SSC (Class 10 / SSC-II) PBA: Notes and Solved Model Papers

Subjects: Physics, Chemistry, Computer Science. Source: the official FBISE composite Practical Based Assessment (PBA) frameworks for SSC, notified 14 March 2025, effective from the 2026 annual exams onward. Each framework has a fixed list of experiments plus one model question paper. This file gives (1) the PBA pattern, (2) short notes for every listed experiment, and (3) the full model paper solved.

Source files (downloaded from fbise.edu.pk, ModelPaper/2025/Practical Based Assessment Composite): Final Physics PBA SSC Merged.pdf, Final Chemistry PBA SSC Merged.pdf, Final Computer Science PBA SSC Merged_.pdf (the copy without the underscore is the HSSC paper, do not use it).

PBA pattern at a glance

Subject	Total / time	Section A (60%)	Section B (40%)
Physics	20 marks, 2 hours	2 questions x 6 marks, one MAJOR experiment each (8 major experiments)	2 questions x 4 marks, MINOR experiments, single or mixed (8 minor experiments)
Chemistry	20 marks, 2 hours	2 questions x 6 marks (six parts of 1 mark each), MAJOR experiments (5 major)	2 questions x 4 marks (four parts of 1 mark each), MINOR experiments (8 minor)
Computer Science	40 marks, 2 hours	24 marks: Q1 (10, JavaScript debug and write, with OR), Q2 (10, HTML page), Q3 (4, CSS). All from Domain C (web: HTML, CSS, JavaScript)	16 marks: Q4 (5, concept map or flowchart, OR), Q5 (5, label devices and classify software), Q6 (6, business plan)

- No MCQs, no marks for notebook or viva. You must have performed the practicals in the lab to attempt the paper. Questions are answered on an E-sheet. A single part never carries 0.5 mark.
- Questions are practical recall: apparatus, procedure, fill the table, calculate, draw the graph, give the conclusion, state the precaution.

PART 1: PHYSICS PBA

A. Major experiments (Section A, 6 marks each)

P-Major 1. Radius and length of a metallic cylinder with vernier callipers

- **Apparatus:** vernier callipers, metallic cylinder.
- **Least count (LC)** = value of 1 main scale division / number of vernier divisions = 1 mm / 10 = 0.1 mm = 0.01 cm.
- **Reading** = main scale reading (MSR, just before the vernier zero) + vernier coincidence number x LC. Correct for zero error: true reading = observed reading minus zero error.
- **Procedure:** check zero error with jaws closed. Grip the cylinder between the jaws for length, then for diameter at three different places and in two perpendicular directions. Take the mean. Radius r = d/2.
- **Significant figures:** an answer cannot have more significant figures than the least precise measurement, so round the final result (volume = pi r^2 l) to the same number of significant figures as the data.
- **Precautions:** do not squeeze the object, read at eye level (avoid parallax), correct the zero error.

P-Major 2. Thickness of a wire with vernier callipers and a screw gauge

- **Screw gauge LC** = pitch / number of circular scale divisions = 1 mm / 100 = 0.01 mm (0.001 cm). Pitch is the distance the screw moves in one full turn.
- **Reading** = sleeve (linear) scale reading + circular scale reading x LC. Correct for zero error (positive if zero line is below the datum line, negative if above).
- **Precision:** screw gauge (0.01 mm) is more precise than vernier callipers (0.1 mm), so use the screw gauge for thin wire.
- **Procedure:** measure the diameter at 3 places along the wire and in 2 perpendicular directions each, take the mean. Use the ratchet to tighten, so the pressure is always the same.

P-Major 3. Motion of a ball rolling down an angle iron (distance-time graph)

- **Apparatus:** angle iron (V-shaped channel), steel ball, stop watch, metre rule, wooden block or stand to raise one end, chalk or marker.
- **Procedure:** incline the angle iron. Mark distances 200, 180, 160, 140, 120, 100 cm from the bottom. Release the ball from the top mark each time and time it to the bottom. Repeat for each distance, take t_1 and t_2, find the mean time t. Velocity = distance / mean time.
- **Graph:** plot distance (y) against time (x). Constant velocity gives a straight line through the origin whose slope is the speed. A ball that speeds up gives a curve bending upward.
- **Effect of angle:** a smaller angle of inclination means smaller acceleration, so the speed of the ball is less and the time taken is more.
- **Precautions:** release without pushing, start and stop the watch together with the ball, keep the track clean and straight.

P-Major 4. Time period of a simple pendulum, relation between length and time period

- **Apparatus:** cork or clamp stand, thread, metal bob, stop watch, metre rule.
- **Procedure:** measure length L from the point of suspension to the centre of the bob. Displace the bob through a small angle (less than 10 degrees), release, time 20 oscillations, T = total time / 20. Repeat for 5 or more lengths (for example 40, 60, 80, 100 cm).
- **Relation:** T = 2 pi sqrt(L/g). T^2 is directly proportional to L, so the graph of T^2 against L is a straight line through the origin. g = 4 pi^2 L / T^2 (about 9.8 m/s^2). Period does not depend on the mass of the bob.
- **Why many oscillations:** timing 20 oscillations reduces the reaction-time error.

P-Major 5. Specific heat capacity by the method of mixtures

- **Apparatus:** calorimeter with stirrer, thermometer, metal (lead) shots, beaker, heater, balance, thread.
- **Procedure:** find mass of the empty calorimeter m_c. Add water, find mass of water m_w, note its temperature T_2. Heat the metal in boiling water to T_1 (about 100 C), drop it quickly in the calorimeter, stir, note the highest temperature T.
- **Principle:** heat lost by hot metal = heat gained by water and calorimeter.
  $m_s\, c_s\, (T_1 - T) = (m_w\, c_w + m_c\, c_c)(T - T_2)$, with c_w = 4200 J/kg K. Solve for c_s. Lead is about 130 J/kg K.
- **Precautions:** transfer the metal quickly without splashing, insulate or lag the calorimeter, stir before reading.

P-Major 6. Temperature-time graph for ice and water, latent heats

- **Heating ice graph:** rises from below 0 C, flat at 0 C (melting, latent heat of fusion), rises as water, flat at 100 C (boiling, latent heat of vaporization). On the flat parts the heat goes into breaking bonds (potential energy), not raising temperature.
- **Latent heat of fusion by mixtures:** drop dry ice cubes at 0 C into warm water in a calorimeter. Heat lost by water and calorimeter = $m_i\, L_f + m_i\, c_w\, (T - 0)$. Accepted value L_f = 334 kJ/kg (3.34×10^5 J/kg).
- **Latent heat of vaporization:** pass steam at 100 C into cold water, steam condenses and gives $m_s\, L_v + m_s\, c_w\, (100 - T)$ to the water and calorimeter. Accepted L_v = 2260 kJ/kg.
- **Precautions:** dry the ice with blotting paper, use a steam trap so no hot water enters.

P-Major 7. Image formed by a convex lens at different object positions

Object position	Image position	Nature and size
Beyond 2F	Between F and 2F	Real, inverted, diminished
At 2F	At 2F	Real, inverted, same size
Between F and 2F	Beyond 2F	Real, inverted, magnified
At F	At infinity	Very large, no image on screen
Between F and lens	Same side as object	Virtual, erect, magnified

- **Apparatus:** optical bench, convex lens, lens holder, illuminated object (candle or cross-wire), white screen, metre scale.
- **Procedure:** find focal length first by focusing a distant object on the screen (distance lens to screen = f). Then place the object at each position, move the screen to get a sharp image, record u and v. Lens formula: $1/f = 1/v + 1/u$ (real-is-positive convention). Magnification $m = v/u$.

P-Major 8. Resistors in series and parallel

- **Series:** $R_e = R_1 + R_2$ (+ R_3). Same current through every resistor, total voltage $V = V_1 + V_2$. Adding another resistor increases the equivalent resistance and decreases the current.
- **Parallel:** $1/R_e = 1/R_1 + 1/R_2$. Same voltage across each, total current $I = I_1 + I_2$. R_e is smaller than the smallest resistor.
- **Circuit components:** cell or battery, key (switch), rheostat, ammeter connected in series, voltmeter connected in parallel across the resistor.
- **Procedure:** measure total V and I, find R = V/I by Ohm's law, compare with the calculated R_e. The small difference R_e - R is experimental error.

B. Minor experiments (Section B, 4 marks each)

P-Minor 1. Spring constant from a load-extension graph

- Hang the spring, add loads (weight W = mg), measure extension x each time. Plot load (force) on x-axis, extension on y-axis.
- Hooke's law: F = kx, so extension is proportional to load up to the **limit of proportionality** (the point where the graph stops being a straight line). Slope of the extension-load graph = extension per unit load = 1/k. Slope of force-extension (force on y) = k.
- Use a force meter (newton meter) to measure weight. Do not overload past the limit.

P-Minor 2. Centre of gravity of a plane lamina by plumb line

- Make three small holes near the edge. Hang the lamina freely from a pin through one hole, hang the plumb line from the same pin, mark the vertical line on the lamina. Repeat with the other holes. The lines meet at one point: the centre of gravity.
- Check: the lamina balances horizontally on a pencil tip at that point.

P-Minor 3. Volume of an irregular stone by displacement, and its density

- Measure mass m on an electronic balance. Fill a measuring cylinder with some water, read V_1, tie the stone with thread, lower it gently, read V_2. Volume $V = V_2 - V_1$. Density = m/V (g/cm^3 or kg/m^3).
- Read the bottom of the meniscus at eye level, no air bubbles, no splashing.

P-Minor 4. Laws of reflection using a plane mirror

- Fix a plane mirror upright on white paper, draw its line. Fix two pins P_1 and P_2 to give the incident ray. Look into the mirror and fix P_3 and P_4 in line with the images. Draw the normal, measure angle of incidence i and angle of reflection r.
- Laws: (1) angle of incidence = angle of reflection, (2) incident ray, reflected ray and normal lie in one plane.

P-Minor 5. Refraction through a glass slab and refractive index

- Place the slab on paper, trace it. Fix pins P_1, P_2 on one side, look through the other side and fix P_3, P_4 in line with their images. Join P_3P_4 to the edge, join the entry and exit points. Draw the normal at the entry point, measure angle of incidence i and angle of refraction r.
- n = sin i / sin r (glass is about 1.5). The emergent ray is parallel to the incident ray and is shifted sideways: this is the **lateral shift**. Ray bends towards the normal when entering glass (denser).

P-Minor 6. Critical angle of a prism

- Critical angle C = the angle of incidence in the denser medium for which the angle of refraction in the rarer medium is 90 degrees. Total internal reflection happens when the angle of incidence is greater than C. Conditions: ray goes from denser to rarer medium, and the angle of incidence exceeds C.
- Use a right-angled isosceles (45-45-90) glass prism. Send rays through the prism, rotate until the emergent ray just disappears along the surface, measure that angle. For glass C is about 42 degrees. sin C = 1/n.

P-Minor 7. V-I characteristics of a resistor (Ohm's law)

- Ammeter in series, voltmeter across the resistor, vary current with the rheostat, record V and I. Plot V (y) against I (x): a straight line through the origin. Slope = R = V/I.
- Ohm's law: V is proportional to I at constant temperature. A filament lamp gives a curve (resistance rises as it heats). A diode conducts in one direction only.

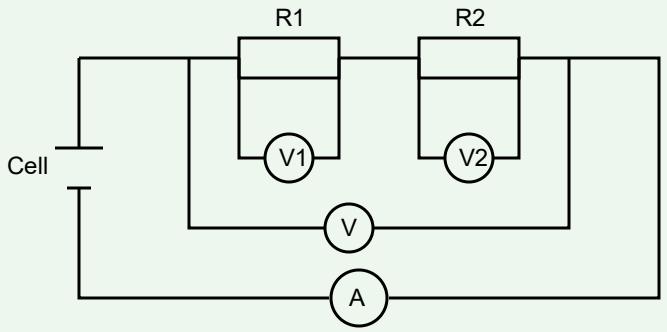
P-Minor 8. Potential difference across a wire against its length

- Pass a constant current through a uniform wire fixed on a metre scale. Measure V across lengths of 20, 40, 60, 80, 100 cm. V is directly proportional to length l, so V against l is a straight line through the origin. Reason: R = rho l / A, so V = IR grows with l. Keep the current constant using the rheostat and switch it off between readings so the wire does not heat.

C. Model paper solved (Physics, 20 marks)

Q.1 Series combination of resistances (6 marks)

i. Circuit diagram (2). Draw: battery (cell symbol) and key in series with R_1, R_2 and an ammeter A in one loop. Connect voltmeter V_1 in parallel across R_1, V_2 in parallel across R_2, and a voltmeter V across the pair.



(Sketch only. In your answer draw it neatly with standard symbols and label V1 across R1, V2 across R2, V across both.)

ii. Table (3). $R_e = R_1 + R_2$. $V = V_1 + V_2$. $I = V_1/R_1$ (same in series). $R = V/I$.

Obs	V1 (V)	V2 (V)	R1 (ohm)	R2 (ohm)	Re (ohm)	V (V)	I (A)	R = V/I (ohm)	Re - R
1	2	10	10	50	60	12	0.2	60	0
2	6	10	60	100	160	16	0.1	160	0
3	4.8	12	80	200	280	16.8	0.06	280	0

Check: $V_1/R_1 = V_2/R_2$ in every row (2/10 = 10/50 = 0.2; 6/60 = 10/100 = 0.1; 4.8/80 = 12/200 = 0.06), so the current is the same through both resistors, as it must be in series.

iii. (1) The equivalent resistance increases (it becomes $R_1 + R_2 + R_3$) and, for the same voltage, the current decreases.

Q.2 Ball rolling down an angle iron (6 marks)

i. Apparatus (1): angle iron, steel ball, stop watch, metre rule, wooden block or stand (to raise one end), chalk or marker.

ii. Table (2). Mean time $t = (t_1 + t_2)/2$, velocity = distance / t.

Obs	Distance (cm)	t1 (s)	t2 (s)	Mean t (s)	Velocity (cm/s)
1	200	4.4	4.6	4.50	44.4
2	180	4.1	4.0	4.05	44.4
3	160	3.9	3.3	3.60	44.4
4	140	3.2	3.1	3.15	44.4
5	120	2.8	2.6	2.70	44.4
6	100	2.5	2.0	2.25	44.4

iii. Graph (2). Plot time t (x-axis, 0 to 5 s) and distance d (y-axis, 0 to 200 cm). Points: (2.25, 100), (2.70, 120), (3.15, 140), (3.60, 160), (4.05, 180), (4.50, 200). They lie on one straight line through the origin, slope = 44.4 cm/s. Give a title, label both axes with units, choose a scale that fills the page.

iv. (1) If the angle of inclination is reduced, the acceleration of the ball decreases, so its speed is less and it takes more time to cover the same distance.

Q.3 Refraction through a glass slab (4 marks)

i. (2) Draw the normal (a line perpendicular to the surface) at the point where the ray enters the slab. Angle of incidence i = angle between the incident ray (in air) and the normal. Angle of refraction r = angle between the refracted ray (in glass) and the normal. Measured on the printed figure with a protractor: i is about 60 degrees and r is about 21 degrees.
ii. (2) n = sin i / sin r = sin 60 / sin 21 = 0.866 / 0.358 = about 2.4.

The printed figure is only a rough sketch, and the angles scale off the image only approximately, so n comes out higher than real glass (about 1.5). In the exam the marks go for: drawing the normal, correct i and r from your own measurement, writing n = sin i / sin r, substituting, and the unit-free answer. Show these steps. (As a check, i = 60 and r = 35 would give n = 1.5.)

Q.4 Force-extension graph of a helical spring (4 marks)

i. (1) Independent variable: force (load), on the x-axis. Dependent variable: extension, on the y-axis.
ii. (2) Slope = $(y_B - y_A) / (x_B - x_A)$ = (2.0 - 1.5) cm / (200 - 150) dynes = 0.5 / 50 = 0.01 cm per dyne.
iii. (1) The slope is the extension per unit load, which is 1/k, the reciprocal of the spring constant. So k = 1 / 0.01 = 100 dynes per cm.

PART 2: CHEMISTRY PBA

A. Major experiments (Section A, 6 marks each)

C-Major 1. Separation of water and alcohol by fractional distillation

- **Apparatus:** round-bottom flask (A mixture here), fractionating column, thermometer, Liebig condenser, receiving flask, burner or heating mantle, retort stands, anti-bumping chips (porcelain pieces).
- **Principle:** ethanol boils at 78 C, water at 100 C. The column has a large surface area (glass beads or rings) where vapour repeatedly condenses and re-vaporises, so the more volatile ethanol rises to the top and water is held back. This gives a much better separation than simple distillation.
- **Procedure:** mix water and ethanol in the flask with anti-bumping chips. Thermometer bulb at the level of the side arm to the condenser. Cooling water enters at the bottom of the condenser and leaves at the top. Heat gently. The thermometer rises and holds near 78 C: collect this fraction (ethanol). When the temperature starts to rise towards 100 C, change the receiver, the rest is water.
- **Confirm ethanol:** it has a characteristic smell, it burns with a pale blue flame (water does not), its boiling point is 78 C.
- **Control heat:** low, steady flame, 1 to 2 drops of distillate per second. Reduce the heat if the temperature jumps, because rapid heating lets water vapour pass.

C-Major 2. Paper chromatography of a mixture of inks

- **Apparatus:** chromatography paper, pencil, ruler, capillary tube, beaker with lid, solvent (water or alcohol mixture), glass rod or stick to hang the paper.
- **Procedure:** draw a pencil baseline (origin) about 2 cm from the bottom. Put a small spot of ink on it with the capillary, let it dry, repeat 2 or 3 times so the spot is concentrated but small. Hang the paper in the beaker so only the bottom dips in the solvent, with the solvent level below the baseline. Cover the beaker. When the solvent front is near the top, remove the paper and immediately mark the solvent front with a pencil, then dry it.
- **Why pencil:** pencil graphite is insoluble in the solvent and does not move or dissolve, while pen ink would run and form its own spots.
- **Rf = distance moved by the spot / distance moved by the solvent front.** Rf is always between 0 and 1, same for the same substance in the same solvent. Two spots means two components. A pure substance gives one spot.

C-Major 3. Separate Pb^{2+} and Cd^{2+} by paper chromatography

- Pb^{2+} and Cd^{2+} are **colourless**, so the spots cannot be seen. A **locating agent** (a chemical sprayed after the run that reacts with the ions to give coloured spots) is needed.
- Same procedure as inks, with a suitable solvent (acid or acetone-based). After the run, dry the paper and spray the locating agent. Mark the coloured spots, then calculate Rf for each ion and compare with known samples (identify unknowns by comparing Rf with the known substances).
- Typical locating agents: hydrogen sulfide water or sodium sulfide (Pb^{2+} gives a black spot of PbS, Cd^{2+} gives a yellow spot of CdS), or potassium iodide (Pb^{2+} gives yellow PbI_2).

> The framework names the experiment but not the exact solvent or locating agent. Use whichever your school lab manual used. The agents above are the common ones, but they are not printed in the framework.

C-Major 4. Exact molarity of NaOH by titration

- **Apparatus:** burette, volumetric pipette, conical flask, white tile, funnel, retort stand, wash bottle.
- **Solutions:** standard acid of known molarity (for example 0.1 M HCl) and the NaOH solution; indicator phenolphthalein (colourless in acid, pink in alkali) or methyl orange.
- **Procedure:** rinse the burette with NaOH and fill it, remove air bubbles, note the initial reading. Pipette 10 or 25 cm^3 of the acid into the conical flask, add 2 or 3 drops of indicator. Add NaOH slowly while swirling, until one drop gives a permanent faint pink (end point). Note the final reading. Repeat until two readings agree within 0.10 cm^3 (concordant), take the mean.
- **Calculation:** $M_a V_a / n_a = M_b V_b / n_b$ where n is the number of moles in the balanced equation. For HCl + NaOH (1:1): $M_{NaOH} = M_{HCl} \times V_{HCl} / V_{NaOH}$.
  Example: 25.0 cm^3 of 0.100 M HCl needs 24.5 cm^3 NaOH: M = 0.100 x 25.0 / 24.5 = 0.102 M. In g/dm^3: 0.102 x 40 = 4.08 g/dm^3.
- Chemists use cm^3, g and s because the quantities in a lab are small (1 dm^3 = 1000 cm^3).

C-Major 5. Tests for ammonia, carbon dioxide and chlorine

Gas	Test	Positive result	Usual preparation
Ammonia NH_3	Damp red litmus paper	Turns blue (pungent smell, alkaline gas)	Warm NH_4Cl with NaOH
Carbon dioxide CO_2	Pass through limewater, $Ca(OH)_2$	Turns milky ($CaCO_3$); clears with excess CO_2	$CaCO_3$ + dilute HCl
Chlorine Cl_2	Damp (blue) litmus paper	Bleached white (first red), greenish-yellow gas	MnO_2 + conc. HCl, warm

- Other gas tests on the same SLO: hydrogen (lighted splint, squeaky pop), oxygen (glowing splint relights), sulfur dioxide (acidified potassium manganate(VII) turns from purple to colourless).
- Equations: $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$. $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$. $NH_4Cl + NaOH \rightarrow NaCl + H_2O + NH_3$.

B. Minor experiments (Section B, 4 marks each)

C-Minor 1. Separate naphthalene from sand and salt by sublimation

- Put the mixture in a china dish, cover with an inverted funnel plugged with cotton wool, heat gently. Naphthalene sublimes (solid to gas, no liquid) and its vapour condenses as white crystals on the cool funnel. Sand and salt stay in the dish. Cool and scrape the naphthalene off. Salt and sand can then be separated by adding water, filtering the sand and evaporating the filtrate. Other sublimers: ammonium chloride, iodine, camphor.

C-Minor 2. Flame test for metal ions

Ion	Flame colour
Na^+	Golden yellow
K^+	Lilac (pale violet)
Ca^{2+}	Brick red (orange-red)
Cu^{2+}	Blue-green
Ba^{2+}	Apple green (pale green)

- Clean the nichrome or platinum wire by dipping in conc. HCl and heating until no colour, so earlier samples do not contaminate the next flame. Moisten with HCl, dip in the sample, hold it in the edge of the hot non-luminous (blue) Bunsen flame and watch the colour. Yellow means sodium (it also masks other colours, so sodium contamination must be avoided).

C-Minor 3. Pure crystals of $CuSO_4.5H_2O$

- Warm dilute H_2SO_4, add copper(II) oxide (or carbonate) in small portions until some solid stays unreacted (excess). Filter to remove the excess (residue = unreacted CuO, filtrate = blue $CuSO_4$ solution). Heat the filtrate in an evaporating dish on a water bath until it is saturated (a drop on a glass rod forms crystals when cooled). Leave to cool slowly, filter the crystals, wash with a little cold distilled water, dry between filter papers.
- $CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$. Slow cooling gives large, well-formed crystals, fast cooling gives many small crystals. Do not heat to dryness, or the water of crystallisation is lost.

C-Minor 4. Melting point of naphthalene

- Fill a capillary tube with powdered naphthalene, attach it to a thermometer, heat in a water bath (or liquid paraffin), stirring. Note the temperature when it just melts. Pure naphthalene melts sharply at about 80 C. An impure sample melts below this value over a range.

C-Minor 5. Boiling point of ethyl alcohol

- Heat ethanol in a flask or test tube (water bath) with a thermometer, the bulb in the vapour just above the liquid (not touching the glass), with anti-bumping chips. The steady temperature is the boiling point, about 78 C. Repeat 3 times and take the mean.
- Accuracy vs precision: accuracy is closeness to the true value, precision is closeness of repeated readings to each other.

C-Minor 6. Metal displacement reaction in aqueous medium

- A more reactive metal displaces a less reactive metal from its salt solution. $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$. Observation: the blue colour fades, reddish-brown copper is deposited on the zinc. $Cu + ZnSO_4$: no reaction (copper is less reactive). Reactivity order: Mg, Zn, Fe, Cu, Ag. Cu in $AgNO_3$ gives silver and a blue solution.

C-Minor 7. Test for water with anhydrous copper(II) sulfate

- Add the liquid to white anhydrous $CuSO_4$. It turns blue (hydrated $CuSO_4.5H_2O$) if water is present. $CuSO_4 + 5H_2O \rightarrow CuSO_4.5H_2O$. The test proves water is present, it does not prove the water is pure. Heating the blue crystals gives white powder again (reversible).

C-Minor 8. Purity of water by melting and boiling point

- Pure water: melts at 0 C and boils at 100 C (standard pressure), sharp and fixed. Impurities (such as salt) lower the melting point and raise the boiling point, and make them spread over a range. Distilled water has no dissolved salts, leaves no residue on evaporation and is used in labs, car batteries, irons. Tap water has dissolved minerals and chlorine and leaves scale.

C. Model paper solved (Chemistry, 20 marks)

Q.1 Paper chromatography of ink mixture X (6 marks)

a. A horizontal baseline (origin) about 2 cm from the bottom edge, above the solvent level. A pencil is used because graphite does not dissolve in the solvent and does not run up the paper, while pen ink would dissolve and move, giving false spots.
b. Touch the capillary lightly to the line for a very small spot, let it dry, repeat 2 or 3 times in the same place to concentrate it. Keep the spot small (a few mm) and on the baseline, leaving space between different spots and from the edges.
c. The solvent level must be below the baseline (otherwise the ink dissolves into the solvent). The paper must hang straight without touching the beaker walls, the beaker should be covered so the air is saturated with solvent vapour, and it must stand still.
d. The run is finished when the solvent front is near the top of the paper (about 1 cm below it) and the spots stop separating further. Immediately mark the solvent front with a pencil, because it evaporates and becomes invisible, then dry the paper.
e. Two distinct spots mean X is a mixture of two different substances (components), not a pure substance.
f. From the diagram: solvent front = 8 cm, substance A = 2.6 cm, substance B = 5.6 cm from the origin. Rf(A) = 2.6 / 8 = 0.325 (about 0.33). Rf(B) = 5.6 / 8 = 0.70.

Q.2 Fractional distillation of water and alcohol (6 marks)

a. A = fractionating column, B = (Liebig) condenser, C = round-bottom flask holding the water-alcohol mixture, D = receiving (conical) flask holding the distillate.
b. The fractionating column (packed with glass beads or rings) gives a large surface area where vapours condense and evaporate repeatedly. The more volatile ethanol travels to the top and the less volatile water drains back down, so the separation is much sharper than in simple distillation.
c. Alcohol vaporises first, because its boiling point (78 C) is lower than that of water (100 C), so it is more volatile.
d. A steady 78 C means pure ethanol is distilling (the boiling point of ethanol). Ethanol is collected at this temperature. When the temperature rises above this, water is starting to come over.
e. Ethanol has a distinct smell and burns with a pale blue flame (a few drops on a watch glass catch fire), while water does not burn. Its boiling point is 78 C.
f. Heat gently and steadily with a small flame, or use a water bath or heating mantle. Aim for about 1 to 2 drops of distillate per second, lower the flame if the thermometer rises too fast, and keep the condenser water flowing (in at bottom, out at top).

Q.3 Flame test, accuracy and precision, sublimation (4 marks)

a. Cleaning removes traces of the previous sample. Left-over salts would give their own colours and make the result wrong. Dip in conc. HCl and heat in the flame until it burns without colour.
b. Hold the wire loop in the edge (the hot blue part) of the non-luminous Bunsen flame, so it heats evenly and the colour is clear. A persistent golden-yellow flame shows sodium, Na^+.
c. The readings (70, 71, 70.5 C) are close to each other (spread 1 C), so the work is **precise**. The mean 70.5 C is 7.5 C away from the true value 78 C, so it is **not accurate**. Likely cause: a systematic error such as the thermometer bulb not in the vapour, heat loss, or an uncalibrated thermometer.
d. Put the mixture (for example naphthalene or ammonium chloride mixed with sand or salt) in a china dish. Cover with an inverted funnel plugged with cotton wool. Heat gently. The sublimable solid turns to vapour and deposits as pure crystals on the cool funnel. The other substances stay in the dish. Cool and collect the crystals.

Q.4 Purity of water, displacement, crystals (4 marks)

a. Sample A melts at 0 C and boils at 100 C, exactly like pure water, so it is pure. Sample B melts at -2 C (lower) and boils at 102 C (higher), so it contains dissolved impurities. Impurities lower the melting point and raise the boiling point.
The experiment helps because a salt or solute makes the water freeze below 0 C and boil above 100 C. Any shift from these fixed values, or a range instead of a sharp point, shows contamination. The bigger the shift, the more impurity.
b. Zinc is more reactive than copper, so it displaces copper: $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$. The blue colour of the solution fades (zinc sulfate is colourless) and reddish-brown copper deposits on the zinc.
c. Slow cooling gives the particles time to arrange themselves on a few seeds, so fewer, larger and well-shaped crystals form. Fast cooling (as in icy water) forms many nuclei at once, so many small crystals.

PART 3: COMPUTER SCIENCE PBA

SSC Computer Science PBA uses Domain C (web: HTML, CSS, JavaScript) for the 24 marks of Section A, and Domains B (algorithms), A (computer systems) and H (entrepreneurship) for Section B. Note that Section A is on the web, not Python or C.

A. Section A: Web practicals

CS-1. HTML page skeleton and the tags to know

```
<!DOCTYPE html>
<html>
<head>
  <title>My Portfolio</title>
  <link rel="stylesheet" href="style.css">   <!-- or a <style> block -->
</head>
<body>
  <header><h1>Name</h1><p>Short intro</p></header>
  <nav><a href="#home">Home</a> | <a href="#about">About Me</a> | <a href="#contact">Contact</a>
</nav>
  <main>
    <img src="profile.jpg" alt="Profile picture">
    <p>Short biography.</p>
    <ul><li>HTML</li><li>CSS</li><li>JavaScript</li></ul>
  </main>
</body>
</html>
```

- Formatting: <b>, <i>, <u>, <h1> to <h6>, <br>, <hr>. Anchor: <a href="url">. Image: <img src alt>. Lists: <ul> (bullets), <ol> (numbers), <dl><dt><dd> (definition). Table: <table>, <tr> row, <th> header cell, <td> data cell.

CS-2. CSS (inline, internal, external) and common properties

```
selector { property: value; }
h1 { color: blue; text-align: center; font-size: 24px; }
th { color: lightblue; }
img { width: 300px; height: 200px; }
table { border: 1px solid black; border-collapse: collapse; }
a:hover { color: red; }          /* hover effect */
div { margin: 10px; padding: 5px; background-color: #eee; position: relative; }
```

- Text styling (color, font-size, text-align), colours, spacing (margin outside, padding inside), borders, positioning (static, relative, absolute, fixed), backgrounds, hover effects.

CS-3. JavaScript basics: variables, I/O, loops, functions, debugging

```
let a = 20, b = 60, c = 75;          // variables (let, const)
let total = a + b + c;
document.write(total);                // output on the page
console.log(total);                   // output in the console
let n = Number(prompt("Enter number"));   // input

if (n > 0) { alert("Positive"); } else if (n < 0) { alert("Negative"); } else { alert("Zero"); }

for (let i = 1; i <= 10; i++) { document.write(n + " x " + i + " = " + n*i + "<br>"); }   // table

let f = 1; for (let i = 1; i <= n; i++) { f *= i; }          // factorial

function area(r) { return 3.14159 * r * r; }                  // function

let big = a; if (b > big) big = b; if (c > big) big = c;       // largest of three

let list = [5, 2, 9, 1];
let found = list.indexOf(9);          // search (found = -1 if absent)
list.sort(function(x, y){ return x - y; });   // ascending sort
```

- Debugging: syntax errors (missing bracket, wrong keyword case) stop the code, logical errors (wrong condition) give wrong output. Use console.log() and the browser console to find them.

B. Section B practicals

CS-4. Devices and software (labelling questions)

Category	Examples
Input devices	keyboard, mouse, scanner, microphone, webcam
Output devices	monitor, printer, speakers, projector
Processing devices	CPU (processor, e.g. Intel Core i7), microprocessor, motherboard
Storage devices	hard disk, SSD, USB flash drive, memory card (SD or microSD), external hard drive
Communication devices	modem, router, network interface card, Wi-Fi adapter
System software	operating system (Windows, Linux, MS-DOS), utility programs (antivirus such as AVG, disk cleanup), language translators (compiler, interpreter, assembler), device drivers
Application software	productivity (MS Word, Excel), business (accounting), entertainment (games, media players), education software, browsers (Chrome)

CS-5. Flowchart symbols, concept map and algorithms

- Symbols: oval = start/stop, rectangle = process, parallelogram = input/output, diamond = decision (Yes/No), arrows = flow. A concept map shows ideas as boxes joined by labelled lines.
- Algorithm patterns to practise: sum of numbers, even/odd, factorial, table, largest/smallest, linear search, bubble sort.

```
Factorial (pseudocode)          Largest of three
START                           START
INPUT n                         INPUT a, b, c
f = 1                           max = a
FOR i = 1 TO n                  IF b > max THEN max = b
   f = f * i                    IF c > max THEN max = c
PRINT f                         PRINT max
END                             END
```

CS-6. Business plan (Executive summary, objectives, product specification, market)

- **Company name and slogan:** short, catchy. **Executive summary:** one line on what the business is and who it serves. **Objectives:** main goals (for example, deliver healthy meals within 30 minutes, reduce plastic waste). **Product specification:** pricing, promotion, packaging, delivery. **Potential customers:** target groups.

C. Model paper solved (Computer Science, 40 marks)

Q.1 (10 marks)

a. Debug (5 marks). Errors found: (1) `let 4 = rows;` should be `let rows = 4;` (variable on the left). (2) Condition `i < 0` should be `i > 0` (the loop would never run). (3) Inner loop `j < i` should be `j <= i` (to print i stars, the output shows 4, 3, 2, 1 stars). (4) The inner for loop has a closing brace but no opening brace (missing {). (5) `Document.write` should be `document.write` (JavaScript is case sensitive). (6) Missing semicolon after `let pattern = ""`. (7) Add `<br>` so each row prints on a new line.

```
let rows = 4;
for (let i = rows; i > 0; i--) {
  let pattern = "";
  for (let j = 1; j <= i; j++) {
    pattern += "* ";
  }
  document.write(pattern + "<br>");
}
```

Output: row of 4 stars, then 3, then 2, then 1.

b. Shopping cart (5 marks).

```
let item1 = 20, item2 = 60, item3 = 75;
let totalPrice = item1 + item2 + item3;
document.write("Total price = " + totalPrice);   // prints 155
```

OR a. Negative or positive (5 marks).

```
let num = Number(prompt("Enter a number"));
if (num < 0) { alert("The number is negative"); }
else if (num > 0) { alert("The number is positive"); }
else { alert("The number is zero"); }
```

OR b. Output (5 marks). The loop runs 10 times (i = 0 to 9) and adds start + i x step = 1 + 2i each time. The array becomes [1,3,5,7,9,11,13,15,17,19], and join(', ') puts it in the element with id "output" (when displaySeries() is called): **1, 3, 5, 7, 9, 11, 13, 15, 17, 19**.

Q.2 Personal portfolio page (10 marks)

```
<!DOCTYPE html>
<html>
<head>
  <title>Ali Khan - My Portfolio</title>                    <!-- a (1) -->
</head>
<body>
  <header>                                                    <!-- b (1) -->
    <h1>Ali Khan</h1>
    <p>I am a student who loves computers and web design.</p>
  </header>

  <nav>                                                       <!-- d (1) -->
    <a href="#home">Home</a> | <a href="#about">About Me</a> | <a href="#contact">Contact</a>
  </nav>

  <main>                                                      <!-- c (3) -->
    <img src="profile.jpg" alt="Profile picture">
    <p>I study in class 10 and enjoy building websites.</p>
    <h3>Skills</h3>
    <ul><li>HTML</li><li>CSS</li><li>JavaScript</li></ul>

    <table border="1">                                        <!-- e (4) -->
      <tr><th>Sr#</th><th>Degree</th><th>Passing year</th><th>GPA/ Grade</th><th>Board/
University</th></tr>
      <tr><td>1</td><td>Matriculation</td><td>2015</td><td>A+</td><td>FBISE</td></tr>
      <tr><td>2</td><td>Intermediate</td><td>2017</td><td>B+</td><td>FBISE</td></tr>
      <tr><td>3</td><td>BS</td><td>2021</td><td>3.56</td><td>AIOU</td></tr>
    </table>
  </main>
</body>
</html>
```

Q.3 CSS (4 marks)

a. `th { color: lightblue; }` (foreground colour of the header text; `th` is the header cell tag of the table).
b. `img { width: 300px; height: 200px; }` (or give the image an id or class and style it).

Q.4 Library book issue (5 marks, concept map or flowchart)

Flowchart steps (draw with oval, parallelogram, diamond, rectangle):

```
START
 -> INPUT member ID and book ID
 -> [Decision] Is the book available?
       NO  -> PRINT "Book not available" -> STOP
       YES -> [Decision] Has the user borrowed the maximum number of books (for example 3)?
                 YES -> PRINT "Limit reached" -> STOP
                 NO  -> Issue the book, add to the user's record, mark the book as issued,
                        set the due date -> PRINT "Book issued" -> STOP
```

OR ATM withdrawal:

```
START -> Insert card -> Enter PIN -> [PIN correct?]
   NO  -> PRINT "Wrong PIN" (retry up to 3 times, else block card) -> STOP
   YES -> Choose amount -> [Balance >= amount?]
        NO  -> PRINT "Insufficient balance" -> STOP
        YES -> Dispense cash -> Deduct amount from balance -> Print receipt -> Return card -> STOP
```

Q.5 Devices and software (5 marks)

a. Labels (2.5): i. motherboard (circuit board, processing/main board), ii. CPU (microprocessor, Intel Core i7), iii. microSD memory card, iv. external hard disk drive, v. USB flash drive (pen drive).
b. Classify (2.5): i. MS Excel = application software (productivity). ii. Google Chrome = application software. iii. Windows = system software (operating system). iv. AVG antivirus = system software (utility program). v. MS-DOS = system software (operating system).

The device pictures are small. Image i looks like a green circuit board (motherboard or single-board computer), so the label may be written differently on your sheet. Check against the printed picture.

Q.6 Business plan: MY FOOD CART (6 marks)

Company name	MY FOOD CART
Slogan (1)	"Fresh food, fast at your door."
Executive summary (1)	MY FOOD CART delivers fresh, healthy and affordable meals to busy professionals and students through a mobile app with real-time tracking.
Objectives, any two (1)	1. Deliver every order within 30 minutes. 2. Use eco-friendly packaging to reduce waste.
Product specification (2)	Pricing: affordable meal packs (for example Rs 300 to 600) with discounts for students. Promotion: social media ads, first-order discount, referral rewards. Packaging: recyclable, biodegradable boxes, sealed to stay fresh. Delivery: app orders, real-time tracking, delivery in 30 minutes by bike riders.
Potential customers, any two (1)	1. Busy office professionals. 2. University and college students in urban areas.

Notes on accuracy

- Everything in the model-paper solutions is derived from the printed FBISE questions. The 2026 PBA is expected to follow this pattern, but the real paper will use different numbers and different experiments from the same list.

- Physics Q.3: the angles read off the printed sketch give a refractive index of about 2.4, higher than real glass (about 1.5). Use the method and your own measurement in the exam.
- Chemistry Major 3: solvent and locating agent are not in the framework, check your lab manual.
- Computer Science Q.5: the device pictures are small, the first one is read as a motherboard.
- The 2025 SSC-II PBA model papers (old curriculum, Physics/Chemistry 2006, Computer C language and HTML) also exist on the FBISE site, but they are superseded by this composite framework, so they are not covered.