CUET 2026 May 15 Shift 1 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. The molar conductivity of $0.5\,\textbf{mol/dm}^3$ solution of $AgNO_3$ with electrolytic conductivity of 5.76×10^{-3} S cm^{-1} at $298\,K$ is:

(A) $0.086\,\text{S cm}^2/\text{mol}$

(B) $28.8\,\text{S cm}^2/\text{mol}$

(C) $2.88\,\text{S cm}^2/\text{mol}$

(D) $11.52\,\text{S cm}^2/\text{mol}$

Correct Answer: (D) $11.52\,\text{S cm}^2/\text{mol}$

Solution:

Concept: Molar conductivity (Λ_m) is defined as the conductance of all ions produced by one mole of an electrolyte dissolved in a given volume of solution.

The relation between molar conductivity and conductivity is:

$$\Lambda_m = \frac{\kappa \times 1000}{C}$$

where:

- Λ_m = molar conductivity (S cm^2/mol)
- κ = conductivity (S cm^{-1})
- C = concentration in (mol L^{-1})

Step 1: Write the given data

Given:

$$\kappa = 5.76 \times 10^{-3}\,\text{S cm}^{-1}$$

$$C = 0.5\,\text{mol dm}^{-3}$$

Since:

$$1\,\text{dm}^3 = 1\,\text{L}$$

therefore:

$$C = 0.5\,\text{mol L}^{-1}$$

Step 2: Apply the molar conductivity formula

$$\Lambda_m = \frac{\kappa \times 1000}{C}$$

Substitute values:

$$\Lambda_m = \frac{5.76 \times 10^{-3} \times 1000}{0.5}$$

Step 3: Simplify the numerator

$$5.76 \times 10^{-3} \times 1000$$

Since:

$$1000 = 10^3$$

$$5.76 \times 10^{-3} \times 10^3 = 5.76$$

Thus:

$$\Lambda_m = \frac{5.76}{0.5}$$

Step 4: Perform the division

$$\frac{5.76}{0.5} = 11.52$$

Therefore:

$$\Lambda_m = 11.52\,\text{S cm}^2/\text{mol}$$

Final Answer:

$$\boxed{11.52\,\text{S cm}^2/\text{mol}}$$

Quick Tip: While calculating molar conductivity, always remember the formula:

$$\Lambda_m = \frac{\kappa \times 1000}{C}$$

where concentration must be in mol L^{-1}.

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2. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R:

Assertion (A): A reaction can have zero activation energy.

Reason (R): The minimum extra amount of energy absorbed by reactant molecules so that their energy becomes equal to threshold value, is called activation energy.

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

(A) Both A and R are true and R is the correct explanation of A

(B) Both A and R are true and R is NOT the correct explanation of A

(C) A is true but R is false

(D) A is false but R is true

Correct Answer: (B) Both A and R are true and R is NOT the correct explanation of A

Solution:

Concept: Activation energy is the minimum energy required by reacting molecules to form the activated complex and undergo successful collision. According to collision theory, only those collisions which possess energy equal to or greater than activation energy lead to product formation.

Some reactions, especially very fast ionic reactions, may have nearly zero activation energy.

Step 1: Analyze Assertion (A)

Assertion states:

A reaction can have zero activation energy.

This statement is true.

Certain reactions occur so rapidly that practically no extra energy barrier exists between reactants and products. Such reactions are considered to have negligible or nearly zero activation energy.

Examples include some ionic reactions occurring in aqueous medium.

Therefore:

Assertion A is true.

Step 2: Analyze Reason (R)

Reason states:

Activation energy is the minimum extra energy required to reach threshold energy.

This is the correct definition of activation energy.

Thus:

Reason R is also true.

Step 3: Check whether R explains A

Although Reason correctly defines activation energy, it does not explain why some reactions can have zero activation energy.

The statement in Reason is only a definition and does not justify the condition of zero activation energy.

Hence:

R is not the correct explanation of A.

Final Answer:

$$\boxed{\text{Both A and R are true and R is NOT the correct explanation of A}}$$

Quick Tip: In Assertion-Reason questions, first check whether each statement is independently true, then verify whether the Reason logically explains the Assertion.

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3. The following data is for a reaction between reactants A and B:

Rate (mol $L^{-1}s^{-1}$)	$[A]$	$[B]$
2×10^{-3}	$0.1\,M$	$0.1\,M$
4×10^{-3}	$0.2\,M$	$0.1\,M$
1.6×10^{-2}	$0.2\,M$	$0.2\,M$

The order of the reaction with respect to A and B, respectively are:

(A) $1, 0$
(B) $0, 1$
(C) $1, 2$
(D) $2, 1$

Correct Answer: (C) $1, 2$

Solution:

Concept: For a reaction:

$$aA + bB \longrightarrow \text{Products}$$

Rate law is:

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

where:

- $m =$ order with respect to A

- $n =$ order with respect to B

Orders are determined experimentally by comparing rate changes with concentration changes.

Step 1: Determine order with respect to A

Compare experiment 1 and 2:

$$\frac{\text{Rate}_2}{\text{Rate}_1} = \frac{4 \times 10^{-3}}{2 \times 10^{-3}} = 2$$

Concentration change:

$$\frac{[A]_2}{[A]_1} = \frac{0.2}{0.1} = 2$$

[B] remains constant.

Thus:

$$2 = 2^m$$

$$m = 1$$

So, order with respect to A is:

$$1$$

Step 2: Determine order with respect to B

Compare experiment 2 and 3:

$$\frac{\text{Rate}_3}{\text{Rate}_2} = \frac{1.6 \times 10^{-2}}{4 \times 10^{-3}} = 4$$

Concentration change:

$$\frac{[B]_3}{[B]_2} = \frac{0.2}{0.1} = 2$$

[A] remains constant.

Thus:

$$4 = 2^n$$

$$n = 2$$

So, order with respect to B is:

$$2$$

Step 3: Write final order pair

$$(m,n) = (1,2)$$

Final Answer:

$$\boxed{(1,2)}$$

Quick Tip: While finding reaction order, compare only those experiments where one reactant concentration changes and the other remains constant.

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4. $t_{99.9\%}$ with respect to $t_{90\%}$ for a first order reaction is:

(A) Two

(B) One

(C) Three

(D) Four

Correct Answer: (C) Three

Solution:

Concept: For a first-order reaction:

$$t = \frac{2.303}{k}\log\frac{a}{a-x}$$

For percentage completion:

$$\frac{a}{a-x} = \frac{100}{\text{unreacted percentage}}$$

Step 1: Calculate $t_{90\%}$

At 90% completion:

$$10\% \text{ reactant remains}$$

Thus:

$$t_{90\%} = \frac{2.303}{k} \log \frac{100}{10}$$

$$= \frac{2.303}{k} \log 10$$

Since:

$$\log 10 = 1$$

$$t_{90\%} = \frac{2.303}{k}$$

Step 2: Calculate $t_{99.9\%}$

At 99.9% completion:

$$0.1\% \text{ reactant remains}$$

Thus:

$$t_{99.9\%} = \frac{2.303}{k} \log \frac{100}{0.1}$$

$$= \frac{2.303}{k} \log 1000$$

Since:

$$\log 1000 = 3$$

$$t_{99.9\%} = \frac{2.303}{k} \times 3$$

Step 3: Find ratio

$$\frac{t_{99.9\%}}{t_{90\%}} = \frac{3\left(\frac{2.303}{k}\right)}{\left(\frac{2.303}{k}\right)}$$

$$= 3$$

Final Answer:

$$\boxed{3}$$

Quick Tip: For first-order reactions:

$$t_{90\%} : t_{99\%} : t_{99.9\%} = 1 : 2 : 3$$

This shortcut is extremely useful in MCQs.

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5. 99% of a first order reaction was completed in 32 minutes. When will 99.9% of the reaction complete?

(A) 48 minute

(B) 49 minute

(C) 46 minute

(D) 50 minute

Correct Answer: (A) 48 minute

Solution:

Concept: For first-order reactions:

$$t = \frac{2.303}{k} \log \frac{a}{a-x}$$

Special results:

$$t_{90\%} = \frac{2.303}{k}$$

$$t_{99\%} = \frac{4.606}{k}$$

$$t_{99.9\%} = \frac{6.909}{k}$$

Hence:

$$t_{99.9\%} = \frac{3}{2} t_{99\%}$$

Step 1: Write given information

Given:

$$t_{99\%} = 32 \text{ minutes}$$

We use relation:

$$\frac{t_{99.9\%}}{t_{99\%}} = \frac{3}{2}$$

Step 2: Calculate $t_{99.9\%}$

$$t_{99.9\%} = \frac{3}{2} \times 32$$

$$= 48 \text{ minutes}$$

Final Answer:

$$\boxed{48 \text{ minutes}}$$

Quick Tip: For first-order reactions:

$$t_{90\%} : t_{99\%} : t_{99.9\%} = 1 : 2 : 3$$

Use this direct ratio method to solve questions quickly.

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6. The slope of Arrhenius Plot ($\ln k$ v/s $\frac{1}{T}$) of the first-order reaction is $-5 \times 10^3\,K$. The value of E_a of the reaction is. Choose the correct option for your answer. [Given $R = 8.314 JK^{-1}mol^{-1}$]

(A) $166\,kJ\ mol^{-1}$

(B) $-83\,kJ\ mol^{-1}$

(C) $41.5\,kJ\ mol^{-1}$

(D) $83.0\,kJ\ mol^{-1}$

Correct Answer: (C) $41.5\,kJ\ mol^{-1}$

Solution:

Concept: The Arrhenius equation explains the dependence of rate constant on temperature. It is expressed as:

$$k = Ae^{-\frac{E_a}{RT}}$$

where:

- $k =$ rate constant
- $A =$ Arrhenius frequency factor
- $E_a =$ activation energy
- $R =$ gas constant
- $T =$ absolute temperature

Taking natural logarithm on both sides converts the equation into linear form:

$$\ln k = \ln A - \frac{E_a}{RT}$$

This equation represents the equation of a straight line:

$$y = mx + c$$

Hence, for a graph of $\ln k$ versus $\frac{1}{T}$:

$$\text{Slope} = -\frac{E_a}{R}$$

Step 1: Writing the relation between slope and activation energy.

For Arrhenius plot:

$$\text{Slope} = -\frac{E_a}{R}$$

Given:

$$\text{Slope} = -5 \times 10^3\, K$$

Substituting into the equation:

$$-\frac{E_a}{R} = -5 \times 10^3$$

Removing negative signs:

$$\frac{E_a}{R} = 5 \times 10^3$$

Therefore:

$$E_a = 5 \times 10^3 \times R$$

Step 2: Substituting the value of gas constant.

Given:

$$R = 8.314 JK^{-1} mol^{-1}$$

Thus:

$$E_a = 5 \times 10^3 \times 8.314$$

$$E_a = 41570 J mol^{-1}$$

Step 3: Converting Joule into kilojoule.

Since:

$$1\, kJ = 1000\, J$$

Therefore:

$$E_a = \frac{41570}{1000}$$

$$E_a = 41.57\, kJ mol^{-1}$$

Approximating:

$$E_a \approx 41.5\, kJ mol^{-1}$$

Final Answer:

$$\boxed{41.5\,kJ\,mol^{-1}}$$

Quick Tip: For Arrhenius plots:

$$\ln k \text{ vs } \frac{1}{T} \Rightarrow \text{Slope} = -\frac{E_a}{R}$$

while

$$\log k \text{ vs } \frac{1}{T} \Rightarrow \text{Slope} = -\frac{E_a}{2.303R}$$

Always check whether the logarithm is natural log or common log.

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7. 'Spin only' magnetic moment is same for which of the following ions?

A. Ti^{3+}

B. Cr^{2+}

C. Mn^{2+}

D. Fe^{2+}

E. Sc^{3+}

Choose the most appropriate answer from the options given below:

(a) B and D only

(b) A and E only

(c) B and C only

(d) A and D only

Correct Answer: (a) B and D only

Solution:

Concept: The spin-only magnetic moment depends on the number of unpaired electrons present in the atom or ion.

Formula:

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

where:

- n = number of unpaired electrons
- BM = Bohr Magneton

If two ions possess the same number of unpaired electrons, they will have the same magnetic moment.

Step 1: Finding the electronic configuration of each ion.

Ti^{3+}
Atomic number of Ti = 22
Electronic configuration:

$$Ti = [Ar]3d^2 4s^2$$

For Ti^{3+}, remove 3 electrons:

$$Ti^{3+} = [Ar]3d^1$$

Number of unpaired electrons:

$$n = 1$$

Cr^{2+}
Atomic number of Cr = 24
Electronic configuration:

$$Cr = [Ar]3d^5 4s^1$$

Removing two electrons:

$$Cr^{2+} = [Ar]3d^4$$

According to Hund's rule:

$$n = 4$$

Mn^{2+}

Atomic number of Mn = 25

$$Mn = [Ar]3d^5 4s^2$$

Removing two electrons:

$$Mn^{2+} = [Ar]3d^5$$

All electrons remain unpaired.

$$n = 5$$

Fe^{2+}

Atomic number of Fe = 26

$$Fe = [Ar]3d^6 4s^2$$

Removing two electrons:

$$Fe^{2+} = [Ar]3d^6$$

In $3d^6$, four electrons remain unpaired.

$$n = 4$$

Sc^{3+}

Atomic number of Sc = 21

$$Sc = [Ar]3d^1 4s^2$$

Removing three electrons:

$$Sc^{3+} = [Ar]3d^0$$

$$n = 0$$

Step 2: Comparing the number of unpaired electrons.

$$Ti^{3+} \Rightarrow n = 1$$

$$Cr^{2+} \Rightarrow n = 4$$

$$Mn^{2+} \Rightarrow n = 5$$

$$Fe^{2+} \Rightarrow n = 4$$

$$Sc^{3+} \Rightarrow n = 0$$

Thus:

$$Cr^{2+} \text{ and } Fe^{2+}$$

have equal unpaired electrons.
Hence both possess same magnetic moment.

Final Answer:

$$\boxed{\text{B and D only}}$$

Quick Tip: For d^n configuration:

$$n \leq 5 \Rightarrow \text{Unpaired electrons} = n$$

$$n > 5 \Rightarrow \text{Unpaired electrons} = 10 - n$$

This shortcut helps in rapid calculation of magnetic moments.

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8. Which of the following set of ions act as oxidizing agents?

(a) Ce^{4+} and Tb^{4+}

(b) La^{3+} and Lu^{3+}

(c) Eu^{2+} and Yb^{2+}

(d) Eu^{2+} and Tb^{4+}

Correct Answer: (a) Ce^{4+} and Tb^{4+}

Solution:

Concept: Lanthanoids most commonly exhibit the +3 oxidation state. Ions existing in oxidation states other than +3 tend to convert back into the more stable +3 state.

- +4 ions gain electrons and get reduced to +3, hence act as oxidizing agents.
- +2 ions lose electrons and get oxidized to +3, hence act as reducing agents.

Step 1: Analyzing Ce^{4+} and Tb^{4+}.

$$Ce^{4+} \rightarrow Ce^{3+}$$

Since Ce^{4+} gains an electron, it gets reduced.
Thus, it behaves as an oxidizing agent.
Similarly:

$$Tb^{4+} \rightarrow Tb^{3+}$$

It also gets reduced easily.

Hence Tb^{4+} also acts as an oxidizing agent.

Step 2: Checking other options.

Option (b)

$$La^{3+} \text{ and } Lu^{3+}$$

Both are already in their stable oxidation state.

Hence they do not act as strong oxidizing agents.

Option (c)

$$Eu^{2+} \text{ and } Yb^{2+}$$

These ions tend to lose electrons:

$$Eu^{2+} \rightarrow Eu^{3+}$$

$$Yb^{2+} \rightarrow Yb^{3+}$$

Hence they act as reducing agents, not oxidizing agents.

Option (d)

$$Eu^{2+}$$

is reducing in nature while

$$Tb^{4+}$$

is oxidizing in nature.

Thus both are not oxidizing agents together.

Final Answer:

$$\boxed{Ce^{4+} \text{ and } Tb^{4+}}$$

Quick Tip: In Lanthanoids:

$$+4 \rightarrow +3$$

means reduction, so the ion acts as an oxidizing agent.

$$+2 \rightarrow +3$$

means oxidation, so the ion acts as a reducing agent.

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9. Assertion (A): Ionization enthalpy increases along each series of transition elements from left to right. However, small variations occur.

Reason (R): There is a corresponding increase in nuclear charge which accompanies the filling of electrons in the inner d-orbitals.

(a) (A) is correct but (R) is not correct

(b) (A) is not correct but (R) is correct

(c) Both (A) and (R) are correct and (R) is the correct explanation of (A)

(d) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

Correct Answer: (c) Both (A) and (R) are correct and (R) is the correct explanation of (A)

Solution:

Concept: Ionization enthalpy is the minimum energy required to remove the most loosely bound electron from an isolated gaseous atom.
It mainly depends upon:

- Effective nuclear charge
- Atomic size
- Shielding effect
- Stability of electronic configuration

Step 1: Analyzing the Assertion.

Across the transition series, atomic number increases continuously.

As protons increase, nuclear charge also increases.

Electrons are added into inner d-orbitals, but d-electrons do not shield effectively.

Therefore outer electrons experience stronger attraction from nucleus.

Hence more energy is required to remove electrons.

Thus ionization enthalpy generally increases from left to right.

However, due to:

- half-filled stability
- fully-filled stability
- electron repulsion

small irregular variations occur.

Hence Assertion is true.

Step 2: Analyzing the Reason.

Reason states that nuclear charge increases while electrons are filled in inner d-orbitals.

This statement is correct.

Increase in nuclear charge causes stronger attraction on valence electrons.

Hence ionization enthalpy increases.

Step 3: Checking the relationship between A and R.

The Reason directly explains why ionization enthalpy increases across transition series.

Therefore:

$$\text{Both A and R are true and R correctly explains A.}$$

Final Answer:

$$\boxed{\text{Both A and R are true and R correctly explains A}}$$

Quick Tip: d-electrons shield poorly compared to s- and p-electrons. Hence effective nuclear charge increases significantly across transition series.

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10. The incorrect statement among the following is :

(a) Lanthanoids are good conductors of heat and electricity.

(b) Actinoids are highly reactive metals, especially when finely divided.

(c) Actinoid contraction is greater for element-to-element than Lanthanoid contraction.

(d) Most of the trivalent Lanthanoid ions are colourless in the solid state.

Correct Answer: (d) Most of the trivalent Lanthanoid ions are colourless in the solid state.

Solution:

Concept: Lanthanoids and Actinoids belong to the f-block elements and exhibit characteristic properties such as variable oxidation states, contraction, color, magnetic behavior, and high metallic character.

Step 1: Checking statement (a).

Lanthanoids are metallic elements.
They possess free electrons responsible for metallic conductivity.
Therefore they conduct:

- Heat
- Electricity

efficiently.
Hence statement (a) is correct.

Step 2: Checking statement (b).

Actinoids are highly electropositive metals.
Finely divided actinoids react rapidly because surface area increases significantly.
Hence statement (b) is correct.

Step 3: Checking statement (c).

Actinoid contraction is larger because:

- $5f$-electrons shield very poorly
- effective nuclear charge increases strongly

Thus contraction becomes greater than lanthanoid contraction.
Hence statement (c) is correct.

Step 4: Checking statement (d).

Most trivalent lanthanoid ions are actually colored due to $f-f$ electronic transitions.
Only ions having:

$$f^0,\ f^7,\ f^{14}$$

configurations are generally colorless.
Examples:

$$La^{3+},\ Gd^{3+},\ Lu^{3+}$$

Since most lanthanoid ions are colored, statement (d) is incorrect.

Final Answer:

$$\boxed{\text{Most of the trivalent Lanthanoid ions are colourless in the solid state}}$$

Quick Tip: Color in Lanthanoids arises due to $f-f$ transitions. Ions with completely empty, half-filled, or completely filled f-orbitals are generally colorless.
