

# MHT CET 2026 April 19 Shift 2

## 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. The EAN of cobalt in the complex  $[\text{Co}(\text{NH}_3)_6]^{3+}$  is:

- (A) 27
- (B) 30
- (C) 33
- (D) 36

**Correct Answer:** (D) 36

## Solution:

### Step 1: Understanding the Question:

The question asks for the Effective Atomic Number (EAN) of the central metal atom, cobalt (Co), in the coordination complex  $[\text{Co}(\text{NH}_3)_6]^{3+}$ .

### Step 2: Key Formula or Approach:

The Effective Atomic Number (EAN) can be calculated using the formula:

$$\text{EAN} = Z - \text{ON} + (2 \times \text{CN})$$

Where:

- $Z$  is the atomic number of the central metal.
- $\text{ON}$  is the oxidation state of the central metal.
- $\text{CN}$  is the coordination number (number of ligands if they are monodentate).

### Step 3: Detailed Explanation:

1. **Atomic number ( $Z$ ):** For cobalt (Co),  $Z = 27$ .

2. **Oxidation State (ON):** Let the oxidation state of Co be  $x$ .

Ammonia ( $\text{NH}_3$ ) is a neutral ligand, so its charge is 0.

Sum of charges:  $x + 6(0) = +3 \Rightarrow x = +3$ .

So, the oxidation state of cobalt is +3.

3. **Coordination Number (CN):** There are six  $\text{NH}_3$  ligands attached to the cobalt atom. Since  $\text{NH}_3$  is a monodentate ligand, the coordination number is 6.

4. **Calculate EAN:**

$$\text{EAN} = 27 - 3 + (2 \times 6)$$

$$\text{EAN} = 24 + 12 = 36$$

### Step 4: Final Answer:

The EAN of cobalt in the complex  $[\text{Co}(\text{NH}_3)_6]^{3+}$  is 36, which corresponds to the atomic number of the noble gas Krypton (Kr).

**Quick Tip:** The EAN rule (Sidgwick's rule) suggests that stable complexes often have an EAN equal to the atomic number of the next noble gas. Cobalt's next noble gas is Krypton ( $Z = 36$ ), which helps verify your calculation.

2. 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:**

**Step 1: Understanding the Question:**

The goal is to find the density of a cubic object given its mass and edge length, and then express it in the International System of Units (SI), which is kilograms per cubic meter ( $\text{kg/m}^3$ ).

**Step 2: Key Formula or Approach:**

1. Volume of a cube:  $V = l^3$ , where  $l$  is the edge length.
2. Density formula:  $\rho = \frac{\text{mass}}{\text{volume}}$ .
3. Conversion: To convert  $\text{g/cm}^3$  to  $\text{kg/m}^3$ , multiply by 1000.

**Step 3: Detailed Explanation:**

**Given data:**

- Edge length ( $l$ ) = 4 cm
- Mass ( $m$ ) = 256 g

**Calculation:**

1. Calculate the volume in  $\text{cm}^3$ :

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

2. Calculate the density in  $\text{g/cm}^3$ :

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

3. Convert to SI units ( $\text{kg/m}^3$ ):

Since  $1 \text{ g} = 10^{-3} \text{ kg}$  and  $1 \text{ cm}^3 = 10^{-6} \text{ m}^3$ :

$$1 \text{ g/cm}^3 = \frac{10^{-3} \text{ kg}}{10^{-6} \text{ m}^3} = 1000 \text{ kg/m}^3$$

Therefore,  $\rho = 4 \times 1000 \text{ kg/m}^3 = 4000 \text{ kg/m}^3$ .

**Step 4: Final Answer:**

The density of the material is  $4000 \text{ kg/m}^3$ .

**Quick Tip:** Always be careful with units. You can convert to SI units at the very beginning (mass = 0.256 kg, edge = 0.04 m) or at the end. Often converting at the end is easier to avoid working with many leading zeros.

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3. 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:**

**Step 1: Understanding the Question:**

The question asks for the Van't Hoff factor ( $i$ ) for the electrolyte  $K_2SO_4$  (assuming "KSO" is a typo for Potassium Sulfate,  $K_2SO_4$ , as it is a common exam example) when dissolved in water. The Van't Hoff factor represents the degree of dissociation of a solute.

**Step 2: Key Formula or Approach:**

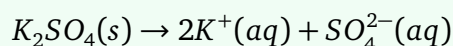
For strong electrolytes that dissociate completely in dilute solutions:

$$i = \text{total number of ions produced per formula unit}$$

For an electrolyte  $A_xB_y$  that dissociates into  $xA^{y+}$  and  $yB^{x-}$ , the number of ions is  $n = x + y$ .

**Step 3: Detailed Explanation:**

When Potassium Sulfate ( $K_2SO_4$ ) dissolves in water, it dissociates into its constituent ions as follows:



- Number of potassium ions ( $K^+$ ) = 2

- Number of sulfate ions ( $SO_4^{2-}$ ) = 1

Total number of ions produced =  $2 + 1 = 3$ .

Assuming complete dissociation (ideal solution), the Van't Hoff factor  $i$  is equal to the number of ions produced.

Therefore,  $i = 3$ .

**Step 4: Final Answer:**

The Van't Hoff factor for a solution of  $K_2SO_4$  in water is 3.

**Quick Tip:** For salts, just count the subscripts in the chemical formula to find the number of ions. For example,  $NaCl$  has 2 ions ( $i = 2$ ),  $K_2SO_4$  has 3 ions ( $i = 3$ ), and  $AlCl_3$  has 4 ions ( $i = 4$ ).

**4. Rosenmund reduction is used to convert acyl chlorides into:**

- (A) Alcohols
- (B) Carboxylic acids
- (C) Aldehydes
- (D) Ketones

**Correct Answer:** (C) Aldehydes

### Solution:

#### Step 1: Understanding the Question:

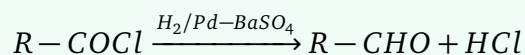
The question asks about the functional group transformation achieved using the Rosenmund reduction reaction.

#### Step 3: Detailed Explanation:

1. **Reaction Description:** Rosenmund reduction is a catalytic hydrogenation reaction where an acyl chloride (acid chloride) is selectively reduced.

2. **Reagents:** The catalyst used is hydrogen gas ( $H_2$ ) over palladium ( $Pd$ ) supported on barium sulfate ( $BaSO_4$ ). The catalyst is often "poisoned" or partially deactivated with sulfur or quinoline to prevent over-reduction.

#### 3. Chemical Transformation:



- The acyl chloride ( $R - COCl$ ) group is converted into an aldehyde ( $R - CHO$ ) group.

- Without the poisoned catalyst ( $BaSO_4$ ), the aldehyde would be further reduced to a primary alcohol.

#### Step 4: Final Answer:

Rosenmund reduction converts acyl chlorides into aldehydes.

**Quick Tip:** Remember the specific reagent for Rosenmund:  $Pd - BaSO_4$ . It is the standard method to "stop" the reduction at the aldehyde stage.

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:**

**Step 1: Understanding the Question:**

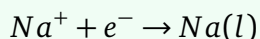
The question asks to identify the substance formed at the negative electrode (cathode) during the electrolysis of liquid (molten) sodium chloride.

**Step 3: Detailed Explanation:**

1. **Components:** Molten  $\text{NaCl}$  contains only  $\text{Na}^+$  and  $\text{Cl}^-$  ions. Unlike aqueous  $\text{NaCl}$ , there is no water to compete for reduction or oxidation.

2. **At the Cathode (Negative Electrode):**

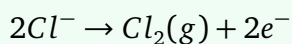
Reduction occurs here. The positive  $\text{Na}^+$  ions move toward the cathode, where they gain electrons.



Sodium metal is deposited or formed at the cathode.

3. **At the Anode (Positive Electrode):**

Oxidation occurs here. The negative  $\text{Cl}^-$  ions move toward the anode, where they lose electrons.



Chlorine gas is evolved at the anode.

**Step 4: Final Answer:**

The product at the cathode during the electrolysis of molten  $\text{NaCl}$  is sodium (Na) metal.

**Quick Tip:** Always distinguish between **molten** and **aqueous** electrolysis. In aqueous  $\text{NaCl}$  electrolysis, hydrogen gas ( $\text{H}_2$ ) is obtained at the cathode instead of sodium metal because water is easier to reduce than sodium ions.