

CUET 2026 May 20 Shift 2 Chemistry

Question Paper (Memory-Based) with Solutions

Conducted by National Testing Agency (NTA)



General Instructions

- (i) The examination will be conducted in Computer-Based Test (CBT) mode.
- (ii) Each question carries +5 marks for correct answer and -1 mark for wrong answer.
- (iii) The total number of questions are 50.
- (iv) Duration of the exam is 1 hour (60 minutes).

1. In the actinoid series, which oxidation state is the most stable for most actinoids?

- (A) +2
- (B) +3
- (C) +4
- (D) +6

Correct Answer: (B) +3

Solution:

Concept: Actinoids exhibit variable oxidation states because the energies of $5f$, $6d$, and $7s$ orbitals are very close to one another. However, the +3 oxidation state is the most stable and most commonly observed oxidation state for the majority of actinoids.

Step 1: Understanding the electronic configuration of actinoids.

Actinoids belong to the $5f$ -series where electrons are progressively filled in the $5f$ -orbitals. Since the $5f$, $6d$, and $7s$ orbitals have comparable energies, multiple oxidation states become possible.

Step 2: Formation of the +3 oxidation state.

Most actinoids lose:

2 electrons from $7s$ and 1 electron from $5f/6d$

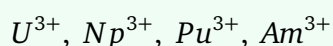
leading to the formation of:



This state is particularly stable because removal of three electrons gives a comparatively stable electronic arrangement.

Step 3: Examples of stable +3 oxidation state.

Elements like uranium, neptunium, plutonium, and americium commonly form:



Thus, the most stable oxidation state for most actinoids is:



Quick Tip: Both lanthanoids and actinoids most commonly exhibit the +3 oxidation state due to stability achieved after losing outer electrons.

2. The magnetic moment of a complex having 3 unpaired electrons is closest to:

$$\mu = \sqrt{n(n+2)} \text{ BM}$$

- (A) 1.73 BM
- (B) 2.84 BM
- (C) 3.87 BM
- (D) 4.90 BM

Correct Answer: (C) 3.87 BM

Solution:

Concept: The spin-only magnetic moment of a coordination complex is calculated using:

$$\mu = \sqrt{n(n+2)} \text{ BM}$$

where n is the number of unpaired electrons.

Step 1: Identify the number of unpaired electrons.

The complex contains:

$$n = 3$$

unpaired electrons.

Step 2: Substitute the value into the formula.

Using the formula:

$$\mu = \sqrt{n(n+2)}$$

Substituting $n = 3$:

$$\mu = \sqrt{3(3+2)}$$

$$\mu = \sqrt{3 \times 5}$$

$$\mu = \sqrt{15}$$

Step 3: Calculate the numerical value.

$$\sqrt{15} \approx 3.87$$

Therefore:

$$\mu \approx 3.87 \text{ BM}$$

Quick Tip: Common magnetic moments: 1 unpaired electron \rightarrow 1.73 BM, 2 unpaired electrons \rightarrow 2.84 BM, 3 unpaired electrons \rightarrow 3.87 BM.

3. Semicarbazide is commonly used to identify:

- (A) Alcohols
- (B) Carboxylic acids
- (C) Aldehydes and ketones
- (D) Amines

Correct Answer: (C) Aldehydes and ketones

Solution:

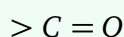
Concept: Semicarbazide reacts with carbonyl compounds such as aldehydes and ketones to form semicarbazones, which are crystalline derivatives useful for identification.

Step 1: Understanding semicarbazide.

Semicarbazide has the structure:

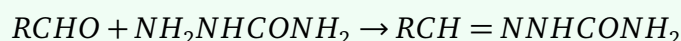


It reacts specifically with the carbonyl group:

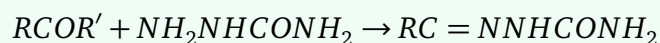
**Step 2: Reaction with aldehydes and ketones.**

Aldehydes and ketones contain carbonyl groups and therefore react with semicarbazide.

For aldehydes:



For ketones:

**Step 3: Purpose of the reaction.**

The semicarbazones formed are crystalline solids with definite melting points. These derivatives help chemists identify unknown aldehydes and ketones.

Hence, semicarbazide is used for identifying:

Aldehydes and ketones

Quick Tip: Carbonyl compounds commonly form derivatives such as oximes, hydrazones, and semicarbazones for identification purposes.

4. Aldol condensation is shown by compounds containing:

- (A) Only carbonyl group
- (B) α -hydrogen and carbonyl group
- (C) Triple bond
- (D) Ether linkage

Correct Answer: (B) α -hydrogen and carbonyl group

Solution:

Concept: Aldol condensation is shown by aldehydes or ketones that contain at least one α -hydrogen atom.

Step 1: Understanding the requirement of aldol condensation.

In aldol condensation, one molecule forms an enolate ion using an α -hydrogen atom.

This enolate ion attacks another molecule containing a carbonyl group.

Step 2: Necessary conditions for the reaction.

The compound must contain:

(i) A carbonyl group

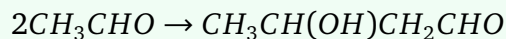
and

(ii) At least one α -hydrogen

Without α -hydrogen, enolate ion formation cannot occur.

Step 3: Example of aldol condensation.

Acetaldehyde undergoes aldol condensation:



Thus, compounds containing both carbonyl group and α -hydrogen undergo aldol condensation.

Therefore, the correct answer is:

α -hydrogen and carbonyl group

Quick Tip: Formaldehyde and benzaldehyde do not undergo aldol condensation because they do not contain α -hydrogen atoms.

5. Match the following reaction orders with their units of rate constant:

Reaction Order	Units of k
(A) Zero order	(I) $L mol^{-1}s^{-1}$
(B) First order	(II) $mol L^{-1}s^{-1}$
(C) Second order	(III) s^{-1}

Choose the correct option:

- (A) A-II, B-III, C-I
- (B) A-III, B-II, C-I
- (C) A-I, B-II, C-III
- (D) A-II, B-I, C-III

Correct Answer: (A) A-II, B-III, C-I

Solution:

Concept: The units of rate constant depend on the order of reaction.

Step 1: Write the general rate equation.

$$\text{Rate} = k[A]^n$$

Units of rate are:

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

Step 2: Find units for zero-order reaction.

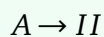
For zero-order:

$$\text{Rate} = k$$

Thus:

$$[k] = mol L^{-1}s^{-1}$$

Hence:



Step 3: Find units for first-order reaction.

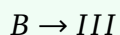
For first-order:

$$k = \frac{\text{Rate}}{[A]}$$

Units become:

$$s^{-1}$$

Thus:



Step 4: Find units for second-order reaction.

For second-order:

$$k = \frac{\text{Rate}}{[A]^2}$$

Units become:

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

Thus:



Therefore, the correct matching is:

$$A - II, B - III, C - I$$

Quick Tip: The unit of rate constant for first-order reactions is always s^{-1} , independent of concentration units.

6. For a first-order reaction, the half-life is given by $t_{1/2} = \frac{0.693}{k}$. Which conclusion is correct?

- (A) Depends on initial concentration
- (B) Is inversely proportional to k
- (C) Is directly proportional to concentration
- (D) Increases with time

Correct Answer: (B) Is inversely proportional to k

Solution:

Concept: For a first-order reaction, the half-life expression is:

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

where k is the rate constant.

Step 1: Understanding the formula.

From the formula:

$$t_{1/2} \propto \frac{1}{k}$$

This means the half-life decreases if the rate constant increases.

Step 2: Checking dependence on concentration.

The formula contains only the rate constant k and no concentration term. Therefore, half-life of a first-order reaction is independent of initial concentration.

Step 3: Final conclusion.

Since half-life varies inversely with k , the correct statement is:

(B) Is inversely proportional to k

Quick Tip: Only first-order reactions have half-life independent of initial concentration. This is one of their most important properties.

7. Which of the following complexes is diamagnetic?

- (A) $[Fe(H_2O)_6]^{3+}$
- (B) $[CoF_6]^{3-}$
- (C) $[Ni(CN)_4]^{2-}$
- (D) $[MnCl_4]^{2-}$

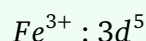
Correct Answer: (C) $[Ni(CN)_4]^{2-}$

Solution:

Concept: A diamagnetic complex contains no unpaired electrons. Strong field ligands can pair electrons and produce diamagnetism.

Step 1: Analyzing option (A).

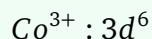
In $[Fe(H_2O)_6]^{3+}$:



H_2O is a weak field ligand. Thus, electrons remain unpaired. Hence, the complex is paramagnetic.

Step 2: Analyzing option (B).

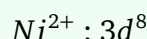
In $[CoF_6]^{3-}$:



F^- is a weak field ligand. The complex is high-spin with unpaired electrons. Therefore, it is paramagnetic.

Step 3: Analyzing option (C).

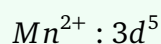
In $[Ni(CN)_4]^{2-}$:



CN^- is a strong field ligand. Electrons pair up and form a square planar complex. All electrons become paired. Therefore, the complex is diamagnetic.

Step 4: Analyzing option (D).

In $[MnCl_4]^{2-}$:



Cl^- is a weak field ligand. The complex contains several unpaired electrons. Hence, it is paramagnetic.

Step 5: Final conclusion.

Only $[Ni(CN)_4]^{2-}$ is diamagnetic.



Quick Tip: Strong field ligands like CN^- often produce low-spin complexes with paired electrons, leading to diamagnetism.

8. The shape of $[Ni(CN)_4]^{2-}$ is:

- (A) Tetrahedral
- (B) Square planar
- (C) Octahedral
- (D) Trigonal bipyramidal

Correct Answer: (B) Square planar

Solution:

Concept: The geometry of coordination compounds depends upon the metal ion, electronic configuration, and ligand strength.

Step 1: Finding oxidation state of nickel.

In $[Ni(CN)_4]^{2-}$:

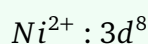
$$x + 4(-1) = -2$$

$$x - 4 = -2$$

$$x = +2$$

Thus, nickel is in +2 oxidation state.

Step 2: Finding electronic configuration.



Step 3: Effect of ligand CN^- .

CN^- is a strong field ligand. It causes pairing of electrons in d -orbitals.

Step 4: Determining hybridization and shape.

For d^8 configuration with strong field ligands:

dsp^2 hybridization occurs

This leads to square planar geometry.

Step 5: Final answer.

Hence, the shape is:

Square planar

Quick Tip: Most d^8 metal ions with strong field ligands form square planar complexes.

9. The rate of a reaction doubles when concentration of reactant is doubled. The order of reaction is:

(A) Zero order

- (B) First order
- (C) Second order
- (D) Third order

Correct Answer: (B) First order

Solution:

Concept: For a reaction:

$$\text{Rate} = k[A]^n$$

where n is the order of reaction.

Step 1: Writing the rate law.

Suppose initial rate is:

$$R_1 = k[A]^n$$

When concentration is doubled:

$$R_2 = k(2[A])^n$$

$$R_2 = 2^n k[A]^n$$

$$R_2 = 2^n R_1$$

Step 2: Using given condition.

The rate doubles:

$$R_2 = 2R_1$$

Thus:

$$2^n R_1 = 2R_1$$

$$2^n = 2$$

$$n = 1$$

Step 3: Final conclusion.

The reaction is first order.

First order

Quick Tip: If doubling concentration doubles rate, the reaction is first order. If rate becomes four times, it is second order.

10. Which statement about physical chemistry numericals in CUET is generally correct?

- (A) Mostly lengthy derivations
- (B) Assertion-reason type only
- (C) Direct formula-based numericals
- (D) Only graph-based questions

Correct Answer: (C) Direct formula-based numericals

Solution:

Concept: CUET physical chemistry questions are generally objective and formula-oriented. Most numericals test direct application of standard equations.

Step 1: Analyzing option (A).

CUET questions are usually not based on lengthy derivations. Hence, this statement is incorrect.

Step 2: Analyzing option (B).

Assertion-reason questions may appear occasionally, but physical chemistry numericals are not limited to this pattern. Hence, incorrect.

Step 3: Analyzing option (C).

Most questions involve direct use of formulas such as:

$$M_1 V_1 = M_2 V_2$$

$$PV = nRT$$

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

Thus, CUET numericals are mainly formula-based.

Step 4: Analyzing option (D).

Graph-based questions are not the only type asked. Hence, incorrect.

Step 5: Final conclusion.

The correct statement is:

Direct formula-based numericals

Quick Tip: For CUET physical chemistry, memorize standard formulas and practice quick substitutions because most questions are application-based.