

Time Allowed: 3 Hours

Maximum Marks: 80

CBSE Class 12 Chemistry Practice Examination Paper

CBSE Class 12 Chemistry Full Syllabus Practice Paper

Q1. What is the value of the van 't Hoff factor (i) for a dilute aqueous solution of potassium sulfate (K_2SO_4) assuming complete dissociation? [1 Mark]

- (a) 1
- (b) 2
- (c) 3
- (d) 4

Q2. Which of the following first-row transition metal ions exhibits the highest spin-only magnetic moment in its gaseous state? [1 Mark]

- (a) Mn^{2+}
- (b) Fe^{2+}
- (c) Co^{2+}
- (d) Ni^{2+}

Q3. For a first-order chemical reaction, if the rate constant k is $2.303 \times 10^{-3} s^{-1}$, what is the half-life period ($t_{1/2}$) of the reaction? [1 Mark]

- (a) 100 s
- (b) 300 s
- (c) 500 s
- (d) 1000 s

Q4. According to Crystal Field Theory, what is the electronic configuration of a d^4 ion in an octahedral crystal field when $\Delta_o < P$ (weak field ligand)? [1 Mark]

- (a) $t_{2g}^4 e_g^0$
- (b) $t_{2g}^3 e_g^1$
- (c) $t_{2g}^2 e_g^2$
- (d) $t_{2g}^0 e_g^4$

Q5. Which of the following alkyl halides undergoes SN_1 reaction at the fastest rate? [1 Mark]

- (a) Chlorobenzene
- (b) 1-Chloropropane
- (c) 2-Chloropropane
- (d) 2-Chloro-2-methylpropane

Q6. Which reagent is used in Hinsberg's test to distinguish between primary, secondary, and tertiary amines? [1 Mark]

- (a) Benzene sulfonyl chloride
- (b) Acetyl chloride
- (c) Nitrous acid
- (d) p-Toluenesulfonyl chloride only

Q7. Which structural level of proteins remains intact and unaffected during denaturation? [1 Mark]

- (a) Primary structure
- (b) Secondary structure
- (c) Tertiary structure
- (d) Quaternary structure

Time Allowed: 3 Hours

Maximum Marks: 80

Q8. Calculate the molarity of a solution containing 5.0 g of NaOH dissolved in enough water to prepare 450 mL of solution. [2 Marks]

Q9. Give reason for each of the following observations: [2 Marks]

- (a) Transition metals and their compounds exhibit excellent catalytic properties.
- (b) Zirconium (Zr) and Hafnium (Hf) exhibit almost identical atomic radii.

Q10. Arrange the following compounds in increasing order of their basic strength in aqueous medium with reasoning: [2 Marks]

(C₂H₅)NH₂, (C₂H₅)₂NH, (C₂H₅)₃N, NH₃

Q11. The resistance of a conductivity cell filled with 0.1 mol L⁻¹ KCl solution is 100 Ω. If the resistance of the same cell when filled with 0.02 mol L⁻¹ KCl solution is 520 Ω, calculate the conductivity and molar conductivity of 0.02 mol L⁻¹ KCl solution. (Given: Conductivity of 0.1 mol L⁻¹ KCl solution is 1.29 S m⁻¹). [3 Marks]

Q12. For the complex coordination compound [Fe(CN)₆]³⁻: [3 Marks]

- (a) Write the IUPAC name of the complex.
- (b) Predict its hybridization state and geometry.
- (c) State whether it is paramagnetic or diamagnetic, calculating its spin-only magnetic moment.

Q13. How will you convert the following? Write the chemical equations involved: [3 Marks]

- (a) Propene to Propan-1-ol
- (b) Phenol to Anisole
- (c) Propanone to Propene

Q14. An organic compound (A) with molecular formula C₈H₈O forms an orange-red precipitate with 2,4-DNP reagent and gives a yellow precipitate of iodoform when heated with NaOH and I₂. Compound (A) neither reduces Tollens' reagent nor Fehling's solution, and it does not decolorize bromine water. On vigorous oxidation with chromic acid (H₂CrO₄), it yields a carboxylic acid (B) having molecular formula C₇H₆O₂. [5 Marks]

- (a) Identify compounds (A) and (B).
- (b) Write balanced chemical reactions for the 2,4-DNP test and Iodoform test given by compound (A).
- (c) Write the oxidation reaction converting compound (A) to compound (B).

Q15. Answer the following questions related to Chemical Kinetics: [5 Marks]

- (a) Derive/state the integrated rate law equation for a first-order reaction.
- (b) A first-order reaction takes 40 minutes for 30% decomposition. Calculate its half-life period (t_{1/2}). [Given: log 10 = 1, log 7 = 0.8451]

Time Allowed: 3 Hours

Maximum Marks: 80

Detailed Solutions & Marking Scheme

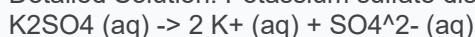
CBSE Class 12 Chemistry Full Syllabus Practice Paper

Q1. What is the value of the van 't Hoff factor (i) for a dilute aqueous solution of potassium sulfate (K_2SO_4) assuming complete dissociation? [1 Mark]

- (a) 1
- (b) 2
- (c) 3
- (d) 4

Correct Option / Answer: (c) 3

Detailed Solution: Potassium sulfate dissociates in aqueous solution as follows:



Since one molecule of K_2SO_4 yields a total of 3 ions (2 K^+ ions and 1 SO_4^{2-} ion) upon complete dissociation, the van 't Hoff factor $i = 3$.

Marking Scheme: 1 mark for selecting the correct option (c).

Q2. Which of the following first-row transition metal ions exhibits the highest spin-only magnetic moment in its gaseous state? [1 Mark]

- (a) Mn^{2+}
- (b) Fe^{2+}
- (c) Co^{2+}
- (d) Ni^{2+}

Correct Option / Answer: (a) Mn^{2+}

Detailed Solution: Electronic configurations and number of unpaired electrons (n):

Mn^{2+} ($3d^5$) $\rightarrow n = 5$ unpaired electrons

Fe^{2+} ($3d^6$) $\rightarrow n = 4$ unpaired electrons

Co^{2+} ($3d^7$) $\rightarrow n = 3$ unpaired electrons

Ni^{2+} ($3d^8$) $\rightarrow n = 2$ unpaired electrons

Spin-only magnetic moment $\mu = \sqrt{n(n+2)}$ BM. Since Mn^{2+} has maximum number of unpaired electrons ($n = 5$), it exhibits the highest spin-only magnetic moment (5.92 BM).

Marking Scheme: 1 mark for correct option selection.

Q3. For a first-order chemical reaction, if the rate constant k is $2.303 \times 10^{-3} s^{-1}$, what is the half-life period ($t_{1/2}$) of the reaction? [1 Mark]

- (a) 100 s
- (b) 300 s
- (c) 500 s
- (d) 1000 s

Correct Option / Answer: (b) 300 s

Detailed Solution: For a first-order reaction:

$$t_{1/2} = 0.693 / k$$

$$t_{1/2} = 0.693 / (2.303 \times 10^{-3} s^{-1}) = (2.303 \times 0.3010) / (2.303 \times 10^{-3}) = 301 s \approx 300 s.$$

Marking Scheme: 1 mark for correct answer calculation.

Q4. According to Crystal Field Theory, what is the electronic configuration of a d^4 ion in an octahedral crystal field when $\Delta_o < P$ (weak field ligand)? [1 Mark]

Time Allowed: 3 Hours**Maximum Marks: 80**

- (a) $t_{2g}^4 e_g^0$
- (b) $t_{2g}^3 e_g^1$
- (c) $t_{2g}^2 e_g^2$
- (d) $t_{2g}^0 e_g^4$

Correct Option / Answer: (b) $t_{2g}^3 e_g^1$

Detailed Solution: When $\Delta_o < P$, the crystal field splitting energy is less than the pairing energy (weak field ligand limit). Pairing of electrons requires more energy than jumping to the e_g orbital. Therefore, high-spin configuration results, where electrons enter e_g orbitals individually before pairing occurs in t_{2g} orbitals. Thus, d_4 gives $t_{2g}^3 e_g^1$ configuration.

Marking Scheme: 1 mark for correct option selection.

Q5. Which of the following alkyl halides undergoes S_N1 reaction at the fastest rate? [1 Mark]

- (a) Chlorobenzene
- (b) 1-Chloropropane
- (c) 2-Chloropropane
- (d) 2-Chloro-2-methylpropane

Correct Option / Answer: (d) 2-Chloro-2-methylpropane

Detailed Solution: S_N1 reactions proceed via a carbocation intermediate. The order of carbocation stability is $3^\circ > 2^\circ > 1^\circ > \text{aryl}$. 2-Chloro-2-methylpropane generates a tertiary carbocation (tert-butyl cation), which is exceptionally stable due to hyperconjugation and inductive effects, thereby reacting fastest via S_N1 mechanism.

Marking Scheme: 1 mark for correct option.

Q6. Which reagent is used in Hinsberg's test to distinguish between primary, secondary, and tertiary amines? [1 Mark]

- (a) Benzene sulfonyl chloride
- (b) Acetyl chloride
- (c) Nitrous acid
- (d) p-Toluenesulfonyl chloride only

Correct Option / Answer: (a) Benzene sulfonyl chloride

Detailed Solution: Hinsberg's reagent is benzene sulfonyl chloride ($C_6H_5SO_2Cl$). Primary amines react to form a sulfonamide soluble in alkali; secondary amines form a product insoluble in alkali; tertiary amines do not react at room temperature.

Marking Scheme: 1 mark for correct identification of the reagent.

Q7. Which structural level of proteins remains intact and unaffected during denaturation? [1 Mark]

- (a) Primary structure
- (b) Secondary structure
- (c) Tertiary structure
- (d) Quaternary structure

Correct Option / Answer: (a) Primary structure

Detailed Solution: During denaturation of proteins by heat, pH change, or chemical reagents, secondary, tertiary, and quaternary structures are disrupted due to the cleavage of hydrogen bonds and non-covalent forces. However, covalent peptide bonds forming the primary structure remain intact.

Marking Scheme: 1 mark for correct option selection.

Time Allowed: 3 Hours

Maximum Marks: 80

Q8. Calculate the molarity of a solution containing 5.0 g of NaOH dissolved in enough water to prepare 450 mL of solution. [2 Marks]

Correct Option / Answer: Molarity = 0.278 M (or mol/L)

Detailed Solution:

1. Molar mass of NaOH = 23 + 16 + 1 = 40 g/mol.
2. Moles of NaOH = Mass / Molar mass = 5.0 g / 40 g/mol = 0.125 mol.
3. Volume of solution in liters = 450 mL / 1000 = 0.450 L.
4. Molarity (M) = Moles of solute / Volume of solution in L = 0.125 mol / 0.450 L = 0.278 M.

Marking Scheme:

- Calculation of moles (0.125 mol): 1 mark
- Calculation of molarity with correct units (0.278 M): 1 mark

Q9. Give reason for each of the following observations: [2 Marks]

(a) Transition metals and their compounds exhibit excellent catalytic properties.

(b) Zirconium (Zr) and Hafnium (Hf) exhibit almost identical atomic radii.

Correct Option / Answer: Detailed explanations provided below.

Detailed Solution:

- (a) Transition metals act as good catalysts because: (i) They possess variable oxidation states allowing them to form reactive intermediates, and (ii) They provide a large surface area for adsorption of reactant molecules.
- (b) Zr (4d series) and Hf (5d series) have almost identical atomic radii (160 pm and 159 pm) due to Lanthanoid Contraction—the poor shielding effect of 4f electrons preceding Hf, which counteracts the normal size increase down the group.

Marking Scheme:

- 1 mark for explaining catalytic behavior (variable oxidation state / surface area).
- 1 mark for attributing atomic radii similarity to Lanthanoid Contraction.

Q10. Arrange the following compounds in increasing order of their basic strength in aqueous medium with reasoning: [2 Marks]

(C₂H₅)NH₂, (C₂H₅)₂NH, (C₂H₅)₃N, NH₃

Correct Option / Answer: NH₃ < (C₂H₅)₃N < C₂H₅NH₂ < (C₂H₅)₂NH

Detailed Solution: In aqueous solution, basic strength of substituted ethyl amines depends on three factors: inductive effect (+I effect), steric hindrance, and hydration energy of the conjugate acid.

Due to the combination of these three factors, the order of basicity for ethyl substituted amines in aqueous solution is:

Secondary (2°) > Primary (1°) > Tertiary (3°) > Ammonia (NH₃).

Hence: NH₃ < (C₂H₅)₃N < C₂H₅NH₂ < (C₂H₅)₂NH.

Marking Scheme:

- 1 mark for correct increasing order.
- 1 mark for mentioning the combined effect of +I effect, steric hindrance, and hydration enthalpy.

Q11. The resistance of a conductivity cell filled with 0.1 mol L⁻¹ KCl solution is 100 Ω. If the resistance of the same cell when filled with 0.02 mol L⁻¹ KCl solution is 520 Ω, calculate the conductivity and molar conductivity of 0.02 mol L⁻¹ KCl solution. (Given: Conductivity of 0.1 mol L⁻¹ KCl solution is 1.29 S m⁻¹). [3 Marks]

Correct Option / Answer: Conductivity (κ) = 0.248 S m⁻¹; Molar conductivity (Λ_m) = 0.0124 S m² mol⁻¹ (or 124 S cm² mol⁻¹)

Detailed Solution:

Time Allowed: 3 Hours

Maximum Marks: 80

1. Find Cell Constant (G^*):

Cell constant (G^*) = Conductivity (κ) x Resistance (R)

$$G^* = 1.29 \text{ S m}^{-1} \times 100 \Omega = 129 \text{ m}^{-1}.$$

2. Calculate Conductivity (κ) of 0.02 mol L^{-1} KCl:

$$\kappa = \text{Cell constant} / R = 129 \text{ m}^{-1} / 520 \Omega = 0.248 \text{ S m}^{-1}.$$

3. Calculate Molar Conductivity (Λ_m):

$$\text{Concentration } C = 0.02 \text{ mol L}^{-1} = 0.02 \times 1000 \text{ mol m}^{-3} = 20 \text{ mol m}^{-3}.$$

$$\Lambda_m = \kappa / C = 0.248 \text{ S m}^{-1} / 20 \text{ mol m}^{-3} = 0.0124 \text{ S m}^2 \text{ mol}^{-1}.$$

Marking Scheme:

- Calculation of cell constant (129 m^{-1}): 1 mark
- Calculation of conductivity (0.248 S m^{-1}): 1 mark
- Calculation of molar conductivity with correct units ($0.0124 \text{ S m}^2 \text{ mol}^{-1}$): 1 mark

Q12. For the complex coordination compound $[\text{Fe}(\text{CN})_6]^{3-}$: [3 Marks]

(a) Write the IUPAC name of the complex.

(b) Predict its hybridization state and geometry.

(c) State whether it is paramagnetic or diamagnetic, calculating its spin-only magnetic moment.

Correct Option / Answer:

(a) Hexacyanidoferrate(III) ion

(b) Hybridization: d^2sp^3 , Geometry: Octahedral

(c) Paramagnetic; $\mu = 1.73 \text{ BM}$

Detailed Solution:

(a) IUPAC Name: Hexacyanidoferrate(III) ion.

(b) Oxidation state of Fe in $[\text{Fe}(\text{CN})_6]^{3-}$: $x + 6(-1) = -3 \Rightarrow x = +3$.

Fe^{3+} has electronic configuration $3d^5$. CN^- is a strong field ligand, forcing pairing of electrons in $3d$ subshell: $t_{2g}^5 e_g^0$.

Two $3d$ orbitals, one $4s$, and three $4p$ orbitals hybridize to form d^2sp^3 hybrid orbitals. Geometry is octahedral (inner orbital complex).

(c) The complex has 1 unpaired electron ($n = 1$). Hence, it is paramagnetic.

Spin-only magnetic moment $\mu = \sqrt{1(1+2)} = \sqrt{3} = 1.73 \text{ BM}$.

Marking Scheme:

- 1 mark for correct IUPAC name.
- 1 mark for hybridization (d^2sp^3) and geometry (octahedral).
- 1 mark for paramagnetic nature and calculated magnetic moment (1.73 BM).

Q13. How will you convert the following? Write the chemical equations involved: [3 Marks]

(a) Propene to Propan-1-ol

(b) Phenol to Anisole

(c) Propanone to Propene

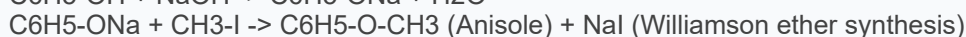
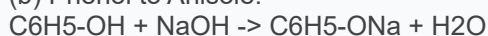
Correct Option / Answer: Detailed step-by-step reaction pathways provided below.

Detailed Solution:

(a) Propene to Propan-1-ol (Hydroboration-Oxidation):



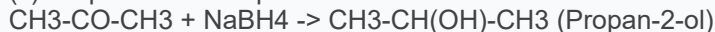
(b) Phenol to Anisole:



Time Allowed: 3 Hours

Maximum Marks: 80

(c) Propanone to Propene:



Marking Scheme:

- 1 mark for correct reaction steps and reagents for (a).
- 1 mark for correct reaction steps and reagents for (b).
- 1 mark for correct reaction steps and reagents for (c).

Q14. An organic compound (A) with molecular formula C₈H₈O forms an orange-red precipitate with 2,4-DNP reagent and gives a yellow precipitate of iodoform when heated with NaOH and I₂. Compound (A) neither reduces Tollens' reagent nor Fehling's solution, and it does not decolorize bromine water. On vigorous oxidation with chromic acid (H₂CrO₄), it yields a carboxylic acid (B) having molecular formula C₇H₆O₂. [5 Marks]

(a) Identify compounds (A) and (B).

(b) Write balanced chemical reactions for the 2,4-DNP test and Iodoform test given by compound (A).

(c) Write the oxidation reaction converting compound (A) to compound (B).

Correct Option / Answer:

(a) Compound (A) = Acetophenone (C₆H₅COCH₃), Compound (B) = Benzoic acid (C₆H₅COOH).

Detailed Solution:

Reasoning:

- Forms orange-red precipitate with 2,4-DNP => Contains a carbonyl group (C=O).
- Gives positive iodoform test => Contains a methyl ketone group (-COCH₃).
- Does not reduce Tollens'/Fehling's reagent => It is a ketone, not an aldehyde.
- Unreactive towards bromine water => Aromatic ring present with no non-aromatic C=C double bonds.
- Formula C₈H₈O with -COCH₃ group leaves C₆H₅- => Compound (A) is Acetophenone (C₆H₅COCH₃).
- Vigorous oxidation of Acetophenone gives Benzoic acid (C₆H₅COOH, C₇H₆O₂), which is compound (B).

Chemical Reactions:

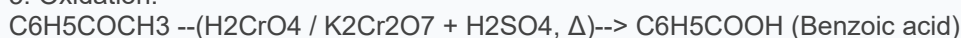
1. 2,4-DNP Test:



2. Iodoform Test:



3. Oxidation:



Marking Scheme:

- 1 mark each for correct identification of (A) and (B).
- 1 mark for 2,4-DNP reaction equation.
- 1 mark for Iodoform reaction equation.
- 1 mark for Oxidation reaction equation.

Q15. Answer the following questions related to Chemical Kinetics: [5 Marks]

(a) Derive/state the integrated rate law equation for a first-order reaction.

(b) A first-order reaction takes 40 minutes for 30% decomposition. Calculate its half-life period (t_{1/2}). [Given: log 10 = 1, log 7 = 0.8451]

Correct Option / Answer:

(a) $k = (2.303 / t) * \log([R]_0 / [R])$

(b) $t_{1/2} = 77.7 \text{ minutes}$

Detailed Solution:

Time Allowed: 3 Hours**Maximum Marks: 80**

(a) Integrated Rate Law for First-Order Reaction:

Let reaction be $R \rightarrow P$.

$$\text{Rate} = -\frac{d[R]}{dt} = k[R]$$

$$\frac{d[R]}{[R]} = -k dt$$

Integrating both sides: $\ln[R] = -kt + I$

$$\text{At } t = 0, [R] = [R]_0 \Rightarrow I = \ln[R]_0$$

$$\ln[R] = -kt + \ln[R]_0 \Rightarrow kt = \ln([R]_0 / [R])$$

$$k = (2.303 / t) * \log([R]_0 / [R])$$

(b) Calculation of half-life:

Let initial concentration $[R]_0 = 100$.

After 30% decomposition at $t = 40$ min, remaining concentration $[R] = 100 - 30 = 70$.

Using rate equation:

$$k = (2.303 / 40) * \log(100 / 70)$$

$$k = (2.303 / 40) * (\log 10 - \log 7)$$

$$k = (2.303 / 40) * (1 - 0.8451) = (2.303 / 40) * 0.1549 = 0.00892 \text{ min}^{-1}.$$

Now, calculating $t_{1/2}$:

$$t_{1/2} = 0.693 / k = 0.693 / 0.00892 \text{ min}^{-1} = 77.69 \text{ min} \approx 77.7 \text{ min}.$$

Marking Scheme:

- 2 marks for integrated rate law derivation/statement.
- 1.5 marks for correct rate constant (k) calculation.
- 1.5 marks for correct half-life ($t_{1/2}$) calculation with units.

DISCLAIMER & TERMS OF SERVICE

1. AI Limitations & Liability: This practice paper and its solutions are generated dynamically using Artificial Intelligence. While every effort is made to ensure accuracy, AI can make mistakes. Jayna Technologies assumes no responsibility, liability, or warranty for any errors, omissions, or academic consequences arising from the use of this material.

2. Refund Policy: By proceeding with the purchase, you acknowledge that this is an instant digital delivery service. Once the payment is successfully completed, no refunds, cancellations, or chargebacks will be entertained under any circumstances.

3. Legal Jurisdiction: Any claims, disputes, or legal proceedings arising out of or in connection with this service shall be subject to the exclusive jurisdiction of the competent courts located in Roorkee, Uttarakhand, India.