

JEE Main Chemistry Sample Paper-4

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.

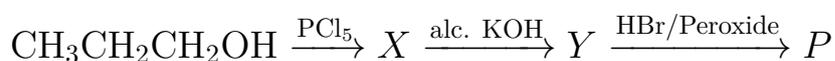
Section A — Multiple Choice Questions

Q1. Which of the following species has the highest bond dissociation energy?

[JEE Main 2024]

- (A) N_2
- (B) O_2
- (C) F_2
- (D) H_2

Q2. The major product P in the sequence



is:

[JEE Main 2023]

- (A) 1-bromopropane
- (B) 2-bromopropane
- (C) 1,2-dibromopropane
- (D) Propene

Q3. Which of the following transition metal ions is colorless in aqueous solution?

[JEE Main 2022]



- (A) Ti^{4+}
- (B) V^{3+}
- (C) Cr^{3+}
- (D) Mn^{2+}

Q4. The unit of the rate constant for a zero-order reaction is: [JEE Main 2025]

- (A) $\text{mol L}^{-1}\text{s}^{-1}$
- (B) s^{-1}
- (C) $\text{L mol}^{-1}\text{s}^{-1}$
- (D) $\text{mol}^2\text{L}^{-2}\text{s}^{-1}$

Q5. The number of P–O–P bonds in P_4O_{10} is: [JEE Main 2024]

- (A) 4
- (B) 6
- (C) 8
- (D) 10

Q6. Which of the following is most reactive towards electrophilic aromatic substitution? [JEE Main 2021]

- (A) Phenol
- (B) Benzene
- (C) Nitrobenzene
- (D) Chlorobenzene

Q7. The primary structure of a protein refers to: [JEE Main 2023]

- (A) The sequence of amino acids
- (B) The folding of the polypeptide chain
- (C) The three-dimensional shape
- (D) The assembly of multiple subunits

Q8. Which of the following is a "Cationic" detergent? [JEE Main 2022]



- (A) Sodium stearate
- (B) Cetyltrimethylammonium bromide
- (C) Sodium dodecylbenzene sulphonate
- (D) Glyceryl oleate

Q9. For the reaction $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$, the degree of dissociation α is related to K_c by: [JEE Main 2025]

- (A) $K_c = \frac{\alpha^2}{4(1-\alpha)^2}$
- (B) $K_c = \frac{\alpha^2}{(1-\alpha)^2}$
- (C) $K_c = \frac{4\alpha^2}{(1-\alpha)}$
- (D) $K_c = \alpha^2$

Q10. The hybridisation of central iodine atom in I_3^- is: [JEE Main 2024]

- (A) sp^3d
- (B) sp^3d^2
- (C) sp^3
- (D) sp^2

Q11. Which of the following is a greenhouse gas? [JEE Main 2021]

- (A) CH_4
- (B) O_2
- (C) N_2
- (D) Ar

Q12. The major product of the reaction between propanal and dilute $NaOH$ is: [JEE Main 2023]

- (A) 2-methylpent-2-enal
- (B) 3-hydroxybutanal
- (C) 2-methyl-3-hydroxypentanal
- (D) Hex-2-enal



- Q13.** The osmotic pressure of 0.1 M solution of $BaCl_2$ at $27^\circ C$ is (100% ionization): [JEE Main 2022]
- (A) 7.38 atm
(B) 2.46 atm
(C) 4.92 atm
(D) 1.23 atm
- Q14.** The most stable conformation of *n*-butane is: [JEE Main 2025]
- (A) Anti-periplanar
(B) Gauche
(C) Eclipsed
(D) Partially eclipsed
- Q15.** Which of the following acts as a "Self-indicator"? [JEE Main 2024]
- (A) $KMnO_4$
(B) $K_2Cr_2O_7$
(C) I_2
(D) Oxalic acid
- Q16.** The monomer of Teflon is: [JEE Main 2021]
- (A) Tetrafluoroethene
(B) Vinyl chloride
(C) Styrene
(D) Isoprene
- Q17.** Which of the following ions has the smallest size? [JEE Main 2023]
- (A) Al^{3+}
(B) Mg^{2+}
(C) Na^+
(D) F^-



Q18. The conversion of an amide to a primary amine with one less carbon atom is: [JEE Main 2022]

- (A) Hoffmann bromamide degradation
- (B) Gabriel phthalimide synthesis
- (C) Cannizzaro reaction
- (D) Clemmensen reduction

Q19. The number of octahedral voids per atom in a ccp structure is: [JEE Main 2025]

- (A) 1
- (B) 2
- (C) 4
- (D) 0.5

Q20. Lucas reagent is a mixture of: [JEE Main 2024]

- (A) Conc. HCl and anhydrous $ZnCl_2$
- (B) Conc. H_2SO_4 and $ZnCl_2$
- (C) Conc. HCl and $MgCl_2$
- (D) Pd/BaSO₄



Section B — Numerical Questions

Q21. The number of moles of $KMnO_4$ required to oxidize 1 mole of Sn^{2+} to Sn^{4+} in acidic medium is $0.x$. Find x . [JEE Main 2024]

Q22. The half-life of a first-order reaction is 69.3 minutes. The rate constant k in min^{-1} is $0.0x$. Find x . [JEE Main 2023]

Q23. The number of $P-OH$ bonds in pyrophosphoric acid ($H_4P_2O_7$) is: [JEE Main 2025]

Q24. For a reaction $A \rightarrow B$, $E_a = 0$. If $k = 3.2 \times 10^4 \text{ s}^{-1}$ at 300 K, the value of k at 600 K is $X \times 10^4$. Find X . [JEE Main 2022]

Q25. The total number of isomers (including stereoisomers) for the complex $[Co(en)_2Cl_2]^+$ is: [JEE Main 2024]



Detailed Solutions

Q1.

Solution

Concept: Bond dissociation energy increases with bond order and bond strength.

Solution: Among the given molecules:



has a triple bond,



has a double bond, and



have single bonds.

Since triple bond is strongest, the highest bond dissociation energy is for



Final Answer: (A)

Answer: (A)

Q2.

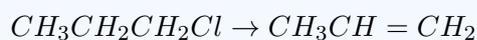
Solution

Concept: Convert alcohol to alkyl chloride, then eliminate to alkene, then anti-Markovnikov addition of HBr in presence of peroxide.

Solution:



Then alcoholic KOH gives elimination:



Now propene reacts with HBr in presence of peroxide by anti-Markovnikov addition, giving:



which is 1-bromopropane.

Final Answer: (A)

Answer: (A)

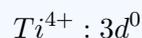


Q3.

Solution

Concept: Aqueous ions are colorless when they have d^0 or d^{10} configuration because no d-d transition is possible.

Solution:



So it is colorless.

Other ions have partially filled d-orbitals and are colored.

Final Answer: (A)

Answer: (A)

Q4.

Solution

Concept: For a zero-order reaction:

$$\text{Rate} = k$$

So unit of k is same as rate.

Solution: Unit of rate is:

$$\text{mol L}^{-1}\text{s}^{-1}$$

Hence unit of zero-order rate constant is also:

$$\text{mol L}^{-1}\text{s}^{-1}$$

Final Answer: (A)

Answer: (A)

Q5.

Solution

Concept: In P_4O_{10} , phosphorus atoms are connected through bridging oxygens forming P-O-P linkages.

Solution: Structure of



contains 6 bridging oxygen atoms, so number of P-O-P bonds is:

$$6$$

Final Answer: (B)

Answer: (B)



Q6.

Solution

Concept: Electrophilic aromatic substitution is favored by electron-donating groups.

Solution: Phenol has



group, which strongly activates the benzene ring by resonance.

Nitrobenzene and chlorobenzene are less reactive than phenol.

Thus the most reactive compound is phenol.

Final Answer: (A)

Answer: (A)

Q7.

Solution

Concept: Protein structure levels: primary = amino acid sequence, secondary = local folding, tertiary = overall 3D structure, quaternary = arrangement of subunits.

Solution: Thus primary structure refers to:

the sequence of amino acids

Final Answer: (A)

Answer: (A)

Q8.

Solution

Concept: Cationic detergents contain a positively charged ammonium group.

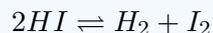
Solution: Cetyltrimethylammonium bromide is a quaternary ammonium salt and hence a cationic detergent.

Final Answer: (B)

Answer: (B)



Q9.

Solution**Concept:** For

start with 1 mole HI.

Solution: If degree of dissociation is

$$\alpha$$

then at equilibrium:

$$HI = 1 - \alpha$$

$$H_2 = \frac{\alpha}{2}, \quad I_2 = \frac{\alpha}{2}$$

So,

$$K_c = \frac{[H_2][I_2]}{[HI]^2} = \frac{(\frac{\alpha}{2})(\frac{\alpha}{2})}{(1 - \alpha)^2}$$

$$K_c = \frac{\alpha^2}{4(1 - \alpha)^2}$$

Final Answer: (A)

Answer: (A)

Q10.

Solution**Concept:** In I_3^- , the central iodine has 5 electron pairs: 2 bond pairs and 3 lone pairs.**Solution:** Steric number = 5, so hybridisation is:

Final Answer: (A)

Answer: (A)

Q11.

Solution**Concept:** Greenhouse gases absorb infrared radiation and trap heat in the atmosphere.**Solution:** Among the given gases,

is a greenhouse gas.

Final Answer: (A)

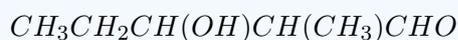
Answer: (A)

Q12.

Solution

Concept: Propanal contains α -hydrogen, so with dilute NaOH it undergoes aldol addition.

Solution: Two molecules of propanal combine to form:



which is

2-methyl-3-hydroxypentanal

Final Answer: (C)

Answer: (C)

Q13.

Solution

Concept: Osmotic pressure:

$$\pi = iMRT$$

Solution: For



$$i = 3$$

Given:

$$M = 0.1, \quad R = 0.0821, \quad T = 300 \text{ K}$$

So,

$$\pi = 3 \times 0.1 \times 0.0821 \times 300$$

$$\pi = 7.389 \approx 7.38 \text{ atm}$$

Final Answer: (A)

Answer: (A)

Q14.

Solution

Concept: The most stable conformation of *n*-butane is the anti conformation, where two methyl groups are farthest apart.

Solution: Thus the most stable conformation is:

Anti-periplanar

Final Answer: (A)

Answer: (A)



Q15.

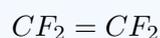
Solution**Concept:** A self-indicator is a reagent that itself shows color change at end point.**Solution:**

acts as a self-indicator because its purple color disappears until the end point.

Final Answer: (A)

Answer: (A)

Q16.

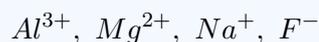
Solution**Concept:** Teflon is formed by polymerization of tetrafluoroethene.**Solution:** The monomer is:

called tetrafluoroethene.

Final Answer: (A)

Answer: (A)

Q17.

Solution**Concept:** For isoelectronic species, radius decreases as nuclear charge increases.**Solution:** The species

are isoelectronic with 10 electrons.

Among them, the highest nuclear charge is for



so it has the smallest size.

Final Answer: (A)

Answer: (A)

Q18.

Solution

Concept: Hoffmann bromamide degradation converts an amide into a primary amine with one fewer carbon atom.

Solution: Hence the required reaction is:

Hoffmann bromamide degradation

Final Answer: (A)

Answer: (A)

Q19.

Solution

Concept: In ccp structure, number of octahedral voids equals number of atoms.

Solution: So number of octahedral voids per atom is:

1

Final Answer: (A)

Answer: (A)

Q20.

Solution

Concept: Lucas reagent is used to distinguish 1°, 2°, and 3° alcohols.

Solution: It is a mixture of:

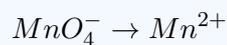
Concentrated HCl and anhydrous $ZnCl_2$

Final Answer: (A)

Answer: (A)



Q21.

Solution**Concept:** In acidic medium,

gains 5 electrons. Also,



loses 2 electrons.

Solution: To oxidize 1 mole of

electrons lost = 2.

Each mole of



accepts 5 electrons, so moles required:

$$\frac{2}{5} = 0.4$$

Thus,

$$0.x = 0.4 \Rightarrow x = 4$$

Final Answer: $x = 4$ **Answer: (4)**

Q22.

Solution**Concept:** For a first-order reaction:

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

Solution: Given:

$$t_{1/2} = 69.3 \text{ min}$$

So,

$$k = \frac{0.693}{69.3} = 0.01 \text{ min}^{-1}$$

Thus,

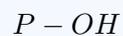
$$0.0x = 0.01 \Rightarrow x = 1$$

Final Answer: $x = 1$ **Answer: (1)**

Q23.

Solution**Concept:** Pyrophosphoric acid is

and it contains four



bonds.

Final Answer: 4

Answer: (4)

Q24.

Solution**Concept:** Arrhenius equation:

$$k = Ae^{-E_a/RT}$$

If

$$E_a = 0$$

then

$$k = A$$

and becomes independent of temperature.

Solution: So the value of

$$k$$

at 600 K remains:

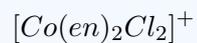
$$3.2 \times 10^4$$

Hence,

$$X = 3.2$$

Final Answer: $X = 3.2$ **Answer: (3.2)**

Q25.

Solution**Concept:** The complex

shows cis and trans isomerism. The cis form is optically active and exists as two enantiomers, while the trans form is optically inactive.

Solution: Thus total number of isomers:

$$2 \text{ (cis enantiomers)} + 1 \text{ (trans)} = 3$$

Final Answer: 3

Answer: (3)

Answer Key — Section A

Q	Ans								
1	A	2	A	3	A	4	A	5	B
6	A	7	A	8	B	9	A	10	A
11	A	12	C	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	4	22	1
23	4	24	3.2
25	3		

