MHT CET 2026 April 19 Shift 1

Question Paper with Solutions (Memory Based)

Conducted by CET Cell, Maharashtra

General Instructions

(i) **Duration:** The total duration of the examination is 3 hours (180 minutes).

(ii) **Total Marks:** The complete paper carries a maximum of 200 marks.

(iii) **Structure:** The paper has 3 Sections:

- **Section A:** 50 Multiple Choice Questions (Physics)
- **Section B:** 50 Multiple Choice Questions (Chemistry)
- **Section C:** 50 Multiple Choice Questions (Mathematics)

(iv) **Compulsory Questions:** All 150 questions are compulsory.

(v) Each question has four options. Only **one** option is correct.

(vi) **Right Answer:** Physics (+1 marks), Chemistry (+1 marks) and Mathematics (+2 marks).

(vii) **Incorrect Answer:** (No Negative marking).

(viii) **Unanswered/Marked for Review:** 0 marks.

1. For a first-order reaction, the time required to reduce the concentration of the reactant to half its initial value is:

(A) $0.3010/k$

(B) $1/k$

(C) $0.693/k$

(D) $2.303/k$

Correct Answer: (C) $0.693/k$

Solution:

Concept:

For a **first-order reaction**, the rate of reaction depends linearly on the concentration of the reactant.

The integrated rate law for a first-order reaction is:

$$\ln\left(\frac{[A]_0}{[A]}\right) = kt$$

where

- $[A]_0$ = initial concentration
- $[A]$ = concentration at time t
- k = rate constant
- t = time

The **half-life** $t_{1/2}$ is the time required for the concentration of the reactant to become half of its initial value.

Step 1: Definition of half-life.

For half-life,

$$[A] = \frac{[A]_0}{2}$$

Substitute this in the first-order rate equation:

$$\ln\left(\frac{[A]_0}{[A]_0/2}\right) = kt_{1/2}$$

$$\ln(2) = kt_{1/2}$$

Step 2: Evaluating the logarithmic value.

$$\ln 2 = 0.693$$

Therefore,

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

Quick Tip: For a **first-order reaction**, the half-life is independent of the initial concentration and is given by:

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

This is a key result frequently used in chemical kinetics problems.

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2. The EAN of cobalt in the complex $[Co(NH_3)_6]^{3+}$ is:

(A) 27

(B) 30

(C) 33

(D) 36

Correct Answer: (D) 36

Solution:

Concept:

The **Effective Atomic Number (EAN)** rule states that the total number of electrons around the central metal atom in a complex tends to equal the atomic number of the nearest noble gas. The formula for EAN is:

$$\text{EAN} = Z - \text{oxidation state} + \text{electrons donated by ligands}$$

where

- Z = atomic number of the metal
- Ligands donate electron pairs to the central metal atom

Step 1: Find the oxidation state of cobalt.

In the complex $[Co(NH_3)_6]^{3+}$:

- NH_3 is a neutral ligand

- Overall charge on the complex $= +3$

Therefore,

$$\text{Oxidation state of Co} = +3$$

Step 2: Determine electrons donated by ligands.

Each NH_3 ligand donates **2 electrons**.

Number of ligands $= 6$

$$\text{Total electrons donated} = 6 \times 2 = 12$$

Step 3: Calculate the EAN.

Atomic number of cobalt:

$$Z = 27$$

$$\text{EAN} = 27 - 3 + 12$$

$$\text{EAN} = 36$$

Thus, the effective atomic number of cobalt in the complex is:

$$\boxed{36}$$

Quick Tip: To calculate **EAN**, remember the shortcut:

$$\text{EAN} = Z - \text{oxidation state} + 2 \times (\text{number of ligands})$$

since most ligands donate **two electrons**. Many stable complexes satisfy the **EAN = noble gas configuration**.

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3. A cube of edge 4 cm has mass 256 g. The density of the material in SI unit is:

(A) $4\,\text{kg/m}^3$

(B) $1600\,\text{kg/m}^3$

(C) $4000\,\text{kg/m}^3$

(D) $1000\,\text{kg/m}^3$

Correct Answer: (C) $4000\,\text{kg/m}^3$

Solution:

Concept:

Density is defined as the mass per unit volume of a substance.

$$\rho = \frac{m}{V}$$

where

- ρ = density
- m = mass
- V = volume

For a cube, the volume is given by

$$V = a^3$$

where a is the edge length of the cube.

Step 1: Calculate the volume of the cube.

Edge of cube:

$$a = 4 \text{ cm}$$

$$V = a^3 = 4^3 = 64 \text{ cm}^3$$

Step 2: Calculate density in CGS unit.

Mass given:

$$m = 256 \text{ g}$$

$$\rho = \frac{256}{64} = 4 \text{ g/cm}^3$$

Step 3: Convert density into SI unit.

$$1 \text{ g/cm}^3 = 1000 \text{ kg/m}^3$$

Therefore,

$$4 \text{ g/cm}^3 = 4 \times 1000$$

$$= 4000 \text{ kg/m}^3$$

Thus, the density of the material is

$$\boxed{4000 \text{ kg/m}^3}$$

Quick Tip: Remember the important conversion:

$$1 \text{ g/cm}^3 = 1000 \text{ kg/m}^3$$

Always convert CGS units to SI units carefully when density is asked in kg/m^3.

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4. The Van't Hoff factor for a solution of K_2SO_4 in water is:

(A) 1

(B) 2

(C) 3

(D) 4

Correct Answer: (C) 3

Solution:

Concept:

The **Van't Hoff factor** (i) represents the number of particles formed when one formula unit of a solute dissociates in solution.

$$i = \text{Number of ions produced after dissociation}$$

For strong electrolytes that dissociate completely in water, the Van't Hoff factor equals the total number of ions produced.

Step 1: Write the dissociation of potassium sulfate in water.

$$K_2SO_4 \rightarrow 2K^+ + SO_4^{2-}$$

Step 2: Count the total number of ions formed.
From one formula unit of K_2SO_4:

- 2 potassium ions (K^+)
- 1 sulfate ion (SO_4^{2-})

Total ions formed:

$$2 + 1 = 3$$

Step 3: Determine the Van't Hoff factor.

$$i = 3$$

Thus, the Van't Hoff factor for K_2SO_4 in water is

$$\boxed{3}$$

Quick Tip: For ionic compounds in water, the Van't Hoff factor equals the **total number of ions produced after dissociation**. Example: $NaCl \rightarrow Na^+ + Cl^- \Rightarrow i = 2$ $K_2SO_4 \rightarrow 2K^+ + SO_4^{2-} \Rightarrow i = 3$

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5. In the electrolysis of molten NaCl, the product obtained at the cathode is:

(A) Cl gas

(B) Na metal

(C) NaOH

(D) H gas

Correct Answer: (B) Na metal

Solution:

Concept:

Electrolysis is the process in which electrical energy is used to drive a non-spontaneous chemical reaction.

- **Cathode:** Reduction occurs (gain of electrons)
- **Anode:** Oxidation occurs (loss of electrons)

In **molten NaCl**, only Na^+ and Cl^- ions are present because there is no water.

Step 1: Identify the ions present in molten NaCl.

$$NaCl\ (molten) \rightarrow Na^+ + Cl^-$$

Step 2: Reaction occurring at the cathode (reduction).

At the cathode, sodium ions gain electrons:

$$Na^+ + e^- \rightarrow Na$$

Thus, **sodium metal** is deposited at the cathode.

Step 3: Reaction occurring at the anode.

Chloride ions lose electrons:

$$2Cl^- \rightarrow Cl_2 + 2e^-$$

This produces **chlorine gas** at the anode.

Therefore, the product formed at the **cathode** during electrolysis of molten NaCl is

$$\boxed{\text{Na metal}}$$

Quick Tip: In electrolysis of **molten salts**, only the ions of the salt participate in the reaction since water is absent.

Cathode (reduction): metal ion gains electrons → metal formed. Example: $Na^+ + e^- \rightarrow Na$.

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6. Which of the following is an example of physisorption?

(A) Adsorption of NH_3 on charcoal

(B) Adsorption of H on Ni

(C) Adsorption of noble gases on solid surface

(D) Adsorption of O on heated metal

Correct Answer: (C) Adsorption of noble gases on solid surface

Solution:

Concept:

Adsorption can be of two types:

- **Physisorption (Physical adsorption):** Occurs due to weak van der Waals forces between the adsorbent and adsorbate.
- **Chemisorption (Chemical adsorption):** Involves formation of a chemical bond between adsorbent and adsorbate.

Characteristics of **physisorption**:

- Weak intermolecular forces
- Low heat of adsorption
- Reversible process
- Usually occurs with gases like noble gases

Step 1: Analyze each option.

- Adsorption of H on Ni involves formation of chemical bonds → **chemisorption**.
- Adsorption of O on heated metal also involves chemical interaction → **chemisorption**.

- Adsorption of NH_3 on charcoal may involve stronger interactions.
- Adsorption of **noble gases** occurs due to weak van der Waals forces.

Step 2: Identify the correct example of physisorption.

Noble gases are chemically inert and interact only through weak intermolecular forces.

Thus,

Adsorption of noble gases on solid surface

is a classic example of **physisorption**.

Therefore, the correct answer is

Adsorption of noble gases on solid surface

Quick Tip: **Physisorption** occurs due to weak van der Waals forces and is common for inert gases like He, Ne, Ar on solid surfaces. **Chemisorption** involves chemical bond formation and is usually irreversible.

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7. Which of the following reagents are used in Friedel–Crafts alkylation?

(A) $AlCl_3$

(B) $FeCl_3$

(C) RCOCl

(D) H_2SO_4

Correct Answer: (A) $AlCl_3$

Solution:

Concept:

Friedel–Crafts alkylation is an electrophilic aromatic substitution reaction in which an alkyl group is introduced into an aromatic ring.

The reaction generally uses:

- An **alkyl halide** $(R-X)$
- A **Lewis acid catalyst**

The most commonly used Lewis acid catalyst is $AlCl_3$.

Step 1: Role of the Lewis acid catalyst.

The Lewis acid catalyst $AlCl_3$ helps generate the electrophile from the alkyl halide.

Example:

$$R-Cl+AlCl_3 \rightarrow R^+ + AlCl_4^-$$

The carbocation R^+ then attacks the aromatic ring.

Step 2: Examine the options.

- $AlCl_3$: Lewis acid catalyst used in Friedel–Crafts alkylation.
- $FeCl_3$: Commonly used in halogenation of benzene.
- RCOCl: Used in Friedel–Crafts **acylation**, not alkylation.
- H_2SO_4: Used in nitration and sulfonation reactions.

Step 3: Identify the correct reagent.

Thus, the reagent used in Friedel–Crafts alkylation is

$$\boxed{AlCl_3}$$

Quick Tip: Remember the difference:

Friedel–Crafts **alkylation**: Alkyl halide + $AlCl_3$

Friedel–Crafts **acylation**: Acyl chloride $(RCOCl)$ + $AlCl_3$