JEE Main Chemistry Sample Paper-5

Duration: 1 Hour   **Maximum Marks: 100**


> ### Instructions
>
> - This paper contains TWO sections: **Section A** (MCQs) and **Section B** (Numerical).
>
> - Section A contains 20 Multiple Choice Questions.
>
> - Section B contains 5 Numerical Value Questions.
>
> - Each correct answer carries **+4 marks**.
>
> - Each incorrect answer carries **-1 mark**.
>
> - No negative marking for unattempted questions.

Section A — Multiple Choice Questions

Q1. Which of the following is the correct order of increasing field strength of ligands in the spectrochemical series?   [JEE Main 2024]

(A) $Cl^- < F^- < C_2O_4^{2-} < CN^-$

(B) $CN^- < C_2O_4^{2-} < F^- < Cl^-$

(C) $F^- < Cl^- < CN^- < C_2O_4^{2-}$

(D) $C_2O_4^{2-} < F^- < Cl^- < CN^-$

Q2. The major product P of the reaction

$$\text{Anisole} \xrightarrow{\text{HI, } \Delta} P$$
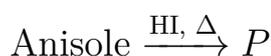
is: [JEE Main 2023]

(A) Phenol + Methyl iodide

(B) Iodobenzene + Methanol

(C) Phenol + Methanol

(D) Iodobenzene + Methyl iodide

Q3. Which of the following is a "Polar Molecular Solid"?   [JEE Main 2022]

(A) HCl

(B) Ar

(C) H_2O (Ice)

(D) CCl_4

Q4. For a cell reaction $Cu(s) + 2Ag^+(aq) \rightarrow Cu^{2+}(aq) + 2Ag(s)$, the log of the equilibrium constant $\log K_c$ is given by: [JEE Main 2025]

(A) $\frac{nE^\circ_{cell}}{0.059}$

(B) $\frac{E^\circ_{cell}}{0.059}$

(C) $\frac{0.059}{nE^\circ_{cell}}$

(D) $\frac{nFE^\circ_{cell}}{RT}$

Q5. Which of the following oxides of Nitrogen is a blue solid and acidic in nature? [JEE Main 2024]

(A) N_2O_3

(B) N_2O

(C) NO_2

(D) N_2O_5

Q6. The S_N1 reaction of (R)-2-bromooctane with OH^- ions gives: [JEE Main 2021]

(A) (S)-octan-2-ol with partial racemization

(B) (R)-octan-2-ol with complete inversion

(C) (S)-octan-2-ol with 100% inversion

(D) A $1:1$ mixture of (R) and (S) octan-2-ol

Q7. Which of the following hormones contains Iodine? [JEE Main 2023]

(A) Thyroxine

(B) Insulin

(C) Adrenaline

(D) Testosterone

Q8. The calculated spin-only magnetic moment of Cr^{2+} ion is: [JEE Main 2022]

(A) 4.90 BM

(B) 3.87 BM

(C) 5.92 BM

(D) 2.84 BM

Q9. The IUPAC name of the compound $CH_3 - CH(Cl) - CH(Br) - CH_3$ is:
[JEE Main 2025]

(A) 2-bromo-3-chlorobutane

(B) 3-bromo-2-chlorobutane

(C) 2-chloro-3-bromobutane

(D) 1-bromo-2-chlorobutane

Q10. Which of the following will show the highest osmotic pressure? [JEE Main 2024]

(A) 0.1 M Na_2SO_4

(B) 0.1 M Glucose

(C) 0.1 M $MgCl_2$

(D) 0.1 M $Al_2(SO_4)_3$

Q11. In the presence of a catalyst, the activation energy of a reaction: [JEE Main 2021]

(A) Decreases

(B) Increases

(C) Remains the same

(D) Becomes zero

Q12. Which of the following is not a condensation polymer? [JEE Main 2023]

(A) Neoprene

(B) Melamine

(C) Glyptal

(D) Dacron

Q13. The most acidic hydrogen among the following is present in: [JEE Main 2022]

(A) Ethyne

(B) Ethene

(C) Ethane

(D) Benzene

Q14. The molar conductivity of a 0.05 M solution of $MgCl_2$ is 190 S cm^2 mol^{-1}. Its conductivity (κ) is: [JEE Main 2025]

(A) 0.0095 S cm^{-1}

(B) 9.5 S cm^{-1}

(C) 0.095 S cm^{-1}

(D) 0.95 S cm^{-1}

Q15. Which of the following is a "Narrow spectrum" antibiotic? [JEE Main 2024]

(A) Penicillin G

(B) Chloramphenicol

(C) Vancomycin

(D) Ofloxacin

Q16. The shape of XeF_4 is: [JEE Main 2021]

(A) Square planar

(B) Tetrahedral

(C) Octahedral

(D) Pyramidal

Q17. Which reagent is used in the "Gattermann Reaction" for the synthesis of haloarenes? [JEE Main 2023]

(A) Cu powder / HCl

(B) Cu_2Cl_2/HCl

(C) $Cl_2/FeCl_3$

(D) $NaNO_2/HCl$

Q18. The process of converting an ore into its oxide by heating it strongly in the absence of air is: [JEE Main 2022]

(A) Calcination

(B) Roasting

(C) Smelting

(D) Refining

Q19. Gold number is a measure of: [JEE Main 2025]

(A) The protective power of a lyophilic colloid

(B) The purity of gold

(C) The coagulation power of an electrolyte

(D) The amount of gold in a solution

Q20. Benzoyl chloride on reduction with $H_2/Pd - BaSO_4$ gives: [JEE Main 2024]

(A) Benzaldehyde

(B) Benzyl alcohol

(C) Benzoic acid

(D) Toluene

Section B — Numerical Questions

Q21. For a cubic unit cell, the density is 10 g cm^{-3} and the edge length is 200 pm. If the atomic mass is 48 g mol^{-1}, the number of atoms per unit cell (Z) is: [JEE Main 2024]

Q22. A first-order reaction has a rate constant $k = 1.15 \times 10^{-3}$ s^{-1}. The time required for 5 g of this reactant to reduce to 3 g is x seconds. Find $x/100$ (Take $\log_{10} 1.67 = 0.22$). [JEE Main 2023]

Q23. The number of P–OH bonds in cyclic trimetaphosphoric acid $(HPO_3)_3$ is: [JEE Main 2025]

Q24. In the complex $[Co(en)_2(H_2O)_2]^{3+}$, the coordination number of Cobalt is: [JEE Main 2022]

Q25. The total number of sp^2 hybridized carbons in one molecule of Aspirin (Acetylsalicylic acid) is: [JEE Main 2024]

Detailed Solutions

Q1.

> ### Solution
>
> **Concept:** In spectrochemical series, ligand field strength increases from weak ligands to strong ligands.
>
> **Solution:** Among the given ligands, the increasing order of field strength is:
>
> $$Cl^- < F^- < C_2O_4^{2-} < CN^-$$
>
> since cyanide is a strong field ligand, while chloride is weak field.
>
> Final Answer: (A)
>
> **Answer: (A)**

Q2.

> ### Solution
>
> **Concept:** Aryl-alkyl ethers on heating with HI cleave at the alkyl-oxygen bond.
>
> **Solution:** Anisole is:
>
> $$C_6H_5OCH_3$$
>
> On treatment with HI and heat, cleavage occurs at the methyl side to give:
>
> $$C_6H_5OH + CH_3I$$
>
> Thus the major products are phenol and methyl iodide.
>
> Final Answer: (A)
>
> **Answer: (A)**

Q3.

> ### Solution
>
> **Concept:** Polar molecular solids are composed of polar covalent molecules held by dipole-dipole forces.
>
> **Solution:**
>
> $$HCl$$
>
> is a polar covalent molecule and forms a polar molecular solid.
>
> Argon is a non-polar atomic solid, ice is generally classified as hydrogen-bonded molecular solid, and
>
> $$CCl_4$$
>
> is non-polar.
>
> Final Answer: (A)
>
> **Answer: (A)**

Q4.

> **Solution**
>
> **Concept:** Standard free energy relation:
>
> $$\Delta G^\circ = -nFE^\circ_{cell}$$
>
> and
>
> $$\Delta G^\circ = -2.303RT \log K_c$$
>
> **Solution:** At
>
> $$298 \text{ K}$$
>
> combining both gives:
>
> $$nFE^\circ_{cell} = 2.303RT \log K_c$$
>
> Hence:
>
> $$\log K_c = \frac{nE^\circ_{cell}}{0.059}$$
>
> Final Answer: (A)
>
> **Answer: (A)**

Q5.

> **Solution**
>
> **Concept:** The blue solid oxide of nitrogen is dinitrogen trioxide.
> **Solution:**
>
> $$N_2O_3$$
>
> is a blue solid and is acidic in nature since it is the anhydride of nitrous acid:
>
> $$N_2O_3 + H_2O \rightarrow 2HNO_2$$
>
> Final Answer: (A)
>
> **Answer: (A)**

Q6.

> **Solution**
>
> **Concept:** S_N1 reaction proceeds via planar carbocation intermediate, giving racemization.
>
> **Solution:** For
> $$(R)\text{-2-bromooctane}$$
> the bromide leaves first, forming a planar carbocation. Hydroxide can attack from either side, leading to both
> $$(R) \text{ and } (S)$$
> octan-2-ol.
>
> In ideal case this gives racemic mixture:
> $$1:1$$
> of both enantiomers.
>
> Final Answer: (D)
>
> **Answer: (D)**

Q7.

> **Solution**
>
> **Concept:** Thyroid hormone thyroxine contains iodine atoms in its structure.
>
> **Solution:** Among the given hormones, iodine is present in:
> $$\text{Thyroxine}$$
> Final Answer: (A)
>
> **Answer: (A)**

Q8.

> **Solution**
>
> **Concept:** Spin-only magnetic moment is:
>
> $$\mu = \sqrt{n(n+2)}$$
>
> where
> $$n$$
>
> is the number of unpaired electrons.
>
> **Solution:** For
> $$Cr^{2+}$$
>
> electronic configuration is:
> $$3d^4$$
>
> So number of unpaired electrons:
> $$n = 4$$
>
> Therefore
> $$\mu = \sqrt{4(4+2)} = \sqrt{24} \approx 4.90 \text{ BM}$$
>
> Final Answer: (A)
>
> **Answer: (A)**

Q9.

> **Solution**
>
> **Concept:** Numbering is done to give lowest locants, and substituents are written alphabetically.
>
> **Solution:** The compound is:
>
> $$CH_3 - CH(Cl) - CH(Br) - CH_3$$
>
> The locants are 2 and 3 either way. In such tie, lower number is given to the substituent cited first alphabetically. Since
> $$bromo$$
>
> comes before
> $$chloro$$
>
> the correct name is:
> $$\text{2-bromo-3-chlorobutane}$$
>
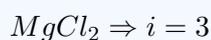> Final Answer: (A)
>
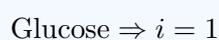> **Answer: (A)**
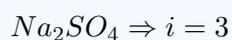
Q10.

> ### Solution
>
> **Concept:** Osmotic pressure depends on van't Hoff factor:
>
> $$\pi = iCRT$$
>
> **Solution:** For same concentration, greater
>
> $$i$$
>
> means higher osmotic pressure.
>
> $$Na_2SO_4 \Rightarrow i = 3$$
> $$\text{Glucose} \Rightarrow i = 1$$
> $$MgCl_2 \Rightarrow i = 3$$
> $$Al_2(SO_4)_3 \Rightarrow i = 5$$
>
> Thus highest osmotic pressure is shown by:
>
> $$0.1 \text{ M } Al_2(SO_4)_3$$
>
> Final Answer: (D)
>
> **Answer: (D)**
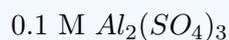
Q11.

> ### Solution
>
> **Concept:** A catalyst provides an alternative pathway with lower activation energy.
> **Solution:** Thus in presence of a catalyst, activation energy:
>
> $$\text{decreases}$$
>
> Final Answer: (A)
>
> **Answer: (A)**

Q12.

> **Solution**
>
> **Concept:** Addition polymers are not condensation polymers.
> **Solution:** Neoprene is formed by addition polymerization of chloroprene, so it is not a condensation polymer.
> Melamine, Glyptal, and Dacron are condensation polymers.
> Final Answer: (A)
>
> **Answer: (A)**

Q13.

> **Solution**
>
> **Concept:** Acidity of hydrogen attached to carbon increases with more s-character.
> **Solution:** In ethyne, carbon is
>
> $$sp$$
>
> hybridized and has 50% s-character, so the acidic hydrogen is more acidic than in ethene, ethane, or benzene.
> Hence the most acidic hydrogen is in:
>
> $$\text{Ethyne}$$
>
> Final Answer: (A)
>
> **Answer: (A)**

Q14.

> **Solution**
>
> **Concept:** Relation between molar conductivity and conductivity:
>
> $$\Lambda_m = \frac{1000\kappa}{C}$$
>
> **Solution:** Given:
> $$\Lambda_m = 190 \text{ S cm}^2 \text{ mol}^{-1}, \quad C = 0.05 \text{ M}$$
>
> So,
>
> $$\kappa = \frac{\Lambda_m C}{1000} = \frac{190 \times 0.05}{1000} = 0.0095 \text{ S cm}^{-1}$$
>
> Final Answer: (A)
>
> **Answer: (A)**

Q15.

> ### Solution
>
> **Concept:** Narrow spectrum antibiotics act only on a limited range of microorganisms.
> **Solution:** Penicillin G is a narrow spectrum antibiotic.
> Chloramphenicol and Ofloxacin are broad spectrum, while Vancomycin is also often treated as narrow against Gram-positive bacteria, but the standard answer here is Penicillin G.
> Final Answer: (A)
>
> **Answer: (A)**

Q16.

> ### Solution
>
> **Concept:** In
>
> $$XeF_4$$
>
> xenon has 6 electron pairs around it: 4 bond pairs and 2 lone pairs.
> **Solution:** Electron pair geometry is octahedral, but because two lone pairs occupy opposite positions, the molecular shape becomes:
>
> Square planar
>
> Final Answer: (A)
>
> **Answer: (A)**

Q17.

> ### Solution
>
> **Concept:** Gattermann reaction uses diazonium salts with copper powder and corresponding acid.
> **Solution:** For haloarene synthesis, Gattermann reaction uses:
>
> $$Cu \text{ powder}/HCl$$
>
> (or HBr depending on product).
> Final Answer: (A)
>
> **Answer: (A)**

Q18.

> ### Solution
>
> **Concept:** Heating ore strongly in absence or limited supply of air to convert it into oxide is called calcination.
>
> **Solution:** Thus the required process is:
>
> Calcination
>
> Final Answer: (A)
>
> **Answer: (A)**

Q19.

> ### Solution
>
> **Concept:** Gold number indicates the protective power of a lyophilic colloid in preventing coagulation of a gold sol.
>
> **Solution:** Hence gold number measures:
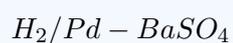>
> the protective power of a lyophilic colloid
>
> Final Answer: (A)
>
> **Answer: (A)**

Q20.

> ### Solution
>
> **Concept:** Rosenmund reduction converts acid chlorides into aldehydes using:
>
> $$H_2/Pd - BaSO_4$$
>
> **Solution:** Thus benzoyl chloride is reduced to:
>
> Benzaldehyde
>
> Final Answer: (A)
>
> **Answer: (A)**

Q21.

> ### Solution
>
> **Concept:** Density relation for cubic unit cell:
>
> $$\rho = \frac{ZM}{N_A a^3}$$
>
> **Solution:** Given:
>
> $$\rho = 10 \text{ g cm}^{-3}$$
>
> $$M = 48 \text{ g mol}^{-1}$$
>
> $$a = 200 \text{ pm} = 2 \times 10^{-8} \text{ cm}$$
>
> So,
>
> $$a^3 = (2 \times 10^{-8})^3 = 8 \times 10^{-24} \text{ cm}^3$$
>
> Thus:
>
> $$Z = \frac{\rho N_A a^3}{M}$$
>
> $$Z = \frac{10 \times 6.02 \times 10^{23} \times 8 \times 10^{-24}}{48} \approx 1$$
>
> Final Answer: 1
>
> **Answer: (1)**

Q22.

> **Solution**
>
> **Concept:** For first-order reaction:
>
> $$t = \frac{2.303}{k} \log \frac{a}{a-x}$$
>
> **Solution:** Initial amount:
> $$a = 5 \text{ g}$$
>
> Remaining amount:
> $$a - x = 3 \text{ g}$$
>
> So,
> $$t = \frac{2.303}{1.15 \times 10^{-3}} \log \frac{5}{3}$$
>
> Given:
> $$\log 1.67 = 0.22$$
>
> Thus:
> $$t = \frac{2.303 \times 0.22}{1.15 \times 10^{-3}} \approx \frac{0.50666}{1.15 \times 10^{-3}} \approx 440.6 \text{ s}$$
>
> Hence
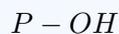> $$\frac{x}{100} = \frac{440.6}{100} \approx 4.4$$
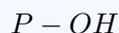>
> Final Answer: 4.4
>
> **Answer: (4.4)**

Q23.

> **Solution**
>
> **Concept:** Cyclic trimetaphosphoric acid is
>
> $$(HPO_3)_3$$
>
> and each phosphorus has one
> $$P - OH$$
>
> bond.
>
> **Solution:** Total number of
> $$P - OH$$
>
> bonds:
> $$3$$
>
> Final Answer: 3
>
> **Answer: (3)**

Q24.

> **Solution**
>
> **Concept:** If
>
> $$E_a = 0$$
>
> then from Arrhenius equation
>
> $$k = Ae^{-E_a/RT} = A$$
>
> so rate constant is independent of temperature.
> **Solution:** Thus at 600 K,
> $$k = 3.2 \times 10^4 \text{ s}^{-1}$$
>
> Hence
> $$X = 3.2$$
>
> Final Answer: 3.2
>
> **Answer: (3.2)**

Q25.

> **Solution**
>
> **Concept:** In aspirin, count all carbons having
>
> $$sp^2$$
>
> hybridisation.
> **Solution:** Aspirin contains: - 6 benzene ring carbons, all
>
> $$sp^2$$
>
> - 2 carbonyl carbons, both
> $$sp^2$$
>
> Total
> $$sp^2$$
>
> hybridized carbons:
> $$6 + 2 = 8$$
>
> Final Answer: 8
>
> **Answer: (8)**

Answer Key — Section A

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	A	2	A	3	A	4	A	5	A
6	D	7	A	8	A	9	A	10	D
11	A	12	A	13	A	14	A	15	A
16	A	17	A	18	A	19	A	20	A

Answer Key — Section B

Q	Ans	Q	Ans
21	1	22	4.4
23	3	24	3.2
25	8		