# CUET 2025 June 3 Chemistry Question Paper With Solutions

| **Time Allowed :**1 Hours | **Maximum Marks :**250 | **Total questions :**50 |
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## General Instructions

**Read the following instructions very carefully and strictly follow them:**

1. The test is of 1 hour duration.
2. The question paper consists of 50 questions. The maximum marks are 250.
3. 5 marks are awarded for every correct answer, and 1 mark is deducted for every wrong answer.

**1. The wavelength of the first line in the Balmer series of hydrogen spectrum is 656 nm. What is the wavelength of the second line?**

(1) 486 nm

(2) 434 nm

(3) 397 nm

(4) 410 nm

**Correct Answer:** (1) 486 nm

**Solution: Step 1: Recall the Balmer series formula.**

The Balmer series corresponds to transitions from $n \geq 3$ to $n = 2$. The wavelength is given by:

$$\frac{1}{\lambda} = R_H \left( \frac{1}{2^2} - \frac{1}{n^2} \right)$$

where $R_H = 1.097 \times 10^7 \, \text{m}^{-1}$

**Step 2: First line in Balmer series.**

This corresponds to $n = 3 \to 2$:

$$\frac{1}{\lambda_1} = R_H \left( \frac{1}{4} - \frac{1}{9} \right) = R_H \left( \frac{5}{36} \right)$$

**Step 3: Second line in Balmer series.**

This corresponds to $n = 4 \to 2$:

$$\frac{1}{\lambda_2} = R_H \left( \frac{1}{4} - \frac{1}{16} \right) = R_H \left( \frac{3}{16} \right)$$

$$\Rightarrow \frac{\lambda_2}{\lambda_1} = \frac{5/36}{3/16} = \frac{5 \cdot 16}{36 \cdot 3} = \frac{80}{108} = \frac{20}{27} \Rightarrow \lambda_2 = \frac{20}{27} \cdot 656 \approx 486 \, \text{nm}$$

**Quick Tip**

In the Balmer series, the first few lines correspond to transitions to $n = 2$ from $n = 3, 4, 5, \ldots$. Use the Rydberg formula to find successive wavelengths.

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**2. Which of the following molecules has the highest bond angle?**

(1) $CH_4$

(2) $NH_3$

(3) $H_2O$

(4) $BF_3$

**Correct Answer:** (4) $BF_3$

**Solution: Step 1: Determine the molecular geometry.**

- $CH_4$: Tetrahedral — bond angle $109.5^\circ$
- $NH_3$: Trigonal pyramidal — bond angle $107^\circ$
- $H_2O$: Bent — bond angle $104.5^\circ$
- $BF_3$: Trigonal planar — bond angle $120^\circ$

**Step 2: Compare bond angles.**

Among these, the trigonal planar geometry of $BF_3$ gives the largest bond angle of $120^\circ$.

**Quick Tip**

Bond angle depends on molecular geometry and lone pairs. Fewer lone pairs and planar structures generally lead to larger bond angles.

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**3. Which of the following gases will deviate most from ideal behavior at high pressure?**

(1) Hydrogen

(2) Helium

(3) Carbon dioxide

(4) Neon

**Correct Answer:** (3) Carbon dioxide

**Solution: Step 1: Understanding deviation from ideal behavior.**

Gases deviate from ideal behavior due to intermolecular forces and the volume occupied by the gas molecules. At high pressure, these deviations become more significant.

**Step 2: Analyze intermolecular forces.**

Hydrogen and Helium are light and exhibit very weak intermolecular forces.

Neon, a noble gas, also has weak van der Waals forces.

Carbon dioxide, being a larger and more polarizable molecule, has stronger intermolecular attractions, leading to greater deviation.

**Step 3: Conclusion.**

At high pressure, Carbon dioxide deviates the most from ideal gas behavior due to its significant van der Waals forces and molecular size.

**Quick Tip**

At high pressures, gases with stronger intermolecular forces and larger molecular sizes show more deviation from ideal behavior. Polar or easily polarizable gases like $CO_2$ deviate more than light, monoatomic gases like He or Ne.

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**4. For a spontaneous process at constant temperature and pressure, which of the following is true?**

(1) $\Delta G > 0$

(2) $\Delta H > 0$

(3) $\Delta G < 0$

(4) $\Delta S < 0$

**Correct Answer:** (3) $\Delta G < 0$

**Solution: Step 1: Use Gibbs free energy criteria.**

For a process to be spontaneous at constant temperature and pressure, the change in Gibbs free energy must be negative, i.e.,

$$\Delta G < 0.$$

**Step 2: Evaluate other options.**

$\Delta G > 0$: Implies non-spontaneous process.

$\Delta H > 0$: Possible, but does not guarantee spontaneity.

$\Delta S < 0$: May occur, but not a definitive condition for spontaneity.

$\Delta G < 0$: This is the correct condition for spontaneity.

**Quick Tip**

For a spontaneous process at constant temperature and pressure, the correct thermodynamic condition is:

$$\Delta G = \Delta H - T\Delta S < 0.$$

This indicates the process proceeds with a decrease in free energy.

**5. For a first-order reaction, the time required to reduce the concentration of the reactant to one-fourth of its initial value is 20 minutes. What is the half-life of the reaction?**

(1) 5 min

(2) 10 min

(3) 20 min

(4) 40 min

**Correct Answer:** (2) 10 min

**Solution: Step 1: Use the first-order decay formula.**

For a first-order reaction:

$$\frac{[A]}{[A]_0} = \left(\frac{1}{2}\right)^{t/t_{1/2}}$$

**Step 2: Plug in the given values.**

We are told the concentration is reduced to one-fourth of the initial:

$$\left(\frac{1}{2}\right)^{t/t_{1/2}} = \frac{1}{4} = \left(\frac{1}{2}\right)^2 \Rightarrow \frac{t}{t_{1/2}} = 2 \Rightarrow t_{1/2} = \frac{t}{2} = \frac{20}{2} = 10 \text{ min}$$

**Quick Tip**

In first-order kinetics, if a concentration reduces to $\frac{1}{2^n}$ in time $t$, then $t = n \cdot t_{1/2}$.

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**6. In an electrochemical cell, the standard electrode potential of $Zn^{2+}$/Zn is $-0.76$ V and that of $Cu^{2+}$/Cu is $+0.34$ V. What is the standard EMF of the cell?**

(1) 1.10 V

(2) -1.10 V

(3) 0.42 V

(4) -0.42 V

**Correct Answer:** (1) 1.10 V

**Solution: Step 1: Identify the cathode and anode.**

In a galvanic cell, the electrode with higher (more positive) potential acts as cathode.

$$\begin{cases} E^\circ_{Cu^{2+}/Cu} = +0.34\,V & \text{(Cathode)} \\ E^\circ_{Zn^{2+}/Zn} = -0.76\,V & \text{(Anode)} \end{cases}$$

**Step 2: Use the EMF formula.**

$$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode} = 0.34 - (-0.76) = 1.10\,V$$

**Quick Tip**

Standard EMF of a cell is calculated as $E^\circ_{cathode} - E^\circ_{anode}$. The more positive potential is the cathode.

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**7. Which of the following is used as a catalyst in the Haber process?**

(1) Iron oxide

(2) Vanadium oxide

(3) Manganese dioxide

(4) Platinum

**Correct Answer:** (1) Iron oxide

**Solution: Step 1: Understand the Haber process.**

The Haber process is used for the industrial synthesis of ammonia from nitrogen and hydrogen:

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

**Step 2: Identify the catalyst.**

The catalyst used in this process is finely divided iron, often promoted with potassium oxide ($K_2O$) and aluminum oxide ($Al_2O_3$) to increase efficiency.

**Quick Tip**

In the Haber process, iron acts as the main catalyst, while other oxides act as promoters to increase surface area and efficiency.

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**8. Which of the following compounds contains a carbonyl group?**

(1) Alcohol

(2) Aldehyde

(3) Amine

(4) Ether

**Correct Answer:** (2) Aldehyde

**Solution: Step 1: Understand what a carbonyl group is.**

A carbonyl group is a functional group consisting of a carbon atom double bonded to an oxygen atom: $\mathrm{C{=}O}$

**Step 2: Identify which compound has this group.**

Alcohol has –OH group

Amine has $-\mathrm{NH_2}$ group. Ether has –O– between two alkyl groups

Aldehyde has –CHO group, which includes the carbonyl

**Quick Tip**

A carbonyl group is found in aldehydes and ketones. Look for the $\mathrm{C{=}O}$ bond to identify such groups in a compound.

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**9. The coordination number of the central metal ion in $[\mathbf{Fe(CN)_6}]^{4-}$ is:**

(1) 4

(2) 6

(3) 2

(4) 3

**Correct Answer:** (2) 6

**Solution: Step 1: Understand the coordination number.**

The coordination number is the number of ligand atoms directly bonded to the central metal ion.

**Step 2: Analyze the complex $[\mathbf{Fe(CN)_6}]^{4-}$.**

Here, Fe is surrounded by 6 cyanide ($CN^-$) ligands.

Each CN is a monodentate ligand (donates one electron pair), so the coordination number is 6.

Quick Tip

To determine coordination number, count the number of ligand donor atoms directly attached to the metal center. Monodentate ligands contribute 1 each.

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**10. Which of the following is a polysaccharide?**

(1) Glucose

(2) Sucrose

(3) Cellulose

(4) Fructose

**Correct Answer:** (3) Cellulose

**Solution: Step 1: Identify types of carbohydrates.**

Monosaccharides: Glucose, Fructose

Disaccharides: Sucrose

Polysaccharides: Cellulose

**Step 2: Cellulose is a polymer.**

Cellulose is a polysaccharide composed of -D-glucose units linked by -1,4-glycosidic bonds. It is a structural component in plant cell walls.

Quick Tip

Polysaccharides are long chains of monosaccharide units. Examples include starch, cellulose, and glycogen.

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