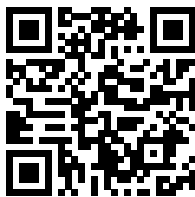


Series: AC411



SESSION – 2

Subject Code: SCO

Roll No.:

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Candidates must write the Roll No on the title page of the Question Paper.

Chemistry | Level 4

Time allowed: 1.5 hours

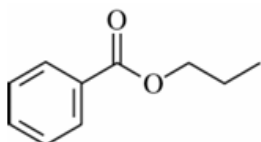
Maximum Marks: 150

Instructions for Candidates:

1. Please verify that this question paper contains **12** printed pages and Ensure that the paper contains a total of **50** questions.
2. Use of mobile phones, smartphones, ipads during examination is **STRICTLY PROHIBITED**.
3. On the OMR sheet, enter all required information carefully in the space provided **ONLY IN BLOCK CAPITALS** and by properly darkening the corresponding bubbles. Incomplete, incorrect, or careless entries may lead to disqualification.
4. Use only a **BLUE or BLACK BALL POINT PEN** for writing entries and filling bubbles. Pencils or other pens are not permitted.
5. **Marking Scheme:** Each question has four alternatives, only one of which is correct. Select the correct option and darken the respective bubble.
 - Each correct answer carries **3 marks**.
 - Each incorrect answer attracts a penalty of **1 mark**.
 - No marks are awarded for unanswered questions.
6. Use only the space provided in the question paper for rough work.
7. Candidates must remain in the examination hall until the exam is officially over. Early exit is not permitted.
8. Do not make stray marks, symbols, or extra writings on the answer sheet. Fill only the designated bubbles neatly.
9. Since answer sheets are machine evaluated, changes in entries are **strictly not allowed**.
10. Avoid scratching, overwriting, or erasing, as these may result in wrong evaluation.
11. **DO NOT write anything on the back side** of the answer sheet.

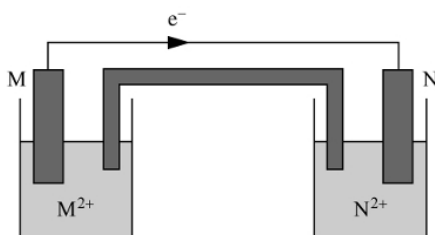
Multiple Choice Questions

Q1. According to IUPAC rules, what is the name of the molecule shown below?



- (A) Benzyl propanoate
- (B) Phenyl propanoate
- (C) Propanoyl benzene
- (D) Propyl benzoate

Q2. Which of the following is true of the cell represented below?



- (A) Metal M is being oxidized.
- (B) Metal N is the reducing agent.
- (C) N^{2+} ions are being oxidized.
- (D) M^{2+} ions are being reduced.

Q3. Of the following substances, which is likely to have the largest value of the coefficient a in the van der Waals equation

$$\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT?$$

- (A) H_2
- (B) N_2
- (C) CH_4

(D) CO_2

Q4. What is the orbital angular momentum quantum number l of the electron that is most easily removed when ground-state aluminum is ionized?

- (A) 3
- (B) 0
- (C) 1
- (D) $\frac{1}{3}$

Q5. Elements with partially filled $4f$ or $5f$ orbitals include all of the following **EXCEPT**

- (A) Cu
- (B) Eu
- (C) Am
- (D) Cm

Q6. Which of the following is always true of a spontaneous process?

- (A) The process does not involve any work.
- (B) The entropy of the system increases.
- (C) The internal energy of the system decreases.
- (D) The total entropy of the system plus surroundings increases.

Q7. The equation $\Delta H = \Delta U + P\Delta V$ is applicable

- (A) only for constant pressure processes
- (B) only for constant temperature processes
- (C) only for constant volume processes
- (D) only for constant entropy processes



- Q8.** Which of the following statements about nuclear binding energies is **NOT** true?
- (A) Binding energy per nucleon reaches a maximum for ^{56}Fe .
 - (B) Nuclear binding energies have about the same magnitude as chemical bond energies.
 - (C) The nuclei of heavy elements have more neutrons than protons to provide sufficient binding energy.
 - (D) When very light elements undergo fusion, the released energy arises from an increased binding energy per nucleon.
- Q9.** Which of the following is classified as a conjugate acid–base pair?
- (A) $\text{H}_3\text{O}^+ / \text{H}_2\text{O}$
 - (B) $\text{O}_2 / \text{H}_2\text{O}$
 - (C) H^+ / Cl^-
 - (D) $\text{NaCl} / \text{NaOH}$
- Q10.** Considering 0.1 M aqueous solutions of each of the following, which solution has the lowest pH?
- (A) Na_2CO_3
 - (B) Na_3PO_4
 - (C) Na_2S
 - (D) CH_3COONa
- Q11.** Of the following compounds, which has the lowest melting point?
- (A) HCl
 - (B) CaCl_2
 - (C) CCl_4
 - (D) SnCl_4
- Q12.** Of the following solutions, which will have the highest ionic strength (assume complete dissociation)?
- (A) 0.050 M AlCl_3
 - (B) 0.100 M NaCl
 - (C) 0.050 M CaCl_2
 - (D) 0.050 M $\text{Ca}(\text{NO}_3)_2$
- Q13.** If $\psi(r)$ is the wavefunction for a 1s electron, the average distance from the nucleus for the electron is equal to
- (A) $\int_0^r \psi^*(r)\psi(r) dr$
 - (B) $\int_0^\infty \psi^*(r)\psi(r) dr$
 - (C) $\psi^*(r) \hat{r} \psi(r)$
 - (D) $4\pi \int_0^\infty \psi^*(r) \hat{r} \psi(r) r^2 dr$
- Q14.** Which of the following experimental observations were explained by Planck's quantum theory?
- (A) Blackbody radiation curves
 - (B) Emission spectra of diatomic molecules
 - (C) Temperature dependence of reaction rates
 - (D) Pressure dependence of boiling points
- Q15.** The +1 oxidation state is more stable than the +3 oxidation state for which group 13 element?
- (A) Al
 - (B) In
 - (C) Ga
 - (D) Tl
- Q16.** A buffer is made from equal concentrations of a weak acid and its conjugate base. Doubling the volume of the buffer solution by adding water has what effect on its pH?
- (A) It has little effect.
 - (B) It significantly increases the pH.



(C) It changes the pH asymptotically to the pK_a of the acid.

(D) It changes the pH asymptotically to the pK_b of the conjugate base.

Q17. Which of the following is the most common naturally occurring form in which silicon is found?

- (A) Sulfide
- (B) Fluoride
- (C) Oxide
- (D) Nitride

Q18. A substance that is NOT generally considered to be a toxic pollutant in water is

- (A) carbonic acid
- (B) a halogenated hydrocarbon
- (C) lead
- (D) cadmium

Q19. Of the following compounds, which is LEAST likely to behave as a Lewis acid?

- (A) $MgCl_2$
- (B) $ZnCl_2$
- (C) SCl_2
- (D) $SnCl_2$

Q20. The strongest base in liquid ammonia is

- (A) NH_3
- (B) NH_2^-
- (C) NH_4^+
- (D) N_2H_4

Q21. Which of the following lists the hydrides of group-14 elements in order of thermal stability, from lowest to highest?

- (A) $PbH_4 < SnH_4 < GeH_4 < SiH_4 < CH_4$
- (B) $PbH_4 < SnH_4 < CH_4 < GeH_4 < SiH_4$
- (C) $CH_4 < SiH_4 < GeH_4 < SnH_4 < PbH_4$

(D) $CH_4 < PbH_4 < GeH_4 < SnH_4 < SiH_4$

Q22. An organic compound has a distribution coefficient $K_p = 2.00$ between an ether and water. If 10.0 g of the compound is dissolved in 100 mL of water that is then extracted twice with 100 mL portions of the ether, what fraction of the compound remains in the water?

$$K_P = \frac{C_{\text{ether}}}{C_{\text{water}}}$$

- (A) 0.111
- (B) 0.209
- (C) 0.150
- (D) 0.100

Q23. Of the following atoms, which has the lowest electron affinity?

- (A) F
- (B) O
- (C) Ca
- (D) Br

Q24. Which of the following is a primary standard for use in standardizing bases?

- (A) Sulfuric acid
- (B) Acetic acid
- (C) Potassium hydrogen phthalate
- (D) Silver nitrate

Q25. Match the columns:

Column-I

- (P) Cyanide process
- (Q) Floatation process
- (R) Electrolytic reduction
- (S) Zone refining

Column-II

- (p) Ultrapure Ge
- (q) Pine oil
- (r) Extraction of Al
- (s) Extraction of Au

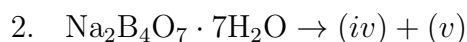
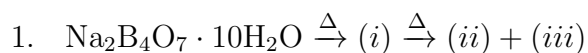
- (A) P – (r), Q – (p), R – (s), S – (q)
- (B) P – (s), Q – (q), R – (r), S – (p)



(C) P – (r), Q – (q), R – (s), S – (p)

(D) P – (s), Q – (p), R – (r), S – (q)

Q26. Identify (i) to (v) in reactions (1) and (2) and on this basis choose the correct code for matching Column–I with Column–II.

**Column–I**

(P) (i)

(Q) (ii)

(R) (iii)

(S) (iv)

(T) (v)

Column–II(p) H_3BO_3 (q) B_2O_3 (r) NaBO_2 (s) NaOH (t) $\text{Na}_2\text{B}_4\text{O}_7$

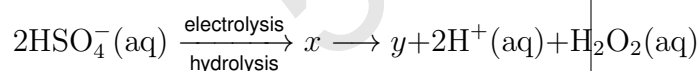
(A) P – (t), Q – (s), R – (p), S – (q), T – (r)

(B) P – (r), Q – (q), R – (s), S – (p), T – (t)

(C) P – (t), Q – (r), R – (q), S – (p), T – (s)

(D) P – (t), Q – (r), R – (s), S – (q), T – (p)

Q27. Identify x and y in the following reaction:

(A) $x = \text{H}_2\text{SO}_4(\text{aq})$, $y = 2\text{HSO}_4^-(\text{aq})$ (B) $x = \text{HO}_3\text{SOOSO}_3\text{H}(\text{aq})$, $y = 2\text{HSO}_4^-(\text{aq})$ (C) $x = \text{HO}_3\text{SOOSO}_3\text{H}(\text{aq})$, $y = \text{H}_2\text{SO}_4(\text{aq})$ (D) $x = \text{H}_2\text{SO}_4(\text{aq})$, $y = \text{HO}_3\text{SOOSO}_3\text{H}(\text{aq})$

Q28. In the crossed Cannizzaro reaction involving HCHO as one of the components:

(A) HCHO is always oxidised because of electronic effect

(B) HCHO is always oxidised because of steric effect

(C) Both of the above statements are true

(D) None of the above statements is true

Q29. Standard enthalpy of vaporisation $\Delta_{\text{vap}}H^\circ$ for water at 100°C is $40.66 \text{ kJ mol}^{-1}$. The internal energy of vaporisation of water at 100°C (in kJ mol^{-1}) is:

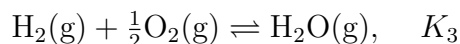
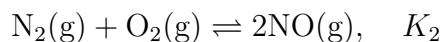
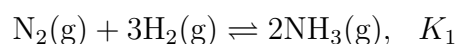
(A) +37.56

(B) –43.76

(C) +43.76

(D) +40.66

(Assume water vapour behaves like an ideal gas.)

Q30.

The equilibrium constant of the reaction

in terms of K_1 , K_2 , and K_3 is:

$$(A) \frac{K_1 K_2}{K_3}$$

$$(B) \frac{K_1 K_3^2}{K_2}$$

$$(C) K_1 K_2 K_3$$

$$(D) \frac{K_2 K_3^3}{K_1}$$

Q31. The solubility product (K_{sp}) of the following compounds are given at 25°C :

Compound	K_{sp}
AgCl	1.1×10^{-10}
AgI	1.0×10^{-16}
PbCrO ₄	4.0×10^{-14}
Ag ₂ CO ₃	8.0×10^{-12}



The most soluble and least soluble compounds are respectively:

- (A) AgCl and PbCrO₄
- (B) AgI and Ag₂CO₃
- (C) AgCl and Ag₂CO₃
- (D) Ag₂CO₃ and AgI

Q32. Match the columns:

Column-I	Column-II
(P) Butter	(p) dispersion of liquid in liquid
(Q) Pumice stone	(q) dispersion of solid in liquid
(R) Milk	(r) dispersion of gas in solid
(S) Paints	(s) dispersion of liquid in solid

- (A) P – (r), Q – (s), R – (p), S – (q)
- (B) P – (s), Q – (r), R – (p), S – (q)
- (C) P – (r), Q – (r), R – (p), S – (s)
- (D) P – (r), Q – (p), R – (q), S – (p)

Q33. Match the columns:

Column-I	Column-II
(P) Argyrol	(p) Kalazar
(Q) Antimony	(q) Intramuscular injection
(R) Colloidal gold	(r) Stomach disorders
(S) Milk of magnesia	(s) Eye lotion

- (A) P – (r), Q – (p), R – (s), S – (q)
- (B) P – (s), Q – (p), R – (q), S – (r)
- (C) P – (r), Q – (q), R – (p), S – (s)
- (D) P – (s), Q – (p), R – (r), S – (q)

Q34. Aryl halides are extremely less reactive towards nucleophilic substitution than alkyl halides. Which of the following accounts for this?

- (i) Due to resonance in aryl halides.
- (ii) In alkyl halides carbon atom in C–X bond is sp³ hybridised whereas in aryl halides carbon atom in C–X bond is sp² hybridized.
- (iii) Due to stability of phenyl cation.
- (iv) Due to possible repulsion there are less chances of nucleophile to approach electron-rich arenes.

- (A) (i), (ii) and (iv)
- (B) (i), (ii) and (iii)
- (C) (i) and (iv)
- (D) (ii), (iii) and (iv)

Q35. Among the following series of transition metal ions, the one where all metal ions have 3d² electronic configuration is (At. Nos. Ti = 22; V = 23; Cr = 24; Mn = 25)

- (A) Ti³⁺, V²⁺, Cr³⁺, Mn⁴⁺
- (B) Ti¹⁺, V⁴⁺, Cr⁶⁺, Mn⁷⁺
- (C) Ti⁴⁺, V³⁺, Cr²⁺, Mn³⁺
- (D) Ti²⁺, V³⁺, Cr⁴⁺, Mn⁵⁺

Q36. The d-electron configurations of Cr²⁺, Mn²⁺, Fe²⁺ and Ni²⁺ are 3d⁴, 3d⁵, 3d⁶ and 3d⁸ respectively. Which one of the following aqua complexes will exhibit the minimum paramagnetic behaviour? (At. Nos.: Cr = 24, Mn = 25, Fe = 26, Ni = 28)

- (A) [Fe(H₂O)₆]²⁺
- (B) [Ni(H₂O)₆]²⁺
- (C) [Cr(H₂O)₆]²⁺
- (D) [Mn(H₂O)₆]²⁺

Q37. According to valence bond theory, which of the following statements is correct about the complexes Ni(CO)₄ and [Ni(CN)₄]²⁻ if both are diamagnetic in nature?

- (A) both are tetrahedral



- (B) both are square planar
 (C) one is square planar and other is tetrahedral
 (D) one is tetrahedral and other is square planar

Q38. Match the columns:

Column-I	Column-II
(P) SF_4	(p) Tetrahedral
(Q) BrF_3	(q) Pyramidal
(R) BrO_3^-	(r) Sea-saw shaped
(S) NH_4^+	(s) Bent T-shaped

- (A) P – (r), Q – (q), R – (p), S – (s)
 (B) P – (p), Q – (s), R – (q), S – (r)
 (C) P – (p), Q – (q), R – (r), S – (s)
 (D) P – (p), Q – (s), R – (r), S – (q)

Q39. Match the columns:

Column-I	Column-II
(P) HClO_2	(p) Contains all different bonds
(Q) HClO_3	(q) Contains maximum Cl = O bond
(R) HClO	(r) Contains Cl with lowest oxidation state
(S) HClO_4	(s) Contains three types of bonds

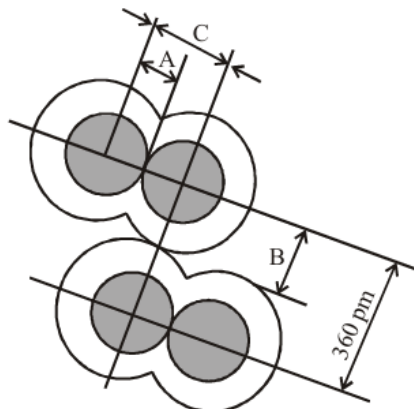
- (A) P – (s), Q – (p), R – (r), S – (q)
 (B) P – (p), Q – (s), R – (r), S – (q)
 (C) P – (s), Q – (p), R – (q), S – (r)
 (D) P – (s), Q – (b), R – (p), S – (r)

Q40. Match the columns of Common names and IUPAC names:

Column-I	Column-II
(P) Cinnamaldehyde	(p) Pentanal
(Q) Acetophenone	(q) Prop-2-enal
(R) Valeraldehyde	(r) 4-Methylpent-3-en-2-one
(S) Acrolein	(s) 3-Phenylprop-2-enal
(T) Mesityl oxide	(t) 1-Phenylethanone

- (A) P – (s), Q – (t), R – (p), S – (q), T – (r)
 (B) P – (p), Q – (t), R – (s), S – (d), T – (r)
 (C) P – (t), Q – (s), R – (p), S – (q), T – (r)
 (D) P – (q), Q – (t), R – (r), S – (s), T – (p)

Q41. The following figure represents a chlorine molecule. Identify A, B and C in the given figure.



- (A) A = Bond length, B = van der Waal's radius, C = Covalent radius
 (B) A = Covalent radius, B = Bond length, C = Ionic radius
 (C) A = Ionic radius, B = van der Waal's radius, C = Covalent radius
 (D) A = Covalent radius, B = van der Waal's radius, C = Bond length

Q42. Match the columns:

Column-I	Column-II
(P) Antifreeze used in car engine	(p) Methanol
(Q) Solvent used in perfumes	(q) Phenol
(R) Starting material for picric acid	(r) Ethyleneglycol
(S) Wood spirit	(s) Ethanol

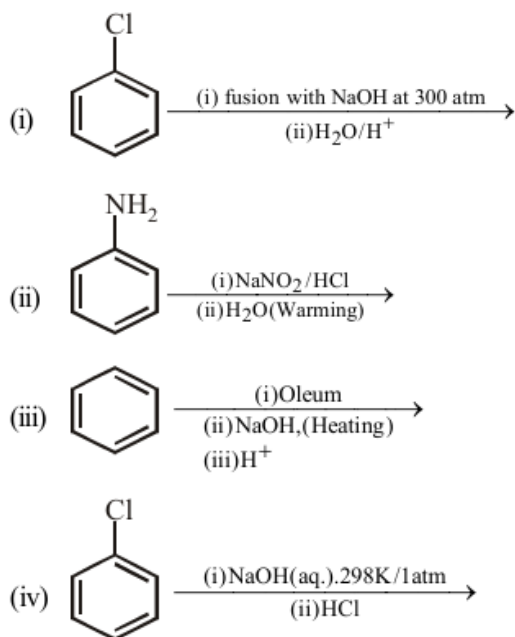


- (A) P – (s), Q – (q), R – (p), S – (r)
 (B) P – (r), Q – (s), R – (q), S – (p)
 (C) P – (s), Q – (q), R – (r), S – (p)
 (D) P – (p), Q – (r), R – (q), S – (s)

Q43. Which is known as the “Third poison of environment” and also creates “Blue baby syndrome”?

- (A) Nitrate present in water
 (B) Phosphate and detergents found in water
 (C) Cyanide
 (D) Pesticides

Q44. Which of the following reactions will yield phenol?

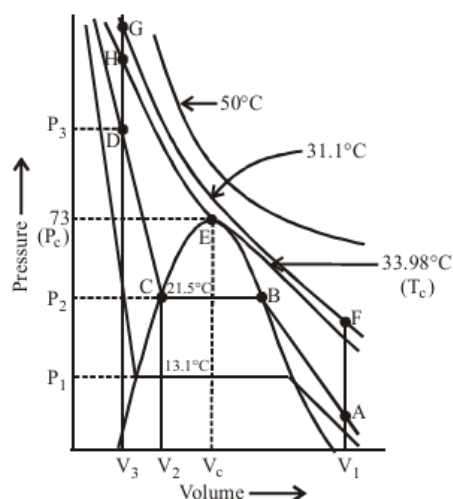


- (A) (i), (ii) and (iii)
 (B) (i) and (iii)
 (C) (i), (iii) and (iv)
 (D) (ii), (iii) and (iv)

Q45. Two moles of PCl_5 were heated in a closed vessel of 2 L. At equilibrium 40% of PCl_5 is dissociated into PCl_3 and Cl_2 . The value of the equilibrium constant is:

- (A) 0.53
 (B) 0.267
 (C) 2.63
 (D) 5.3

Q46. Choose the correct statement based on the following isotherms of carbon dioxide at various temperatures.

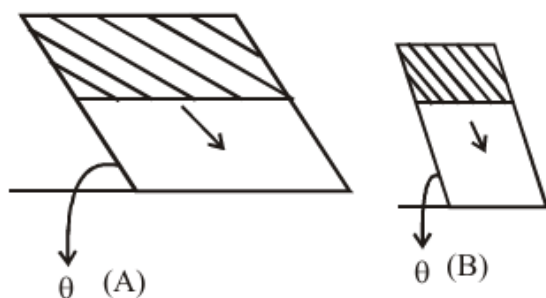


- (i) We can move from point A to F vertically by increasing the temperature.
 (ii) We can reach the point G by compressing the gas at constant temperature.
 (iii) We can move down from G towards D by increasing the temperature.
 (iv) As soon as we cross the point D on the critical isotherm we get liquid.

- (A) (i) and (ii)
 (B) (i), (ii) and (iii)
 (C) (i), (ii) and (iv)
 (D) (ii), (iii) and (iv)

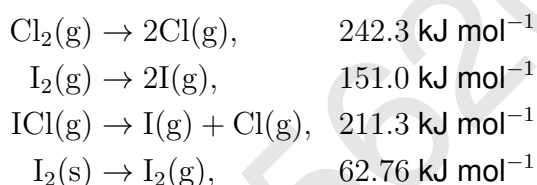
Q47. Consider the case of honey flowing over a slope. For this situation which of the following statement(s) is/are correct?





- (i) Velocity with which honey is flowing is slower in A than in B (θ being same in both cases).
- (ii) Velocity increases with increase in temperature.
- (A) (i) and (ii)
- (B) Only (i)
- (C) Only (ii)
- (D) Neither (i) nor (ii)

Q48. The enthalpy changes for the following processes are listed below:



Given that the standard states for iodine and chlorine are $\text{I}_2(\text{s})$ and $\text{Cl}_2(\text{g})$, the standard enthalpy of formation for $\text{ICl}(\text{g})$ is:

- (A) $+16.8 \text{ kJ mol}^{-1}$
- (B) $+244.8 \text{ kJ mol}^{-1}$
- (C) $-14.6 \text{ kJ mol}^{-1}$
- (D) $-16.8 \text{ kJ mol}^{-1}$

Q49. What is the equilibrium constant if ATP hydrolysis by water produces a standard free energy of -50 kJ mol^{-1} under normal body conditions?

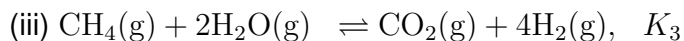
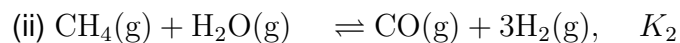
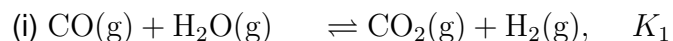
- (A) 2.66×10^8

(B) 5.81×10^8

(C) 1.18×10^7

(D) 1.98×10^8

Q50. For the following three reactions a , b and c , equilibrium constants are given:



The correct relation between K_1 , K_2 and K_3 is:

(A) $K_1\sqrt{K_2} = K_3$

(B) $K_2K_3 = K_1$

(C) $K_3 = K_1K_2$

(D) $K_3K_2^2 = K_1^2$



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My Performance Tracker

- Questions I found **easy**:

- Questions I found **tough**:

- One concept to revise:

Confidence Rating:

- ☐ Fully confident ☐ Partly confident ☐ Guessed the answer

2) Challenge Your Parent / Friend

Pick **any 3 questions** from this paper and ask your parent/sibling/friend to solve them.

Q. No.	Solved? (Y/N)	Time Taken	Who explained better?

3) Teacher's Corner

Teachers can reuse this paper for continued learning:

- Select 5 questions for a **weekly quiz**.
- Discuss the **most missed** question in class.
- Post one “**Question of the Week**” on the noticeboard.

4) Next Steps for Students

- File this paper in your **ScienceX Portfolio**. Reattempt it in **2 weeks** and compare scores.
- Submit your best written explanation (any one question) to your teacher or ScienceX.
- Top student explanations may feature in the **ScienceX Young Innovators Journal**.