal Society (B) **Linnaean Society of London on July 1, 1858** (C) British Museum (D) Cambridge University

44. The Origin of Species was published in:
(A) 1831 (B) 1842 (C) 1858 (D) **1859**

45. Darwin's Descent of Man was published about:
(A) two years later (B) **twelve years later** (C) five years later (D) thirty years later

46. Darwin's two main points in the Origin of Species are:
(A) mutation and drift (B) **descent with modification, and natural selection and adaptation** (C) use and disuse, acquired traits (D) overproduction, mutation

47. In Darwin's view the history of life is like a:
(A) ladder (B) circle (C) **branching tree** (D) straight line

48. Natural selection refers to:
(A) equal reproduction of all (B) **differential reproductive capacity among individuals of a population** (C) artificial breeding (D) random mutation

49. The four observations of Darwin's mechanism are:
(A) mutation, drift, flow, selection (B) **overproduction, variations, struggle for existence, survival of the fittest** (C) use, disuse, inheritance, acquired (D) migration, isolation, selection, speciation

50. Overproduction means:
(A) each species produces only survivors (B) **each species produces more offspring than will survive to maturity** (C) equal births and deaths (D) no offspring

51. The struggle for existence may be:
(A) only between species (B) **interspecific, intraspecific and environmental** (C) only environmental (D) absent

52. Survival of the fittest is also called:
(A) mutation (B) **natural selection** (C) drift (D) adaptation

53. Fittest individuals are those that:
(A) are strongest (B) are largest (C) are most intelligent (D) **reproduce most successfully in the environment**

54. Natural selection causes an increase of:
(A) unfavourable alleles (B) **favourable alleles in the population** (C) mutations only (D) chromosomes

55. The reappraisal of natural selection in terms of population genetics is:
(A) Lamarckism (B) **Neo-Darwinism** (C) Mendelism (D) Creationism

56. According to Neo-Darwinism natural selection operates through:
(A) fighting (B) **variations and differential reproduction** (C) killing the weak (D) use and disuse

57. Biogeography is the study of:
(A) fossils (B) **geographical distribution of plants and animals** (C) embryos (D) DNA

58. Darwin noted that South America lacked:
(A) mice (B) deer (C) **rabbits, though the environment was suitable** (D) birds

59. Barriers which restrict the distribution of species include:
(A) only physical barriers (B) **physical, environmental and ecological barriers** (C) only climate (D) none

60. Evidence of evolution from molecular biology includes:
(A) different DNA in each organism (B) **DNA as hereditary material with a universal genetic code, ATP and cytochrome c** (C) different amino acids in each organism (D) no common molecules

61. The respiratory protein found in the respiratory chain of all aerobic organisms is:
(A) haemoglobin (B) myoglobin (C) **cytochrome c** (D) catalase

62. The number of amino acids used by living organisms to make protein is:
(A) 10 (B) **20** (C) 30 (D) 64

63. Comparative anatomy studies:
(A) embryos (B) fossils (C) **similarities and differences in structures of different species** (D) distribution

64. Homologous structures have:
(A) same function, different origin (B) **different function but similar internal structure due to common ancestry** (C) no similarity (D) same function and origin

65. An example of homologous structures is:
(A) wings of bat and insect (B) wings of bird and butterfly (C) **arm of man, forelimb of horse, flipper of whale and wing of bat** (D) leaves of moss and algae

66. Analogous structures have:
(A) common origin and different function (B) **similar function and appearance but different origin** (C) same origin (D) no function

67. An example of analogous structures is:
(A) human arm and whale flipper (B) **wings of bat, bird and insect** (C) forelimb of horse and man (D) sepals and petals

68. Sepals, petals, stamens and carpels are:
(A) analogous structures (B) **homologous structures as they are modified leaves** (C) vestigial organs (D) unrelated

69. Vestigial organs in humans include:
(A) heart and liver (B) **appendix and tail vertebrae** (C) brain and eyes (D) kidney

70. Vestigial organs are:
(A) analogous (B) **homologous, reduced and having lost most function** (C) new organs (D) functional organs

71. Divergent evolution results in:
(A) analogous structures (B) **homologous structures** (C) identical species (D) no variation

72. Divergent evolution is the evolution of different species from:
(A) different ancestors in a similar habitat (B) **a common ancestor in different habitats** (C) no ancestor (D) the same species only

73. Convergent evolution is the evolution of different species from:
(A) a common ancestor (B) **different ancestors in a common habitat** (C) the same ancestor in different habitats (D) identical genes

74. Convergent evolution results in:
(A) homologous structures (B) **analogous structures** (C) vestigial organs (D) no structure

75. Leaves of tracheophytes, mosses and blades of algae are:
(A) homologous (B) **analogous** (C) vestigial (D) identical

76. Which statement is true?
(A) Wings of birds and insects are homologous (B) **Human hand and wing of bat are homologous** (C) Wing of butterfly and bat are homologous (D) All wings are homologous

77. Fitness according to Darwin refers to:
(A) strength (B) numbers of species (C) **reproductive fitness of an organism** (D) size

78. The statement "survival of the fittest" means:
(A) the strongest survives (B) the most intelligent survives (C) **the species most adaptable to changes survives** (D) the cleverest survives

79. Prevalence of pesticide resistant insects supports:
(A) cloning (B) **Darwin's concept of natural selection** (C) transgenics (D) stem cell use

80. The oldest evidence of life on earth is of:
(A) 600 million years (B) **3.7 billion years** (C) 1.8 million years (D) 420 million years

81. The Cambrian explosion occurred about:
(A) 5 million years ago (B) 50 million years ago (C) **500 million years ago** (D) 5 billion years ago

82. Humans appeared about:
(A) 180 million years ago (B) 59 million years ago (C) **1.8 million years ago or less** (D) 420 million years ago

Scenario based MCQs

Scenario 1: A scientist notes that the forelimb of a human, the flipper of a whale, the wing of a bat and the foreleg of a horse look different externally and perform different tasks, yet all have the same basic bone pattern.

83. These structures are:
(A) analogous (B) **homologous** (C) vestigial (D) unrelated

84. This indicates:
(A) convergent evolution (B) **divergent evolution from a common ancestor** (C) no evolution (D) mutation only

85. Wings of a bat and an insect, in contrast, are:
(A) homologous (B) **analogous** (C) identical (D) vestigial

86. The wings of bat and insect arose by:
(A) divergent evolution (B) **convergent evolution** (C) no evolution (D) inheritance from a common ancestor

Scenario 2: In a woodland a population of moths is mostly light coloured. After industrial pollution darkens tree trunks, the dark moths survive better and become common over generations.

87. This is an example of:
(A) use and disuse (B) inheritance of acquired characters (C) **natural selection** (D) mutation only

88. Darwin would describe the dark moths as:
(A) weaker (B) **fitter for that environment** (C) acquiring colour (D) non-adapted

89. The increase in dark moths is an increase of:
(A) unfavourable alleles (B) **favourable alleles in the population** (C) acquired characters (D) chromosome number

90. The initial variation in colour exists due to:
(A) use and disuse (B) **variations in the population** (C) need (D) will

Scenario 3: A student explains how giraffes got long necks. Her friend says that short necked giraffes stretched their necks for many generations and the longer necks were passed to offspring.

91. This view is known as:
(A) Darwinism (B) **Lamarckism** (C) Neo-Darwinism (D) Mendelism

92. A drawback of this view is:
(A) it uses natural selection (B) **somatic changes are not inherited** (C) it has much experimental proof (D) it uses mutation

93. The Darwinian explanation would be that:
(A) giraffes stretched (B) **giraffes with longer necks, by variation, survived and reproduced more** (C) giraffes wished for longer necks (D) necks grew by

use

94. The book in which Lamarck presented his ideas is:
(A) Origin of Species (B) **Philosophie Zoologique** (C) Descent of Man (D) Principles of Geology

Scenario 4: A biologist finds that mitochondria and chloroplasts have circular DNA, 70S ribosomes and divide by fission.

95. This supports the:
(A) Lamarck's theory (B) **endosymbiosis theory** (C) Neo-Darwinism (D) germ plasm theory

96. The theory was proposed by:
(A) Darwin (B) Wallace (C) **Margulis** (D) Lamarck

97. Mitochondria are believed to have come from an engulfed:
(A) photosynthetic bacterium (B) **aerobic bacterium** (C) archaeon (D) virus

98. Chloroplasts are believed to come from an engulfed:
(A) aerobic bacterium (B) **photosynthetic bacterium** (C) spirochete (D) virus

Unit 15: Ecology

Straight MCQs

1. Ecology is the study of:
(A) only plants (B) only animals (C) **the relationship of living organisms with each other and their physical surroundings** (D) fossils

2. The major unit of ecology is the:
(A) population (B) community (C) **ecosystem** (D) organism

3. An ecosystem consists of atmosphere, hydrosphere, soil and:
(A) only plants (B) **biological communities** (C) only animals (D) only microbes

4. The variety of different species in an ecosystem is called:
(A) community (B) **biodiversity** (C) population (D) succession

5. A group of organisms which can breed freely and produce fertile offspring is a:
(A) community (B) **species** (C) population (D) ecosystem

6. Members of a species living in a geographical area at a given time form a:
(A) community (B) ecosystem (C) **population** (D) biosphere

7. Co-evolving populations of different species form a:
(A) population (B) **community** (C) species (D) niche

8. The biosphere includes:
(A) only land (B) only water (C) **all the ecosystems on the earth** (D) only atmosphere

9. The abiotic factors of an ecosystem include:
(A) plants (B) animals (C) **light, air, water, soil and basic elements and compounds** (D) decomposers

10. The biotic components are classified as:
(A) producers, herbivores and carnivores (B) **producers, consumers and decomposers** (C) autotrophs only (D) plants and animals only

11. Producers are:
(A) heterotrophs (B) **autotrophs like plants, algae and some bacteria** (C) decomposers (D) carnivores

12. In aquatic ecosystems the main producers are:
(A) rooted plants (B) fishes (C) **phytoplankton such as algae** (D) fungi

13. Plants convert light energy into:
(A) heat energy (B) **chemical energy** (C) kinetic energy (D) nuclear energy

14. Consumers are:
(A) autotrophs (B) **heterotrophs** (C) producers (D) photosynthetic

15. Herbivores are:
(A) secondary consumers (B) **primary consumers** (C) tertiary consumers (D) decomposers

16. Cattle, deer, rabbit and grasshopper are:
(A) carnivores (B) **herbivores** (C) omnivores (D) decomposers

17. Secondary consumers feed on:
(A) producers (B) **primary consumers** (C) decomposers (D) tertiary consumers

18. Frogs, snakes and lions are mostly:
(A) primary consumers (B) **secondary consumers** (C) producers (D) decomposers

19. Wolf, owl and hawk are:
(A) primary consumers (B) secondary consumers (C) **tertiary consumers** (D) producers

20. Major decomposers of the ecosystem are:
(A) insects and birds (B) **bacteria and fungi** (C) plants and algae (D) earthworms only

21. Decomposers act on dead organic matter by secreting:
(A) toxins (B) **digestive enzymes** (C) hormones (D) antibodies

22. The sequence of organisms through which food and nutrients move is a:
(A) food web (B) **food chain** (C) trophic level (D) pyramid

23. Interconnected food chains form a:
(A) pyramid (B) **food web** (C) cycle (D) community

24. Food webs are important because they:
(A) reduce the number of species (B) **provide alternatives for food at each trophic level and maintain balance** (C) stop energy flow (D) increase energy

25. Each stage of a food chain is called a:
(A) niche (B) **trophic level** (C) habitat (D) community

26. The first trophic level is occupied by:
(A) herbivores (B) carnivores (C) **producers** (D) decomposers

27. The second trophic level (T2) consists of:
(A) producers (B) **primary consumers** (C) secondary consumers (D) tertiary consumers

28. The third trophic level (T3) consists of:
(A) primary consumers (B) **secondary consumers** (C) tertiary consumers (D) producers

29. The fourth trophic level (T4) consists of:
(A) secondary consumers (B) **tertiary consumers** (C) producers (D) decomposers

30. There are fewer organisms at higher trophic levels because of:
(A) predators (B) **decreasing energy availability** (C) increasing energy (D) lack of space

31. The ultimate source of energy for life on earth is the:
(A) earth (B) **Sun** (C) moon (D) ocean

32. The flow of energy in an ecosystem is:
(A) cyclic (B) **unidirectional (non-cyclic)** (C) random (D) bidirectional

33. Productivity is the rate at which:
(A) consumers eat (B) **organic matter is created by producers through photosynthesis** (C) decomposers work (D) nutrients are lost

34. Total solar energy fixed by producers in photosynthesis is:
(A) net primary productivity (B) **gross primary productivity (GPP)** (C) secondary productivity (D) biomass

35. Net primary productivity (NPP) is:
(A) GPP plus respiration (B) **GPP minus respiration of the producers** (C) GPP divided by respiration (D) total radiation

36. NPP appears as:
(A) heat (B) **organic matter or biomass of producers** (C) lost energy (D) gases

37. NPP is the food available to:
(A) producers only (B) **consumers and decomposers in the ecosystem** (C) only herbivores (D) only decomposers

38. In photosynthesis about what percent of incident radiation is converted?
(A) 10 percent (B) 5 percent (C) **1 percent** (D) 50 percent

39. Energy transferred from one trophic level to the next is about:
(A) 1 percent (B) **10 percent** (C) 50 percent (D) 90 percent

40. Energy loss between trophic levels is through:
(A) photosynthesis only (B) **respiration, growth, reproduction, non-predatory death, excretion, heat and faeces** (C) synthesis (D) none

41. The pyramid which is always upright and most useful is the pyramid of:
(A) numbers (B) biomass (C) **energy** (D) nutrients

42. Ecological pyramids represent:
(A) relationships of climate (B) **a proportionate relationship between organisms at different trophic levels** (C) only energy (D) only numbers

43. The pyramid of biomass represents the total ... at each trophic level:
(A) energy (B) number (C) **dry weight of living material** (D) volume

44. The pyramid of numbers shows:
(A) biomass at each level (B) energy at each level (C) **the number of organisms at each trophic level** (D) productivity

45. Biomass is the:
(A) wet weight of an organism (B) **dry weight of all living material in the ecosystem** (C) number of organisms (D) energy stored

46. The movement of nutrients from environment to organisms and back is a:
(A) food chain (B) **biogeochemical cycle** (C) succession (D) pyramid

47. The major reservoir of water is the:
(A) rivers (B) lakes (C) **ocean, containing over 97 percent of available water** (D) atmosphere

48. The water cycle is driven by:
(A) wind only (B) **solar energy and gravity** (C) plants only (D) gravity only

49. Rain, snow, dew and sleet are forms of:
(A) evaporation (B) transpiration (C) **precipitation** (D) condensation

50. The top of the saturation zone of the ground water is the:
(A) aquifer (B) **water table** (C) basin (D) spring

51. Underground rivers are called:
(A) basins (B) lakes (C) **aquifers** (D) springs

52. Bodies of living organisms are roughly ... water:
(A) 20 percent (B) 50 percent (C) **70 percent** (D) 99 percent

53. The percolation of water into the soil refers to:
(A) runoff (B) **water sinking into the ground** (C) evaporation (D) condensation

54. Nitrogen is needed for the synthesis of:
(A) carbohydrates (B) lipids (C) **amino acids, nucleic acids and proteins** (D) cellulose

55. The processes of the nitrogen cycle include:
(A) photosynthesis and respiration (B) **ammonification, nitrification, nitrogen fixation, assimilation and denitrification** (C) transcription and translation (D) glycolysis and Krebs

56. The production of ammonia from decomposition of organic matter is:
(A) nitrification (B) **ammonification** (C) denitrification (D) assimilation

57. Ammonification is done by:
(A) nitrifying bacteria (B) **saprophytic soil bacteria and fungi** (C) denitrifying bacteria (D) Rhizobium

58. Nitrification is the conversion of ammonia to:
(A) nitrogen gas (B) amino acids (C) **nitrates** (D) proteins

59. Nitrosomonas converts:
(A) nitrites to nitrates (B) **ammonia to nitrites** (C) nitrates to nitrogen (D) nitrogen to ammonia

60. Nitrobacter converts:
(A) ammonia to nitrites (B) **nitrites to nitrates** (C) nitrates to nitrogen (D) nitrogen to ammonia

61. Nitrification takes place in:
(A) waterlogged soils (B) **well aerated soils, as the bacteria are aerobic** (C) anaerobic soils (D) rocks

62. Nitrogen gas is chemically unreactive due to:
(A) a double bond (B) **a very strong triple bond between two atoms** (C) single bond (D) its small size

63. Fixation of nitrogen by lightning is:
(A) biological fixation (B) industrial fixation (C) **atmospheric fixation** (D) denitrification

64. Atmospheric fixation accounts for about:
(A) 60 percent (B) **5 to 8 percent** (C) 90 percent (D) 40 percent

65. Synthesis of nitrogen fertilizers is:
(A) atmospheric fixation (B) biological fixation (C) **industrial fixation** (D) assimilation

66. Biological nitrogen fixation fixes about:
(A) 5 percent (B) 20 percent (C) **60 percent of nitrogen** (D) 100 percent

67. Nitrogen-fixing bacteria convert atmospheric nitrogen to:
(A) nitrates (B) nitrites (C) **ammonia** (D) urea

68. A free-living aerobic nitrogen fixing bacterium is:
(A) Rhizobium (B) Clostridium (C) **Azotobacter** (D) Pseudomonas

69. A free-living anaerobic nitrogen fixing bacterium is:
(A) Azotobacter (B) **Clostridium** (C) Rhizobium (D) Nitrobacter

70. A symbiotic nitrogen fixer in legumes is:
(A) Azotobacter (B) Clostridium (C) **Rhizobium** (D) Nitrosomonas

71. Assimilation in the nitrogen cycle is:
(A) loss of nitrogen (B) **utilization of nitrogen compounds in living bodies** (C) conversion to nitrogen gas (D) production of ammonia

72. Plants obtain nitrogen mostly as:
(A) nitrogen gas (B) ammonia (C) **nitrates** (D) urea

73. Animals obtain nitrogen from:
(A) soil (B) air (C) **eating plants or other animals** (D) water

74. Denitrification is the:
(A) fixation of nitrogen (B) **conversion of nitrates back to nitrogen gas by denitrifying bacteria** (C) production of ammonia (D) production of nitrites

75. A denitrifying bacterium is:
(A) Rhizobium (B) Nitrobacter (C) **Pseudomonas** (D) Azotobacter

76. Denitrification occurs in the:
(A) presence of oxygen (B) **absence of oxygen** (C) light only (D) well aerated soil

77. The sequence of replacement of one community by another in an area is:
(A) adaptation (B) **ecological succession** (C) migration (D) evolution

78. Primary succession occurs on:
(A) an area previously inhabited (B) **an area not previously inhabited, like bare rock or new lava** (C) an abandoned farm (D) a burnt forest

79. Secondary succession occurs where:
(A) there is no soil (B) **soil is already present after a disturbance, like fire or flood** (C) new lava appears (D) glacier retreats

80. An abandoned field reverting to forest is an example of:
(A) primary succession (B) **secondary succession** (C) xerarch succession (D) hydrarch only

81. Succession in water bodies, such as ponds and lakes, is:
(A) xerarch (B) **hydrarch (hydrosere)** (C) primary only (D) secondary only

82. Succession on bare rock, sand dunes and dry areas is:
(A) **xerarch (xerosere)** (B) hydrarch (C) secondary (D) aquatic

83. The first species to colonize a bare area are called:
(A) climax species (B) **pioneer species** (C) seral species (D) dominants

84. The intermediate communities in succession are called:
(A) pioneer communities (B) climax communities (C) **seral communities** (D) final communities

85. The final stable community is the:
(A) pioneer community (B) seral community (C) **climax community** (D) secondary community

86. The pioneer stage of xerarch succession on bare rock is:
(A) moss stage (B) herb stage (C) **crustose lichen stage** (D) shrub stage

87. Crustose lichens help in succession by:
(A) adding water (B) **secreting acids that decompose the rock and forming soil** (C) providing shade (D) fixing carbon

88. The second stage of xerarch succession is the:
(A) moss stage (B) **foliose lichen stage** (C) herb stage (D) shrub stage

89. Which are crustose lichens?
(A) Parmelia (B) Dermatocarpon (C) **Lecanora and Rhizocarpon** (D) Funaria

90. The stage following the lichen stages is the:
(A) herb stage (B) shrub stage (C) **moss stage** (D) tree stage

91. The correct sequence in xerarch succession is:
(A) lichen, herb, moss, shrub, tree (B) **crustose lichen, foliose lichen, moss, herb, shrub, tree** (C) moss, lichen, herb, tree, shrub (D) herb, shrub, moss, lichen

92. Which stage precedes the shrub stage in xerarch succession?
(A) Moss stage (B) **Herb stage** (C) Tree stage (D) Lichen stage

93. In the climax stage of xerarch succession on a rock, the final trees are:
(A) xeric (B) **mesophytic** (C) hydrophytic (D) halophytic

94. Population dynamics studies:
(A) the genes of a population (B) **changes in numbers and structure of populations over time** (C) only birth rate (D) only death rate

95. Population size increases by:
(A) deaths and emigration (B) **births and immigration** (C) predation (D) culling

96. Population size decreases by:
(A) births (B) immigration (C) **predation, natural deaths, culling, accidents and emigration** (D) none

97. The characteristics of a population are:
(A) size only (B) **growth, density, distribution, carrying capacity and viable size** (C) biomass only (D) productivity only

98. An increase in the number of individuals of a population is:
(A) density (B) **population growth** (C) distribution (D) carrying capacity

99. A population with unlimited resources shows:
(A) no growth (B) **exponential growth after a lag phase** (C) negative growth (D) constant size

100. Population density is:
(A) total number of individuals (B) **number of individuals per unit area or volume** (C) size of the individuals (D) biomass

101. The dispersion of individuals in a population is:
(A) density (B) growth (C) **distribution** (D) viability

102. The three patterns of population distribution are:
(A) dense, sparse and moderate (B) linear, circular and square (C) **clumped, uniform and random** (D) young, adult and old

103. Individuals aggregated in patches show a ... distribution:
(A) random (B) uniform (C) **clumped** (D) regular

104. The maximum population size that can be supported by the available resources is the:
(A) viable size (B) **carrying capacity** (C) density (D) growth rate

105. The carrying capacity is:
(A) fixed (B) **not fixed but varies with abundance of limiting resources** (C) zero (D) unlimited

106. Which activity of humans results in habitat fragmentation?
(A) Planting trees (B) **Roads, dams and urban expansion** (C) Recycling (D) Family planning

107. Large-scale clearing of forests is called:
(A) afforestation (B) **deforestation** (C) reforestation (D) urbanization

108. Acid rain and smog are caused by:
(A) water pollution (B) **air pollution from industries and vehicles** (C) soil pollution (D) noise

109. Excessive fishing causing decline in fish populations is:
(A) poaching (B) **overfishing (overexploitation)** (C) pollution (D) fragmentation

110. Planting a large area with a single crop is:
(A) crop rotation (B) **monoculture farming** (C) mixed farming (D) organic farming

111. Monoculture:
(A) increases biodiversity (B) **reduces biodiversity and makes ecosystems more vulnerable to diseases** (C) is good for soil (D) reduces pests

112. Invasive species:
(A) help native species (B) **outcompete native species for resources and may cause extinction** (C) have no effect (D) always die

113. The greenhouse effect is a:
(A) harmful human activity only (B) **natural process that warms the earth by trapping heat radiation** (C) cooling process (D) process of ozone formation

114. The most common greenhouse gas emitted by human activities is:
(A) methane (B) nitrous oxide (C) **carbon dioxide** (D) fluorinated gases

115. Which gas has a much higher heat trapping ability than CO2?
(A) Oxygen (B) Nitrogen (C) **Methane** (D) Hydrogen

116. Livestock and agricultural practices contribute to the emission of:
(A) CO2 only (B) **methane** (C) oxygen (D) ozone

117. Nitrous oxide is released from:
(A) photosynthesis (B) **agricultural and industrial activities and combustion of fossil fuels** (C) respiration only (D) volcanoes only

118. Fluorinated gases are:
(A) natural gases (B) **synthetic gases used in industrial applications** (C) components of air (D) waste of plants

119. Fluorinated gases include:
(A) CO2 and CH4 (B) **HFCs, PFCs, SF6 and NF3** (C) N2 and O2 (D) H2 and He

120. The long-term increase in earth's average surface temperature is:
(A) greenhouse effect (B) **global warming** (C) ocean acidification (D) climate cycle

121. Melting ice caps leads to:
(A) falling sea level (B) **rising sea level threatening coastal ecosystems** (C) no change (D) more ice

122. Excess CO2 in the atmosphere absorbed by oceans causes:
(A) rise in ocean pH (B) **ocean acidification (fall in pH)** (C) cooling (D) rise in oxygen

123. About what percent of CO2 released is absorbed by oceans?
(A) 5 (B) 10 (C) **25** (D) 75

124. In seawater CO2 combines with water to produce:
(A) carbonic acid (B) sulphuric acid (C) nitric acid (D) **carbonic acid, lowering the pH**

125. Ocean acidification mainly harms organisms with:
(A) soft bodies (B) **calcium carbonate shells or skeletons such as corals, molluscs** (C) silica shells (D) chitin skeleton

126. Coral reefs are made up of colonies of tiny animals called:
(A) sponges (B) **coral polyps** (C) jellyfish (D) medusae

127. Coral polyps secrete:
(A) silica (B) chitin (C) **calcium carbonate skeletons** (D) cellulose

128. Coral reefs are called "rainforests of the sea" because of their:
(A) size (B) temperature (C) **incredible biodiversity** (D) depth

129. Coral polyps live in a symbiotic relationship with:
(A) fungi (B) bacteria (C) **photosynthetic algae (zooxanthellae)** (D) fish

130. The algae give corals their:
(A) hardness (B) **vibrant colours and nutrients** (C) movement (D) heat

131. Corals are used as a barometer of the health of:
(A) soil (B) air (C) **aquatic ecosystem** (D) forest

132. Coral reefs serve as natural barriers that:
(A) produce heat (B) **protect coastlines from erosion and storms** (C) increase salinity (D) cause flooding

133. Reefs are found in:
(A) cold deep water (B) polar water (C) **shallow, tropical and subtropical waters** (D) freshwater lakes

134. The thin life-containing blanket around the earth is the:
(A) atmosphere (B) hydrosphere (C) **biosphere** (D) lithosphere

135. The ozone layer screens:
(A) infrared radiation (B) visible light (C) **ultraviolet radiation** (D) X-rays only

136. Which of the following is a desert of Pakistan?
(A) Sahara (B) Gobi (C) **Thar** (D) Kalahari

137. Annual rainfall in desert regions of Pakistan is about:
(A) 500 to 1000 mm (B) 1000 to 2000 mm (C) **100 to 250 mm** (D) 2000 mm

138. In desert regions the rainfall mainly occurs from:
(A) December to February (B) March to May (C) **July to September (monsoon)** (D) October to November

139. Summer temperature in deserts of Pakistan may reach:
(A) 20 degrees (B) 30 degrees (C) **above 40 degrees and sometimes 50 degrees Celsius** (D) 5 degrees

140. Common desert plants are:
(A) hydrophytes (B) mesophytes (C) **xerophytes like cacti, Acacia and Prosopis** (D) halophytes only

141. Desert mammals include:
(A) deer and elephant (B) **jerboas, desert gerbils, desert foxes and wild cats** (C) snow leopards (D) monkeys

142. Primary productivity in deserts is:
(A) high (B) moderate (C) **relatively low due to scarcity of water and limited plant cover** (D) the highest

143. Desert animals avoid heat by being:
(A) diurnal (B) **nocturnal and by burrowing** (C) aquatic (D) arboreal

144. Desert plants conserve water by:
(A) large leaves (B) shallow roots (C) **modified leaves or stems and deep root systems** (D) many stomata

145. Tropical grasslands in Pakistan are also known as:
(A) tundra (B) taiga (C) **savannas** (D) steppes

146. Tropical grassland rainfall varies from about:
(A) 10 to 50 mm (B) **200 to 600 mm during monsoon** (C) 2000 to 3000 mm (D) 1000 mm to 2000 mm

147. A common grass of Pakistan grasslands is:
(A) Triticum (B) **Cenchrus ciliaris (buffel grass)** (C) Oryza (D) Zea

148. Grassland fauna include:
(A) polar bears (B) **deer, antelopes, gazelles, wild goats, rodents, foxes and wolves** (C) penguins (D) whales

149. Temperate grasslands in Pakistan are found in:
(A) Sindh (B) **Balochistan and parts of Punjab** (C) Gilgit (D) coastal areas

150. Temperate grasslands have ... productivity than tropical grasslands:
(A) higher (B) equal (C) **lower** (D) no

151. Threats to grasslands in Pakistan include:
(A) conservation (B) **overgrazing, agriculture, urbanization and climate change** (C) rainfall (D) wildlife protection

152. The coniferous alpine and boreal forests of Pakistan occur in the:
(A) southern deserts (B) **northern mountains of the Western Himalayas and Karakoram** (C) Sindh plains (D) coastal areas

153. Dominant trees of coniferous forests are:
(A) oak and maple (B) **pine, spruce, fir and cedar** (C) mango and neem (D) acacia

154. The leaves of conifers are needle-like to:
(A) increase transpiration (B) **conserve water** (C) increase light (D) attract insects

155. Alpine plants include:
(A) cacti (B) **rhododendrons and junipers** (C) mangroves (D) palms

156. The animals of coniferous forests include:
(A) camels (B) **snow leopard, brown bear, Himalayan tahr and red fox** (C) jerboa (D) gazelle

157. The growth in alpine and boreal forests is:
(A) fast (B) **slow due to short growing season and limited nutrients** (C) continuous (D) very high

158. Temperate deciduous forests are found in:
(A) Thar (B) Sindh (C) **the foothills of the Himalayas and Karakoram, including Azad Kashmir** (D) Makran coast

159. Deciduous trees:
(A) never shed leaves (B) **shed their leaves in autumn** (C) shed leaves in spring (D) are needle leaved

160. Common trees of deciduous forests include:
(A) cactus and Prosopis (B) **oak, maple, ash, walnut and deodar** (C) mangrove (D) date palm

161. The main human threat to deciduous forests is:
(A) rainfall (B) **deforestation and unsustainable logging** (C) afforestation (D) conservation

162. The Department of Population Welfare provides:
(A) food (B) **family planning and reproductive health services** (C) water (D) electricity

163. The rhizobium in the root nodules of legumes is:
(A) a fungus (B) a virus (C) **a nitrogen fixing bacterium** (D) an alga

164. Nitrogen is lost from the soil by:
(A) nitrification (B) fixation (C) **denitrification** (D) ammonification

165. Which of the following is NOT true about ecological succession?
(A) Food chain relationships become more complex (B) Biodiversity increases (C) Role of decomposers increases (D) **It is a random process**

166. A nutrient cycle always involves the movement of nutrients through the:
(A) rocks only (B) **biotic community** (C) atmosphere only (D) oceans only

167. Ecosystems having very low rainfall and high temperature are:
(A) grasslands (B) deciduous forests (C) boreal forests (D) **deserts**

168. The main cause of ocean acidification is:
(A) excess use of water (B) offshore drilling (C) **increasing level of CO2 in the atmosphere** (D) volcanic activity

169. The role of decomposers in the nitrogen cycle is to:
(A) fix atmospheric nitrogen (B) **release ammonia from organic compounds** (C) denitrify ammonia (D) convert ammonia to nitrates

Scenario based MCQs

Scenario 1: In a pond, algae are eaten by small crustaceans, which are eaten by small fish, which are in turn eaten by a large fish and then by a heron.

170. The producers in this food chain are:
(A) crustaceans (B) small fish (C) **algae** (D) heron

171. The primary consumers are:
(A) algae (B) **small crustaceans** (C) small fish (D) heron

172. The heron is a:
(A) primary consumer (B) secondary consumer (C) **top consumer (tertiary or higher)** (D) producer

173. If algae store 10000 joules, the energy available to the small crustaceans is about:
(A) 10000 J (B) **1000 J** (C) 100 J (D) 10 J

Scenario 2: A farmer grows beans in a field. He observes that the soil is poor in nitrogen but the roots of beans have small swellings which contain bacteria.

174. The bacteria in the nodules are:
(A) Nitrosomonas (B) Nitrobacter (C) **Rhizobium** (D) Pseudomonas

175. They convert:
(A) nitrates to nitrogen (B) **atmospheric nitrogen to ammonia** (C) ammonia to nitrate (D) protein to amino acids

176. The relationship between bean and the bacteria is:
(A) parasitism (B) **symbiosis (mutualism)** (C) predation (D) competition

177. After the beans die and decay, the bacteria and fungi release ammonia. This process is:
(A) nitrification (B) denitrification (C) **ammonification** (D) fixation

Scenario 3: A volcano creates a new island of bare lava rock. After many years lichens, mosses, herbs, shrubs and finally trees grow there.

178. This process is:
(A) adaptation (B) **primary ecological succession** (C) secondary succession (D) mutation

179. The first colonizers are:
(A) trees (B) shrubs (C) **crustose lichens** (D) herbs

180. The kind of succession on the dry rock is:
(A) hydrarch (B) **xerarch** (C) aquatic (D) secondary

181. The final stable community is the:
(A) pioneer stage (B) seral stage (C) **climax community** (D) moss stage

Scenario 4: A forest was destroyed by fire. After a few years grasses, shrubs and trees grow back on the same soil.

182. This is:
(A) primary succession (B) **secondary succession** (C) hydrarch succession (D) xerarch succession on rock

183. The soil here is:
(A) absent (B) **already present** (C) formed by lichens (D) formed by mosses

184. The succession is faster than on bare rock because:
(A) no seeds are present (B) **soil and seeds are already present** (C) there is no competition (D) it is a pond

185. The first plants to appear after the fire are usually:
(A) large trees (B) **fast growing grasses and herbs** (C) lichens (D) mosses only

Scenario 5: Burning of coal and oil and clearing of forests have increased the level of gases in the atmosphere. The average temperature of the planet is rising and the sea is becoming slightly more acidic.

186. The most responsible gas is:
(A) oxygen (B) nitrogen (C) **carbon dioxide** (D) hydrogen

187. The long-term rise in temperature is called:
(A) ozone depletion (B) **global warming** (C) acid rain (D) eutrophication

188. The acidification of sea affects:
(A) birds (B) **corals and shellfish** (C) land plants (D) insects

189. A likely result for coastal areas is:
(A) fall of sea level (B) **rise in sea level due to melting ice** (C) no change (D) more ice

Scenario 6: In a pyramid of energy the producers have 10000 kJ of energy.

190. The energy available to primary consumers is about:
(A) 10000 kJ (B) 5000 kJ (C) **1000 kJ** (D) 100 kJ

191. The energy available to secondary consumers is about:
(A) 1000 kJ (B) **100 kJ** (C) 10 kJ (D) 1 kJ

192. The energy available to tertiary consumers is about:
(A) 100 kJ (B) **10 kJ** (C) 1 kJ (D) 0.1 kJ

193. The loss of energy is mainly through:
(A) photosynthesis (B) **respiration and heat** (C) growth (D) gain

Scenario 7: A student visits a hot, dry region in Pakistan having sand dunes, thorny bushes, few rains, and animals like jerboas and desert foxes.

194. The ecosystem is a:
(A) grassland (B) **desert** (C) deciduous forest (D) alpine forest

195. The plants here are:
(A) hydrophytes (B) mesophytes (C) **xerophytes** (D) halophytes only

196. The animals avoid heat by:
(A) swimming (B) **burrowing and nocturnal habits** (C) migrating to the sea (D) hibernating always

197. The primary productivity here is:
(A) high (B) **low** (C) very high (D) none