CUET 2026 May 30 Shift 2 Chemistry

Question Paper (Memory-Based) with Solutions

Conducted by National Testing Agency (NTA)

1. Cumene is industrially used for the preparation of phenol. During the manufacture of phenol from cumene, which of the following compounds is obtained as a valuable by-product?

(A) Acetaldehyde

(B) Acetone

(C) Formaldehyde

(D) Benzaldehyde

Correct Answer: (2) Acetone

Solution:

Concept:

The industrial preparation of phenol from cumene is one of the most important commercial processes discussed in NCERT Organic Chemistry. This method is commonly known as the **Cumene Process** or **Hock Process**. The process involves oxidation of cumene followed by acidic hydrolysis of the intermediate hydroperoxide.

Students often focus only on the formation of phenol, but CUET frequently asks conceptual questions regarding the by-products formed during industrial reactions.

The complete reaction sequence is:

$$\text{Cumene} \xrightarrow{O_2} \text{Cumene Hydroperoxide} \xrightarrow{H^+} \text{Phenol} + \text{Acetone}$$

Thus, both phenol and acetone are important products obtained from this industrial process.

Step 1: Formation of cumene hydroperoxide.

Cumene is isopropyl benzene.

Its structure is:

$$C_6H_5CH(CH_3)_2$$

When exposed to air in the presence of oxygen, oxidation occurs to form cumene hydroperoxide.

$$C_6H_5CH(CH_3)_2 \xrightarrow{O_2} C_6H_5C(CH_3)_2OOH$$

This intermediate is highly reactive.

Step 2: Acidic cleavage of hydroperoxide.

The hydroperoxide undergoes acid-catalyzed rearrangement.

The O-O bond breaks and molecular rearrangement occurs.

As a result:

$$C_6H_5C(CH_3)_2OOH \xrightarrow{H^+} C_6H_5OH + (CH_3)_2CO$$

Products obtained are:

Phenol

and

Acetone

Step 3: Analysis of all options.

- Acetaldehyde is not produced during the cumene process.
- Acetone is formed directly along with phenol.
- Formaldehyde is not generated in this reaction.
- Benzaldehyde is not formed during hydroperoxide cleavage.

Hence the correct answer is:

Acetone

Quick Tip: Always remember the industrial reaction:

$$\text{Cumene} \rightarrow \text{Phenol} + \text{Acetone}$$

CUET frequently asks either the by-product or the intermediate (cumene hydroperoxide) involved in this process.

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2. An organic compound gives a positive semicarbazide test and on reduction produces propan-2-ol. The compound is:

(A) Propanal

(B) Propanone

(C) Ethanal

(D) Methanal

Correct Answer: (2) Propanone

Solution:

Concept:

Semicarbazide reacts with aldehydes and ketones containing the carbonyl group.

The reaction forms crystalline derivatives called semicarbazones.

$$RCHO + H_2NNHCONH_2 \rightarrow RCH = NNHCONH_2$$

$$RCOR' + H_2NNHCONH_2 \rightarrow RC(= NNHCONH_2)R'$$

Thus, a positive semicarbazide test confirms the presence of a carbonyl compound.

The second clue given in the question is reduction.

Reduction of:

- Aldehydes gives primary alcohols.
- Ketones gives secondary alcohols.

Therefore, both pieces of information must be used simultaneously.

Step 1: Interpretation of semicarbazide test.

Since the compound gives a positive semicarbazide test, it must contain:

$$> C = O$$

Therefore the compound is either:

- An aldehyde
- A ketone

All four options except alcohols satisfy this condition.

Step 2: Use the reduction clue.

The reduction product is:

Propan-2-ol

Structure:

$$CH_3CHOHCH_3$$

This is a secondary alcohol.

Since ketones reduce to secondary alcohols, the original compound must be a ketone.

Step 3: Identify the ketone.

The ketone having three carbon atoms is:

$$CH_3COCH_3$$

which is propanone.

Reduction:

$$CH_3COCH_3 \xrightarrow{[H]} CH_3CHOHCH_3$$

The product formed is exactly propan-2-ol.

Step 4: Verification of other options.

Propanal reduces to:

$$CH_3CH_2CH_2OH$$

which is propan-1-ol.

Ethanal reduces to ethanol.

Methanal reduces to methanol.

None of these gives propan-2-ol.

Therefore:

Propanone

Quick Tip: Remember:

Aldehyde → Primary Alcohol

Ketone → Secondary Alcohol

A positive semicarbazide test confirms the presence of a carbonyl group.

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3. Consider the following reaction sequence:

$$2CH_3CHO \xrightarrow{\text{Dil. NaOH}} X$$

$$X \xrightarrow{\Delta} Y$$

The major product Y formed in the above reaction is:

(A) Ethanol

(B) Butanal

(C) Crotonaldehyde

(D) Acetic acid

Correct Answer: (3) Crotonaldehyde

Solution:

Concept:

Aldehydes containing at least one α-hydrogen atom undergo aldol condensation in the presence of dilute alkali. The reaction initially forms a β-hydroxy aldehyde (aldol), which on heating loses water to produce an α,β-unsaturated aldehyde.

This is one of the most important name reactions from NCERT and has recently become a favorite topic for CUET due to its conceptual nature.

Step 1: Identify whether ethanal can undergo aldol condensation.

The given compound is ethanal:

$$CH_3CHO$$

The carbon adjacent to the carbonyl carbon contains hydrogen atoms known as α-hydrogens. Since ethanal contains α-hydrogen atoms, it undergoes aldol condensation.

Step 2: Formation of aldol.

Two molecules of ethanal combine to form:

$$CH_3CH(OH)CH_2CHO$$

This compound is called:

3-Hydroxybutanal

or simply aldol.

Step 3: Dehydration of aldol.

Upon heating:

$$CH_3CH(OH)CH_2CHO \xrightarrow{\Delta} CH_3CH=CHCHO + H_2O$$

The product formed is:

Crotonaldehyde

Step 4: Analysis of options.

- Ethanol is not formed.
- Butanal is not formed.
- Crotonaldehyde is the dehydration product.
- Acetic acid is not produced.

Therefore:

Crotonaldehyde

Quick Tip: Remember:

Aldol Condensation

always produces a β-hydroxy carbonyl compound initially, which upon heating forms an α, β-unsaturated carbonyl compound.

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4. The magnetic moment of a transition metal complex is found to be 4.90 BM. The number of unpaired electrons present is:

(A) 2

(B) 3

(C) 4

(D) 5

Correct Answer: (3) 4

Solution:

Concept:

Magnetic moment is calculated using the spin-only formula:

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

where:

- μ = magnetic moment in BM
- n = number of unpaired electrons

Step 1: Substitute the given value.

$$4.90 = \sqrt{n(n+2)}$$

Squaring both sides:

$$24.01 = n(n+2)$$

Step 2: Find suitable value of n.

For $n = 4$:

$$4(4+2) = 24$$

$$\sqrt{24} = 4.90$$

The value matches perfectly.

Step 3: Conclusion.

Number of unpaired electrons:

$$\boxed{4}$$

Quick Tip: Important values:

$$1.73 \rightarrow 1$$

$$2.83 \rightarrow 2$$

$$3.87 \rightarrow 3$$

$$4.90 \rightarrow 4$$

$$5.92 \rightarrow 5$$

These values are frequently asked in CUET.

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5. Which of the following statements regarding actinoids is correct?

(A) All actinoids show only +3 oxidation state

(B) Actinoids exhibit a wider range of oxidation states than lanthanoids

(C) Actinoids are less radioactive than lanthanoids

(D) Actinoids do not form complexes

Correct Answer: (2) Actinoids exhibit a wider range of oxidation states than lanthanoids

Solution:

Concept:

Actinoids belong to the 5f-block of the periodic table. Due to the small energy difference between 5f, 6d and 7s orbitals, they exhibit multiple oxidation states.

This is one of the most important NCERT facts.

Step 1: Understand oxidation states.

Common oxidation states of actinoids are:

$$+3, +4, +5, +6, +7$$

Examples:

$$U^{3+}, U^{4+}, U^{5+}, U^{6+}$$

Step 2: Compare with lanthanoids.

Lanthanoids mainly show:

$$+3$$

oxidation state.

Hence actinoids display greater variability.

Step 3: Analyze options.

Only statement (B) is correct.

Therefore:

Actinoids exhibit a wider range of oxidation states

Quick Tip: Actinoids:

- Highly radioactive
- Variable oxidation states
- Strong complex formation tendency

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6. For a second-order reaction, the unit of rate constant is:

(A) s^{-1}

(B) $mol\, L^{-1}s^{-1}$

(C) $L\, mol^{-1}s^{-1}$

(D) $L^2 mol^{-2}s^{-1}$

Correct Answer: (3) $L\, mol^{-1}s^{-1}$

Solution:

Concept:

For an n^{th} order reaction:

$$[k] = (\text{concentration})^{1-n}(\text{time})^{-1}$$

Step 1: Write rate law.

For second-order reaction:

$$Rate = k[A]^2$$

Step 2: Substitute units.

Rate:

$$molL^{-1}s^{-1}$$

Concentration:

$$molL^{-1}$$

Therefore:

$$k = \frac{molL^{-1}s^{-1}}{(molL^{-1})^2}$$

$$= Lmol^{-1}s^{-1}$$

Step 3: Conclusion.

$$\boxed{Lmol^{-1}s^{-1}}$$

Quick Tip: Common units:

$$0^{th} : molL^{-1}s^{-1}$$

$$1^{st} : s^{-1}$$

$$2^{nd} : Lmol^{-1}s^{-1}$$

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7. Which reagent converts phenol into salicylaldehyde?

(A) Reimer-Tiemann reagent

(B) Tollen's reagent

(C) Fehling solution

(D) Lucas reagent

Correct Answer: (1) Reimer-Tiemann reagent

Solution:

Concept:

Phenol reacts with chloroform and aqueous sodium hydroxide to produce salicylaldehyde. This reaction is known as:

Reimer-Tiemann Reaction

Step 1: Write reagents.

$$Phenol + CHCl_3 + NaOH$$

Step 2: Formation of dichlorocarbene.

Chloroform generates:

$$: CCl_2$$

which attacks the activated benzene ring.

Step 3: Formation of salicylaldehyde.

The major product obtained is:

$$o-\text{Hydroxybenzaldehyde}$$

commonly called salicylaldehyde.

Thus:

Reimer-Tiemann Reagent

Quick Tip: Remember:

$$Phenol \xrightarrow[NaOH]{CHCl_3} Salicylaldehyde$$

This reaction is asked repeatedly in CUET and Boards.

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8. Which of the following complexes is diamagnetic?

(A) $[Fe(H_2O)_6]^{2+}$

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

(C) $[Mn(H_2O)_6]^{2+}$

(D) $[CoF_6]^{3-}$

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

Solution:

Concept:

Diamagnetic compounds contain no unpaired electrons.

CN^- is a strong field ligand and causes pairing of electrons.

Step 1: Determine oxidation state.

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

$$Ni = +2$$

Electronic configuration:

$$3d^8$$

Step 2: Effect of CN^-.

Strong field ligand causes pairing.

Square planar geometry is formed.

All electrons become paired.

Step 3: Conclusion.

The complex is diamagnetic.

$$\boxed{[Ni(CN)_4]^{2-}}$$

Quick Tip: Strong field ligands:

$$CN^-, CO, NH_3$$

often produce low-spin or diamagnetic complexes.

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9. Which reagent is used to distinguish between ethanal and propanone?

(A) Tollen's reagent

(B) Sodium hydroxide

(C) Ethanol

(D) Acetic acid

Correct Answer: (1) Tollen's reagent

Solution:

Concept:

Tollen's reagent distinguishes aldehydes from ketones.

Composition:

$$[Ag(NH_3)_2]^+$$

Aldehydes reduce silver ions to metallic silver.

Step 1: Analyze ethanal.

Ethanal is an aldehyde.

$$CH_3CHO$$

It gives silver mirror test.

Step 2: Analyze propanone.

Propanone is a ketone.

$$CH_3COCH_3$$

It does not reduce Tollen's reagent.

Step 3: Observation.

Ethanal:

Silver Mirror

Propanone:

No reaction

Thus distinction is possible.

Tollen's reagent

Quick Tip: Tollen's test:

Aldehyde → Silver Mirror

Ketone → No Reaction

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10. The major product obtained when benzene diazonium chloride is heated with water is:

(A) Chlorobenzene

(B) Phenol

(C) Benzaldehyde

(D) Benzoic acid

Correct Answer: (2) Phenol

Solution:

Concept:

Diazonium salts undergo hydrolysis on heating with water.

The diazonium group is replaced by hydroxyl group.

This is a very important NCERT reaction.

Step 1: Write the reaction.

$$C_6H_5N_2^+Cl^- + H_2O$$

$$\xrightarrow{\Delta} C_6H_5OH + N_2 + HCl$$

Step 2: Identify product.

The hydroxyl group replaces the diazonium group.

Thus:

$$C_6H_5OH$$

is produced.

Step 3: Conclusion.

The final product is:

$$\boxed{\text{Phenol}}$$

Quick Tip: Important conversions:

$$Diazonium\ Salt \rightarrow Phenol$$

upon heating with water.

Always remember that nitrogen gas is liberated during the reaction.
