

# SCO INTERNATIONAL OLYMPIAD

## CLASS 12 CHEMISTRY

SCO International Chemistry Olympiad

SAMPLE QUESTION PAPER

Reference Edition 2025 - 26

Ready academic Word document

Designed from the attached SCO cover-page format and the Class 12 Chemistry Olympiad pathway.

- Professional, editable Word structure for website PDF conversion and student download.
- Aligned to physical, inorganic, organic, biomolecular, polymer and everyday chemistry learning.
- Compact question labels, well-spaced answer explanations, and diagrams placed inside question blocks.

Solutions	Electrochemistry	Kinetics	Coordination	Biomolecules
Solid State	p / d / f Blocks	Polymers	Everyday Chemistry	Achievers

<b>Exam Name</b>	SCO International Chemistry Olympiad
<b>Class / Grade</b>	Class 12
<b>Question Paper Set</b>	H
<b>Pattern</b>	50 MCQs   60 minutes   Single correct answer   Achievers questions carry higher weight

### Candidate Instructions

- Read each question carefully. Only one option is correct unless clearly stated otherwise.
- Use an HB pencil or blue/black pen for OMR-style marking when printed.
- Calculators are not required unless permitted by the school/invigilator.
- All passages, data tables and diagrams are part of the corresponding question block.
- This document includes answer keys and explanations for academic review and website-ready publication.

**Q1. Which crystal defect is produced when a smaller ion leaves its normal site and occupies an interstitial site?**

- A. Schottky defect
- B. Frenkel defect
- C. Vacancy defect
- D. Metal excess defect

**Answer: B**

**Explanation:** In a Frenkel defect, an ion, usually a smaller cation, moves from its regular lattice site to an interstitial position.

**Q2. A solution contains 9.0 g glucose ( $C_6H_{12}O_6$ ) in 500 g water. What is its molality? (Molar mass =  $180\text{ g mol}^{-1}$ )**

- A. 0.05 m
- B. 0.10 m
- C. 0.20 m
- D. 0.50 m

**Answer: B**

**Explanation:** Moles =  $9/180 = 0.05$  mol. Solvent mass = 0.500 kg. Molality =  $0.05/0.500 = 0.10$  m.

**Q3. Which colligative property is most useful for determining molar mass of biomolecules without heating them?**

- A. Elevation in boiling point
- B. Depression in freezing point
- C. Osmotic pressure
- D. Relative lowering of vapour pressure only

**Answer: C**

**Explanation:** Osmotic pressure is measurable even for dilute solutions at ordinary temperatures, making it suitable for biomolecules.

**Q4. The conductance of an electrolytic solution increases on dilution mainly because:**

- A. Number of ions per unit volume increases
- B. Ion mobility generally increases
- C. Temperature always falls
- D. Solvent molecules become ions

**Answer: B**

**Explanation:** Dilution reduces interionic attractions, so ionic mobility increases, although concentration per unit volume decreases.

**Q5. Which cell converts chemical energy directly into electrical energy?**

- A. Electrolytic cell
- B. Galvanic cell
- C. Photochemical cell only
- D. Calorimeter

**Answer: B**

**Explanation:** A galvanic cell uses a spontaneous redox reaction to produce electrical energy.

**Q6. For a zero-order reaction, the rate is:**

- A. Independent of concentration
- B. Proportional to concentration
- C. Proportional to square of concentration
- D. Inversely proportional to concentration

**Answer: A**

**Explanation:** In a zero-order reaction, rate =  $k[A]^0 = k$ , so it is independent of reactant concentration.

**Q7. Which factor does NOT usually affect the rate of a chemical reaction?**

- A. Temperature
- B. Catalyst
- C. Nature of reactants
- D. Colour of the container alone

**Answer: D**

**Explanation:** Colour of the container alone is not a general kinetic factor unless it changes light absorption in photochemical reactions.

**Q8. Which type of colloid is represented by fog?**

- A. Solid in gas
- B. Liquid in gas
- C. Gas in liquid
- D. Liquid in solid

**Answer: B**

**Explanation:** Fog consists of tiny liquid water droplets dispersed in air.

**Q9. Which method is used for refining semiconductors like silicon and germanium?**

- A. Froth flotation
- B. Zone refining
- C. Liqutation
- D. Hydraulic washing

**Answer: B**

**Explanation:** Zone refining is used when extremely high purity is required, such as in semiconductor materials.

**Q10. Which element of group 17 has the highest electronegativity?**

- A. Fluorine
- B. Chlorine
- C. Bromine
- D. Iodine

**Answer: A**

**Explanation:** Fluorine is the most electronegative element.

**Q11. The variable oxidation states of transition metals are mainly due to:**

- A. Availability of only s electrons
- B. Small energy difference between  $(n-1)d$  and  $ns$  orbitals
- C. Absence of d orbitals
- D. Complete filling of f orbitals

**Answer: B**

**Explanation:** The  $ns$  and  $(n-1)d$  orbitals are close in energy, so different numbers of electrons can participate in bonding.

**Q12. Which ligand is bidentate?**

- A.  $NH_3$
- B.  $Cl^-$

- C. en (ethylenediamine)
- D. H<sub>2</sub>O

**Answer: C**

**Explanation:** Ethylenediamine has two donor nitrogen atoms and can attach through both, making it bidentate.

**Q13. Which complex ion is tetrahedral?**

- A. [Ni(CN)<sub>4</sub>]<sup>2-</sup>
- B. [NiCl<sub>4</sub>]<sup>2-</sup>
- C. [Co(NH<sub>3</sub>)<sub>6</sub>]<sup>3+</sup>
- D. [Fe(CN)<sub>6</sub>]<sup>4-</sup>

**Answer: B**

**Explanation:** [NiCl<sub>4</sub>]<sup>2-</sup> is generally tetrahedral with weak-field chloride ligands.

**Q14. The C–X bond in haloalkanes becomes weaker in the order:**

- A. C–F > C–Cl > C–Br > C–I
- B. C–I > C–Br > C–Cl > C–F
- C. C–Cl > C–F > C–I > C–Br
- D. All equal

**Answer: A**

**Explanation:** C–F is strongest and C–I is weakest due to increasing bond length down the halogen group.

**Q15. Which alcohol is oxidized to a ketone?**

- A. Primary alcohol
- B. Secondary alcohol
- C. Tertiary alcohol
- D. Phenol only

**Answer: B**

**Explanation:** Secondary alcohols oxidize to ketones under suitable oxidizing conditions.

**Q16. Which reagent converts an aldehyde to a carboxylic acid?**

- A. LiAlH<sub>4</sub>
- B. NaBH<sub>4</sub>
- C. Acidified KMnO<sub>4</sub>
- D. Dry ether only

**Answer: C**

**Explanation:** Acidified KMnO<sub>4</sub> is a strong oxidizing agent and oxidizes aldehydes to carboxylic acids.

**Q17. Which compound is most basic?**

- A. Aniline
- B. p-Nitroaniline
- C. Methylamine
- D. Acetanilide

**Answer: C**

**Explanation:** Methylamine has an electron-releasing alkyl group and no resonance withdrawal of the nitrogen lone pair.

**Q18. Which vitamin deficiency causes scurvy?**

- A. Vitamin A
- B. Vitamin B<sub>12</sub>
- C. Vitamin C
- D. Vitamin D

**Answer: C**

**Explanation:** Deficiency of vitamin C causes scurvy due to impaired collagen formation.

**Q19. Which polymer is used for non-stick cookware coating?**

- A. PVC
- B. Teflon
- C. Nylon-6
- D. Bakelite

**Answer: B**

**Explanation:** Teflon (PTFE) has very low friction and high chemical resistance, making it useful for non-stick coatings.

**Q20. Antacids are used to:**

- A. Kill bacteria
- B. Neutralize excess stomach acid
- C. Increase blood glucose
- D. Act as detergents

**Answer: B**

**Explanation:** Antacids are basic substances that neutralize excess gastric acid and provide relief from acidity.

**Q21. Which unit cell has atoms at corners and at the center of each face?**

- A. Simple cubic
- B. Body-centred cubic
- C. Face-centred cubic
- D. Primitive tetragonal only

**Answer: C**

**Explanation:** A face-centred cubic cell has atoms at all corners and at the centers of all six faces.

**Q22. If a solute associates in solution, its observed molar mass compared with normal molar mass is generally:**

- A. Lower
- B. Higher
- C. Zero
- D. Unchanged always

**Answer: B**

**Explanation:** Association reduces the number of particles in solution, so colligative effect decreases and observed molar mass appears higher.

**Q23. In electrolysis of molten NaCl, sodium is deposited at:**

- A. Anode
- B. Cathode
- C. Salt bridge
- D. Platinum wire only

**Answer: B**

**Explanation:** Na<sup>+</sup> gains electrons at the cathode to form sodium metal.

**Q24. Which expression is correct for the integrated rate law of a first-order reaction?**

- A.  $[A] = [A]_0 - kt$
- B.  $\ln[A] = \ln[A]_0 - kt$
- C.  $\text{rate} = k[A]^2$
- D.  $t_{1/2} = [A]_0/2k$

**Answer: B**

**Explanation:** For a first-order reaction,  $\ln[A] = \ln[A]_0 - kt$ .

**Q25. Emulsions are colloids in which:**

- A. Gas is dispersed in gas
- B. Liquid is dispersed in liquid
- C. Solid is dispersed in gas
- D. Solid is dispersed in solid

**Answer: B**

**Explanation:** An emulsion is a colloidal system of one liquid dispersed in another immiscible liquid.

**Q26. The chief ore of aluminium is:**

- A. Haematite
- B. Bauxite
- C. Calamine
- D. Galena

**Answer: B**

**Explanation:** Bauxite is the principal ore used for extraction of aluminium.

**Q27. Which oxide is amphoteric?**

- A.  $\text{Na}_2\text{O}$
- B.  $\text{MgO}$
- C.  $\text{Al}_2\text{O}_3$
- D.  $\text{SO}_3$

**Answer: C**

**Explanation:** Aluminium oxide reacts with both acids and bases, so it is amphoteric.

**Q28. Which ion has a  $3d^5$  electronic configuration?**

- A.  $\text{Fe}^{2+}$
- B.  $\text{Fe}^{3+}$
- C.  $\text{Cu}^{2+}$
- D.  $\text{Zn}^{2+}$

**Answer: B**

**Explanation:** Fe has configuration  $[\text{Ar}]3d^64s^2$ .  $\text{Fe}^{3+}$  loses two 4s electrons and one 3d electron, giving  $[\text{Ar}]3d^5$ .

**Q29. Which isomerism is shown by  $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{SO}_4$  and  $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Br}$ ?**

- A. Ionization isomerism
- B. Linkage isomerism
- C. Geometrical isomerism
- D. Optical isomerism

**Answer: A**

**Explanation:** These compounds release different ions in solution, so they show ionization isomerism.

**Q30. Which haloalkane undergoes SN1 most readily?**

- A. Methyl chloride
- B. Ethyl chloride
- C. tert-Butyl chloride
- D. Chlorobenzene

**Answer: C**

**Explanation:** SN1 reactions are favoured by stable carbocation formation; tert-butyl chloride forms a stable tertiary carbocation.

## Section B — Assertion and Reason

**Q31. Assertion: Molarity changes with temperature. Reason: Molarity depends on volume of solution, and volume changes with temperature.**

- A. Both true and Reason explains Assertion
- B. Both true but Reason does not explain Assertion
- C. Assertion true, Reason false
- D. Assertion false, Reason true

**Answer: A**

**Explanation:** Molarity is moles per litre of solution; the volume of solution varies with temperature.

**Q32. Assertion: Inert gases at constant volume do not change equilibrium composition for a gas reaction. Reason: At constant volume, partial pressures of reacting gases remain unchanged.**

- A. Both true and Reason explains Assertion
- B. Both true but Reason does not explain Assertion
- C. Assertion true, Reason false
- D. Assertion false, Reason true

**Answer: A**

**Explanation:** Adding inert gas at constant volume changes total pressure but not the partial pressures of reacting gases.

**Q33. Assertion: Aldehydes are generally more reactive than ketones toward nucleophilic addition. Reason: Aldehydes usually have less steric hindrance and less +I effect.**

- A. Both true and Reason explains Assertion
- B. Both true but Reason does not explain Assertion
- C. Assertion true, Reason false
- D. Assertion false, Reason true

**Answer: A**

**Explanation:** Aldehydes are less hindered and their carbonyl carbon is more electrophilic than in many ketones.

**Q34. Assertion: Transition metals form alloys easily. Reason: Their atomic sizes are often similar.**

- A. Both true and Reason explains Assertion
- B. Both true but Reason does not explain Assertion
- C. Assertion true, Reason false
- D. Assertion false, Reason true

**Answer: A**

**Explanation:** Similar atomic sizes allow transition metal atoms to substitute for one another in metallic lattices.

**Q35. Assertion: Soaps do not lather well in hard water. Reason: Calcium and magnesium ions form insoluble salts with soap.**

- A. Both true and Reason explains Assertion
- B. Both true but Reason does not explain Assertion
- C. Assertion true, Reason false
- D. Assertion false, Reason true

**Answer: A**

**Explanation:** Hard water ions form scum with soap, reducing lathering ability.

**Q36. Assertion: Enzymes are highly specific catalysts. Reason: Their active sites have shape and chemical features suited to particular substrates.**

- A. Both true and Reason explains Assertion
- B. Both true but Reason does not explain Assertion
- C. Assertion true, Reason false
- D. Assertion false, Reason true

**Answer: A**

**Explanation:** Enzyme specificity arises from the interaction between substrate and active site.

**Q37. Assertion: The pH of pure water is always exactly 7 at every temperature. Reason:  $K_w$  changes with temperature.**

- A. Both true and Reason explains Assertion
- B. Both true but Reason does not explain Assertion
- C. Assertion true, Reason false
- D. Assertion false, Reason true

**Answer: D**

**Explanation:** The pH of neutral water changes with temperature because  $K_w$  changes; therefore the assertion is false and the reason is true.

**Q38. Assertion: A galvanic cell becomes dead at equilibrium. Reason: At equilibrium,  $E_{cell}$  becomes zero.**

- A. Both true and Reason explains Assertion
- B. Both true but Reason does not explain Assertion
- C. Assertion true, Reason false
- D. Assertion false, Reason true

**Answer: A**

**Explanation:** At equilibrium,  $\Delta G = 0$  and  $E_{cell} = 0$ , so the cell can no longer do electrical work.

**Q39. Assertion: Glycine is an amino acid. Reason: Amino acids contain both amino and carboxyl functional groups.**

- A. Both true and Reason explains Assertion
- B. Both true but Reason does not explain Assertion
- C. Assertion true, Reason false
- D. Assertion false, Reason true

**Answer: A**

**Explanation:** Glycine contains  $-NH_2$  and  $-COOH$  groups, so it is an amino acid.

**Q40. Assertion: Addition polymers form without elimination of small molecules. Reason: Monomers add across multiple bonds or reactive centres.**

- A. Both true and Reason explains Assertion
- B. Both true but Reason does not explain Assertion
- C. Assertion true, Reason false
- D. Assertion false, Reason true

**Answer: A**

**Explanation:** In addition polymerization, monomers link directly; no small molecule such as water is eliminated.

## Section C — Case Study Questions

**Q41. Case: A salt solution has molar conductivity that increases on dilution. What is the most suitable explanation?**

- A. Ions become less mobile
- B. Interionic interactions reduce and ions move more freely
- C. All ions become neutral atoms
- D. The solvent disappears

**Answer: B**

**Explanation:** Dilution lowers interionic attraction, which increases ionic mobility and molar conductivity.

**Q42. Case: A coordination compound  $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$  has two geometrical forms. What is this isomerism called?**

- A. Optical isomerism only
- B. Cis-trans isomerism
- C. Ionization isomerism
- D. Hydrate isomerism

**Answer: B**

**Explanation:** Square planar  $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$  can have cis and trans arrangements of ligands.

**Q43. Case: An organic compound  $\text{C}_2\text{H}_5\text{Br}$  reacts with  $\text{OH}^-$  to give ethanol. What type of reaction occurs?**

- A. Nucleophilic substitution
- B. Electrophilic addition
- C. Free-radical substitution
- D. Esterification

**Answer: A**

**Explanation:** The hydroxide ion replaces bromide in bromoethane, so the reaction is nucleophilic substitution.

**Q44. Case: A food label lists benzoic acid as a preservative. Why is it used?**

- A. It acts as a fuel
- B. It inhibits microbial growth under suitable conditions
- C. It is a polymer
- D. It converts sugar to protein

**Answer: B**

**Explanation:** Benzoic acid and its salts are used as preservatives because they help inhibit microbial growth.

**Q45. Case: A student adds  $\text{AlCl}_3$  to a reaction and sees faster alkylation of benzene. What role does  $\text{AlCl}_3$  play?**

- A. Lewis acid catalyst
- B. Reducing agent
- C. Oxidizing agent only
- D. Solvent only

**Answer: A**

**Explanation:**  $\text{AlCl}_3$  accepts an electron pair and helps generate electrophilic species in Friedel-Crafts reactions.

### Section D — Achievers Section

**Q46. Achievers:** For a first-order reaction, 90% completion occurs in 230 s. Estimate  $k$ .

- A.  $0.005 \text{ s}^{-1}$
- B.  $0.010 \text{ s}^{-1}$
- C.  $0.020 \text{ s}^{-1}$
- D.  $0.100 \text{ s}^{-1}$

**Answer: B**

**Explanation:** For 90% completion,  $k = 2.303/t \log(100/10) = 2.303/230 \approx 0.010 \text{ s}^{-1}$ .

**Q47. Achievers:** A coordination complex has formula  $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl}$ . What is the oxidation state of Cr?

- A. +1
- B. +2
- C. +3
- D. +4

**Answer: C**

**Explanation:** The complex ion has charge +1 because one chloride counter ion is present. Water is neutral and two coordinated chloride ligands contribute  $-2$ , so  $x - 2 = +1$ ;  $x = +3$ .

**Q48. Achievers:** Which pair will give the highest boiling point elevation at equal molality assuming complete dissociation?

- A. Glucose
- B. NaCl
- C.  $\text{CaCl}_2$
- D. Urea

**Answer: C**

**Explanation:**  $\text{CaCl}_2$  dissociates into three ions, giving the largest van't Hoff factor among the options.

**Q49. Achievers:** Which is the correct increasing order of reactivity toward  $\text{SN}1$ ?

- A.  $3^\circ > 2^\circ > 1^\circ > \text{methyl}$
- B.  $\text{methyl} > 1^\circ > 2^\circ > 3^\circ$
- C.  $1^\circ > 2^\circ > 3^\circ > \text{methyl}$
- D. All equal

**Answer: A**

**Explanation:**  $\text{SN}1$  reactivity follows carbocation stability: tertiary > secondary > primary > methyl.

**Q50. Achievers:** If a polymer has repeat unit  $-\text{CH}_2-\text{CHCl}-$ , the monomer is:

- A. Ethene
- B. Vinyl chloride
- C. Styrene
- D. Tetrafluoroethene

**Answer: B**

**Explanation:** The repeat unit  $-\text{CH}_2-\text{CHCl}-$  comes from addition polymerization of vinyl chloride,  $\text{CH}_2=\text{CHCl}$ .

## Answer Key

Questions 1-10	Questions 11-20	Questions 21-30	Questions 31-40	Questions 41-50
1. B	11. B	21. C	31. A	41. B
2. B	12. C	22. B	32. A	42. B
3. C	13. B	23. B	33. A	43. A
4. B	14. A	24. B	34. A	44. B
5. B	15. B	25. B	35. A	45. A
6. A	16. C	26. B	36. A	46. B
7. D	17. C	27. C	37. D	47. C
8. B	18. C	28. B	38. A	48. C
9. B	19. B	29. A	39. A	49. A
10. A	20. B	30. C	40. A	50. B