CUET 2026 May 26 Shift 1 Chemistry

Question Paper (Memory-Based) with Solutions

Conducted by National Testing Agency (NTA)

1. Given below are two statements :

Given: Molar masses of C, H, O, Cl are 12, 1, 16 and 35.5 g mol^{-1} respectively.

Statement I: In 30%(w/w) solution of methanol in CCl_4 (at T K), the mole fraction of CCl_4 is equal to 0.33.

Statement II: Mixture of methanol and CCl_4 shows positive deviation from Raoult's law.

In the light of the above statements, choose the correct answer from the option given below :

(1) Both Statement I and Statement II are true

(2) Both Statement I and Statement II are false

(3) Statement I is true but Statement II is false

(4) Statement I is false but Statement II is true

Correct Answer: (4) Statement I is false but Statement II is true

Solution:

Concept:

Mole fraction is defined as:

$$X_i = \frac{\text{Number of moles of component } i}{\text{Total number of moles}}$$

For solutions showing deviation from Raoult's law:

- Positive deviation occurs when solute-solvent interactions are weaker than solute-solute and solvent-solvent interactions.
- Negative deviation occurs when solute-solvent interactions are stronger.

Methanol is a hydrogen-bonded polar compound whereas CCl_4 is non-polar. Mixing them weakens intermolecular attractions and hence the solution shows positive deviation from Raoult's law.

Step 1: Calculation of mole fraction of CCl_4.

A 30%(w/w) solution of methanol in CCl_4 means:

$$30 \text{ g methanol} + 70 \text{ g } CCl_4$$

Molar mass of methanol (CH_3OH):

$$12 + 4(1) + 16 = 32 \text{ g mol}^{-1}$$

Number of moles of methanol:

$$n_{CH_3OH} = \frac{30}{32} = 0.9375$$

Molar mass of CCl_4:

$$12 + 4(35.5)$$

$$= 12 + 142$$

$$= 154 \text{ g mol}^{-1}$$

Number of moles of CCl_4:

$$n_{CCl_4} = \frac{70}{154}$$

$$= 0.4545$$

Total moles:

$$0.9375 + 0.4545 = 1.392$$

Mole fraction of CCl_4:

$$X_{CCl_4} = \frac{0.4545}{1.392}$$

$$= 0.326 \approx 0.33$$

Thus, Statement I is **true**.

Step 2: Checking Statement II regarding deviation from Raoult's law.

Methanol molecules are strongly hydrogen bonded in pure state.

CCl_4 molecules are non-polar and interact mainly through weak van der Waals forces.

When methanol and CCl_4 are mixed:

- The strong hydrogen bonding between methanol molecules gets disrupted.
- The new methanol-CCl_4 interactions are weaker than original methanol-methanol interactions.

Therefore:

$$A - B < A - A \text{ and } B - B$$

Hence, escaping tendency of molecules increases and vapour pressure becomes greater than expected.

Therefore, the mixture shows:

$$\text{Positive deviation from Raoult's law}$$

Thus, Statement II is also **true**.

Hence, both Statement I and Statement II are true.

$$\boxed{\text{(1) Both Statement I and Statement II are true}}$$

Quick Tip: For $w/w\%$ problems:

$$\text{Mass percentage} = \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$$

Always convert masses into moles before calculating mole fraction.

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2. Which statements are True?

A. In Hoffmann bromamide degradation, 4 moles of NaOH and 2 moles of Br_2 are consumed per mole of an amide.

B. Hoffmann bromamide reaction is not given by alkyl amides.

C. Primary amines can be synthesized by Hoffmann bromamide degradation.

D. Secondary amide on reaction with Br_2 and NaOH will give secondary amine.

E. The by-products of Hoffmann degradation are Na_2CO_3, NaBr and H_2O.

Choose the correct answer from the options given below:

(1) A, C and E only

(2) B, C and D only

(3) C and E only

(4) C, D and E only

Correct Answer: (3) C and E only

Solution:

Concept:

Hoffmann bromamide degradation (also called Hoffmann rearrangement) converts a primary amide into a primary amine containing one carbon less than the parent amide.

General reaction:

$$\mathrm{RCONH_2 + Br_2 + 4NaOH \rightarrow RNH_2 + Na_2CO_3 + 2NaBr + 2H_2O}$$

Important points:

- Only primary amides undergo Hoffmann bromamide degradation.
- Product formed is a primary amine.
- One carbon atom is lost during the reaction.

Step 1: Checking Statement A.

From the balanced Hoffmann bromamide degradation reaction:

$$\mathrm{RCONH_2 + Br_2 + 4NaOH \rightarrow RNH_2 + Na_2CO_3 + 2NaBr + 2H_2O}$$

We observe:

- 1 mole of Br_2 is consumed
- 4 moles of NaOH are consumed

But Statement A says:

$$\text{2 moles of } \mathrm{Br_2}$$

which is incorrect.

Hence, Statement A is **false**.

Step 2: Checking Statement B.

Hoffmann bromamide degradation is shown by:

$$\mathrm{RCONH_2}$$

where R can be:

- Alkyl group
- Aryl group

Thus, alkyl amides definitely undergo Hoffmann degradation.

Example:

$$CH_3CONH_2 \rightarrow CH_3NH_2$$

Therefore, Statement B is **false**.

Step 3: Checking Statement C.

Primary amides on Hoffmann degradation produce primary amines.

Example:

$$C_6H_5CONH_2 \rightarrow C_6H_5NH_2$$

Thus, primary amines can indeed be synthesized by this method.

Hence, Statement C is **true**.

Step 4: Checking Statement D.

Secondary amides do not undergo Hoffmann bromamide degradation because the reaction mechanism requires the presence of:

$$-CONH_2$$

group.

Secondary amides contain:

$$-CONHR$$

Therefore, secondary amides do not form secondary amines in this reaction.

Hence, Statement D is **false**.

Step 5: Checking Statement E.

The balanced reaction clearly shows by-products:

$$Na_2CO_3,\ NaBr,\ H_2O$$

Hence, Statement E is **true**.

Thus, only statements C and E are true.

$$\boxed{\text{(3) C and E only}}$$

Quick Tip: Hoffmann bromamide degradation:

$$RCONH_2 \to RNH_2$$

Always remember:

- Only primary amides react
- One carbon atom is lost
- Product formed is always a primary amine

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3. The incorrect statement from the following with respect to carbohydrates is :

(1) All monosaccharides are reducing sugars.

(2) The monosaccharide units obtained from hydrolysis of oligosaccharides are always the same.

(3) Starch and cellulose are typical examples of polysaccharides, which are very high molecular weight compounds of more than ten monosaccharide units.

(4) Open chain and cyclic structures co-exist at equilibrium that are responsible for certain properties as in the case of D-(+)-glucose.

Correct Answer: (2) The monosaccharide units obtained from hydrolysis of oligosaccharides are always the same.

Solution:

Concept:

Carbohydrates are polyhydroxy aldehydes or ketones or compounds that produce them upon hydrolysis.

They are classified into:

- Monosaccharides
- Oligosaccharides
- Polysaccharides

Reducing sugars contain a free aldehydic or ketonic group capable of reducing Fehling's solution or Tollens' reagent.

Step 1: Checking Statement (1).

All monosaccharides possess either:

- Free aldehyde group
- Or ketone group capable of tautomerisation

Therefore, all monosaccharides act as reducing sugars.

Examples:

$$\text{Glucose, fructose, galactose}$$

Thus, Statement (1) is correct.

Step 2: Checking Statement (2).

Oligosaccharides may produce:

- Same monosaccharide units
- Different monosaccharide units

Example:

- Sucrose on hydrolysis gives glucose and fructose.

Since the hydrolysis products are not always identical, the statement saying "always the same" is incorrect.

Hence, Statement (2) is incorrect.

Step 3: Checking Statement (3).

Polysaccharides contain large numbers of monosaccharide units.

Starch and cellulose are classical examples of polysaccharides.

They possess:

$$n > 10$$

monosaccharide units and very high molecular masses.

Hence, Statement (3) is correct.

Step 4: Checking Statement (4).

Glucose exists in equilibrium between:

- Open chain structure
- Cyclic hemiacetal structures

This equilibrium explains phenomena like:

- Mutarotation
- Reducing behaviour

Therefore, Statement (4) is also correct.

Thus, the incorrect statement is:

$$\boxed{(2)}$$

Quick Tip: Remember:

- All monosaccharides are reducing sugars.
- Oligosaccharides may contain same or different monosaccharide units.
- Glucose shows mutarotation because cyclic and open-chain forms coexist.

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4. An organic compound (P) on treatment with aqueous ammonia under hot condition forms compound (Q) which on heating with Br_2 and KOH forms compound (R) having molecular formula C_6H_7N. Name P, Q and R respectively are :

(1) Benzoic acid, benzamide, aniline

(2) Toluic acid, methylbenzamide, 2-methylaniline

(3) Benzoic acid, 4-methylbenzamide, 4-methylaniline

(4) Phenylethanoic acid, phenylethanamide, benzamine

Correct Answer: (1) Benzoic acid, benzamide, aniline

Solution:

Concept:

Carboxylic acids react with ammonia under heating to form amides.

Further, amides on treatment with:

$$Br_2/KOH$$

undergo Hoffmann bromamide degradation to produce primary amines having one carbon atom less.

General reaction:

$$RCONH_2 \xrightarrow{Br_2/KOH} RNH_2$$

Step 1: Identifying compound R.

Given:

$$R$$

has molecular formula:

$$C_6H_7N$$

This corresponds to:

$$C_6H_5NH_2$$

which is aniline.

Thus:

$$R = \text{aniline}$$

Step 2: Finding compound Q.

In Hoffmann degradation:

$$RCONH_2 \rightarrow RNH_2$$

If the product is aniline:

$$C_6H_5NH_2$$

then the amide must be:

$$C_6H_5CONH_2$$

which is benzamide.

Thus:

$$Q = \text{benzamide}$$

Step 3: Finding compound P.

Benzamide is formed from benzoic acid by treatment with ammonia and heating.

Reaction:

$$C_6H_5COOH \xrightarrow{NH_3,\ \text{heat}} C_6H_5CONH_2$$

Thus:

$$P = \text{benzoic acid}$$

Hence:

$$P = \text{Benzoic acid}$$

$$Q = \text{Benzamide}$$

$$R = \text{Aniline}$$

Therefore, correct option is:

$$\boxed{(1)}$$

Quick Tip: In Hoffmann bromamide degradation:

$$\mathrm{RCONH_2 \longrightarrow RNH_2}$$

the product amine always contains one carbon atom less than the parent amide.

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5. An organic compound P of molecular formula $C_6H_{12}O_3$ gives positive iodoform test but negative Tollens' test. When P is treated with dilute acid, it produces Q. Q gives positive Tollens' test and also iodoform test. Identify compound P.

(1) $CH_3COCH(OCH_3)CH_2OCH_3$

(2) $CH_3COCH_2CH(OCH_3)_2$

(3) $HCOCH_2CH_2CH(OCH_3)_2$

(4) $CH_3COC(OCH_3)_2CH_3$

Correct Answer: (4) $CH_3COC(OCH_3)_2CH_3$

Solution:

Concept:

Iodoform test is given by compounds containing:

$$\mathrm{CH_3CO{-}}$$

group or compounds oxidisable to it.

Tollens' reagent gives positive test mainly with aldehydes.

Acetals and ketals on hydrolysis with dilute acid regenerate carbonyl compounds.

Step 1: Analysing properties of compound P.

Compound P:

- Gives positive iodoform test
- Gives negative Tollens' test

Therefore:

- P must contain methyl ketone functionality or masked methyl ketone.
- It should not contain free aldehyde group.

Step 2: Analysing compound Q.

On hydrolysis with dilute acid:

$$P \rightarrow Q$$

and Q:

- Gives positive Tollens' test
- Gives positive iodoform test

A compound giving both tests is:

$$CH_3CHO$$

that is ethanal.

Ethanal:

- Gives Tollens' test because it is an aldehyde.
- Gives iodoform test because it contains:

$$CH_3CHO$$

Step 3: Identifying the structure of P.

Option (4):

$$CH_3COC(OCH_3)_2CH_3$$

is a ketal derivative.

On acidic hydrolysis:

$$CH_3COC(OCH_3)_2CH_3$$

regenerates:

$$CH_3CHO$$

which satisfies both:

- Positive Tollens' test
- Positive iodoform test

Hence, option (4) is correct.

$$\boxed{(4)}$$

Quick Tip: Remember:

- Iodoform test detects:

  $$CH_3CO-$$

  group.
- Tollens' reagent detects aldehydes.
- Ketals/acetals hydrolyse back to carbonyl compounds in acidic medium.

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6. MnO_4^{2-} **in acidic medium disproportionates to :**

(1) Mn_2O_7 and MnO_2

(2) MnO_4^- and MnO

(3) MnO_4^- and MnO_2

(4) Mn_2O_7 and MnO

Correct Answer: (3) MnO_4^- and MnO_2

Solution:

Concept:

Disproportionation reaction is a reaction in which the same species undergoes:

- Oxidation
- Reduction

simultaneously.

In manganate ion:

$$MnO_4^{2-}$$

oxidation state of manganese is:

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

$$x - 8 = -2$$

$$x = +6$$

Thus, manganese is in:

$$+6$$

oxidation state.

In acidic medium, manganate ion is unstable and undergoes disproportionation.

Step 1: Understanding the oxidation and reduction processes.

During disproportionation:

$$Mn^{+6}$$

undergoes:

- Oxidation to +7
- Reduction to +4

The corresponding compounds are:

For manganese in +7 oxidation state:

$$MnO_4^-$$

For manganese in +4 oxidation state:

$$MnO_2$$

Hence:

$$MnO_4^{2-} \rightarrow MnO_4^- + MnO_2$$

Step 2: Writing the balanced disproportionation reaction.

The balanced reaction in acidic medium is:

$$3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$$

This clearly shows the formation of:

$$MnO_4^-$$

and

$$MnO_2$$

Step 3: Checking all options carefully.

Option (1):

$$Mn_2O_7$$

is manganese(VII) oxide and is not formed in this disproportionation.

Hence incorrect.

Option (2):

$$MnO$$

contains manganese in +2 oxidation state, not formed here.

Hence incorrect.

Option (3):

$$MnO_4^- \text{ and } MnO_2$$

This matches the actual disproportionation products.

Hence correct.

Option (4): Again contains incorrect products.

Thus, the correct answer is:

$$\boxed{(3)\ MnO_4^- \text{ and } MnO_2}$$

Quick Tip: Remember the oxidation states of manganese:

$$MnO_4^- \rightarrow +7$$

$$MnO_4^{2-} \rightarrow +6$$

$$MnO_2 \rightarrow +4$$

Manganate ion (MnO_4^{2-}) is unstable in acidic medium and disproportionates into permanganate and manganese dioxide.

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7. Given below are two statements:

Statement I: Among

$$[Cu(NH_3)_4]^{2+}, [NiO_3]^{2+}, [Ni(NH_3)_6]^{2+} \text{ and } [Mn(H_2O)_6]^{2+},$$

$[Mn(H_2O)_6]^{2+}$ has the maximum number of unpaired electrons.

Statement II: The number of pairs among

$$[NiCl_4]^{2-},\ [NiO_4]^{2-}$$

and

$$[NiO_4],\ [O_4]^{2-}$$

that contain only diamagnetic species is two.

In the light of the above statements, choose the correct answer from the options given below:

(1) Statement I is false but Statement II is true

(2) Both Statement I and Statement II are true

(3) Both Statement I and Statement II are false

(4) Statement I is true but Statement II is false

Correct Answer: (2) Both Statement I and Statement II are true

Solution:

Concept:

The magnetic behaviour of coordination compounds depends on:

- Number of unpaired electrons
- Strength of ligand field
- Electronic configuration of metal ion

Species containing all paired electrons are:

- Diamagnetic

Species containing one or more unpaired electrons are:

- Paramagnetic

Step 1: Checking Statement I.

We determine the number of unpaired electrons in each complex.

$$[\mathrm{Cu(NH_3)_4}]^{2+}$$

Copper:

$$\mathrm{Cu}^{2+} : 3d^9$$

Electronic configuration gives:

$$1$$

unpaired electron.

$$[\mathrm{Ni(NH_3)_6}]^{2+}$$

Nickel:

$$\mathrm{Ni}^{2+} : 3d^8$$

Octahedral complex with ammonia.

Number of unpaired electrons:

$$2$$

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

Manganese:

$$Mn^{2+} : 3d^5$$

Water is a weak field ligand.

Thus high-spin configuration is formed.

Hence:

$$5$$

unpaired electrons are present.

Therefore, among all the given complexes:

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

has maximum number of unpaired electrons.

Thus, Statement I is **true**.

Step 2: Checking Statement II.

First species:

$$[NiCl_4]^{2-}$$

Nickel is:

$$Ni^{2+} : 3d^8$$

Chloride is weak field ligand.

Tetrahedral complex forms.

Complex is paramagnetic with:

$$2$$

unpaired electrons.

Thus, not diamagnetic.

Second species:

$$[Ni(CO)_4]$$

Nickel oxidation state:

$$0$$

Electronic configuration:

$$3d^{10}$$

All electrons are paired.

Hence diamagnetic.

Third species:

$$[NiO_4]^{2-}$$

This species is diamagnetic.

Fourth species:

$$[O_4]^{2-}$$

This species is also diamagnetic.

Thus, two pairs contain only diamagnetic species.

Therefore, Statement II is also **true**.

Hence:

$$\boxed{\text{(2) Both Statement I and Statement II are true}}$$

Quick Tip: Important configurations:

$$Mn^{2+} = 3d^5$$

usually has maximum unpaired electrons.

Also remember:

$$Ni(CO)_4$$

is diamagnetic because nickel attains:

$$3d^{10}$$

configuration.

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8. Identify the correct statements.

A. Arginine and Tryptophan are essential amino acids.

B. Histidine does not contain heterocyclic ring in its structure.

C. Proline is a six membered cyclic ring amino acid.

D. Glycine does not have chiral centre.

E. Cysteine has characteristic feature of side chain as $\mathrm{MeS-CH_2-CH_2-}$

(A) C and E Only

(B) B and E Only

(C) C and D Only

(D) A and D Only

Correct Answer: (D) A and D Only

Solution:

Concept:

Amino acids are classified based on their structure, side chain and nutritional importance.

- Essential amino acids cannot be synthesized by the human body.
- Glycine is achiral because it contains two hydrogen atoms attached to the α-carbon.
- Histidine contains an imidazole heterocyclic ring.
- Proline contains a five-membered cyclic ring.

Step 1: Check statement A

Arginine and Tryptophan are considered essential amino acids.

Hence statement A is correct.

Step 2: Check statement B

Histidine contains an imidazole ring which is heterocyclic.

Hence statement B is incorrect.

Step 3: Check statement C

Proline contains a five-membered cyclic ring and not a six-membered ring.

Hence statement C is incorrect.

Step 4: Check statement D

Glycine has structure $\mathrm{NH_2-CH_2-COOH}$.

Since the central carbon contains two hydrogen atoms, it is achiral.

Hence statement D is correct.

Step 5: Check statement E

The side chain $\mathrm{MeS-CH_2-CH_2-}$ belongs to Methionine and not Cysteine.

Hence statement E is incorrect.

Therefore, the correct statements are A and D only.

Quick Tip:

Remember:

- Glycine is the only achiral amino acid.
- Proline has a five-membered ring.
- Histidine contains an imidazole ring.
- Methionine contains sulfur in thioether form.

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9. The correct statements are:

A. Activation energy for enzyme catalysed hydrolysis of sucrose is lower than that of acid catalysed hydrolysis.

B. During denaturation, secondary and tertiary structures of a protein are destroyed but primary structure remains intact.

C. Nucleotides are joined together by glycosidic linkage between C_1 and C_4 carbons of the pentose sugar.

D. Quaternary structure of proteins represents overall folding of the polypeptide chain.

(A) A, C and D Only

(B) A, B and D Only

(C) A and B Only

(D) B and C Only

Correct Answer: (C) A and B Only

Solution:

Concept:

Proteins and nucleic acids possess different structural levels and bonding patterns.

- Enzymes lower activation energy.
- Denaturation destroys higher structures of proteins.
- Nucleotides are linked by phosphodiester bonds.

- Quaternary structure refers to association of multiple polypeptide chains.

Step 1: Check statement A

Enzymes act as catalysts and lower the activation energy of reactions.

Hence enzyme catalysed hydrolysis has lower activation energy.

Statement A is correct.

Step 2: Check statement B

Denaturation destroys secondary and tertiary structures but peptide bonds remain intact.

Thus primary structure remains unchanged.

Statement B is correct.

Step 3: Check statement C

Nucleotides are connected through $3' - 5'$ phosphodiester linkage and not glycosidic linkage.

Hence statement C is incorrect.

Step 4: Check statement D

Overall folding of a single polypeptide chain represents tertiary structure.

Quaternary structure involves arrangement of multiple chains.

Hence statement D is incorrect.

Therefore, statements A and B only are correct.

Quick Tip:

Important facts:

- Enzymes decrease activation energy.
- Denaturation does not break peptide bonds.
- DNA nucleotides are linked by phosphodiester linkage.
- Tertiary structure represents overall folding of a chain.

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10. The correct order of the rate of the reaction for the following reaction with respect to nucleophiles is:

$$CH_3Br + Nu^- \rightarrow CH_3Nu + Br^-$$

(A) $PhO^- > OH^- > CH_3COO^- > ClO_4^-$ (B) $ClO_4^- > CH_3COO^- > OH^- > PhO^-$ (C) $CH_3COO^- > PhO^- > OH^- >$

(D) $OH^- > PhO^- > CH_3COO^- > ClO_4^-$

Correct Answer: (D) $OH^- > PhO^- > CH_3COO^- > ClO_4^-$

Solution:

Concept:

The reaction shown is an S_N2 nucleophilic substitution reaction.

Rate depends on nucleophilicity of the attacking nucleophile.

- Greater electron density implies stronger nucleophile.
- Resonance decreases nucleophilicity.
- Stable ions are weaker nucleophiles.

Step 1: Compare OH^-

Hydroxide ion has high electron density and no resonance stabilization.

Thus it is a very strong nucleophile.

Step 2: Compare PhO^-

Phenoxide ion undergoes resonance stabilization.

Hence electron density is delocalized and nucleophilicity decreases compared to OH^-.

Step 3: Compare CH_3COO^-

Acetate ion is strongly resonance stabilized.

Thus it is weaker than phenoxide ion.

Step 4: Compare ClO_4^-

Perchlorate ion is highly resonance stabilized and extremely stable.

Hence it is the weakest nucleophile.

Therefore, the correct order is

$$OH^- > PhO^- > CH_3COO^- > ClO_4^-$$

Quick Tip:

For oxygen nucleophiles:

$$\text{Less resonance stabilization} \Rightarrow \text{Greater nucleophilicity}$$

Thus:

$$OH^- > PhO^- > CH_3COO^- > ClO_4^-$$
