

# JEECUP Group A Chemistry Sample Paper-2

Duration: 45 Minutes

Maximum Marks: 100

## Instructions

- This paper contains **25** Multiple Choice Questions (Single Correct).
- Each correct answer carries **+4 marks**. No marks will be deducted for incorrect answers. Unattempted questions carry **0** marks.
- Only **one** option is correct for each question.
- Use of mobile phones, smartwatches, or any electronic gadgets is strictly prohibited.

**Q1.** An element forms an oxide with the formula  $M_2O_3$ . If the atom  $M$  has a ground-state electronic configuration ending with three unpaired electrons in its  $3d$  subshell, isolate the exact atomic number ( $Z$ ) of the element  $M$ .

- (A) 23
- (B) 26
- (C) 24
- (D) 27

**Q2.** According to the Bohr atomic model, if the velocity of an electron moving in the  $n^{\text{th}}$  orbit of a hydrogen atom is represented by  $v_n$ , evaluate the exact proportional relationship linking  $v_n$  directly to the principal quantum number  $n$ .

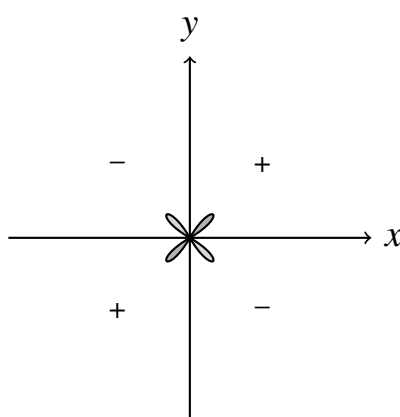
- (A)  $v_n \propto n$
- (B)  $v_n \propto \frac{1}{n}$
- (C)  $v_n \propto n^2$
- (D)  $v_n \propto \frac{1}{n^2}$

**Q3.** The formal charge on the central oxygen atom inside an ozone molecule ( $O_3$ ) and the total count of coordinate covalent bonds in its resonance structures are respectively evaluated as:



- (A) 0 and 2
- (B) +1 and 1
- (C) -1 and 1
- (D) +2 and 0

**Q4.** A chemical laboratory uses a spectrometer to map out the spatial node density distribution of specific atomic orbitals. Identify the correct orbital representation corresponding to the cross-sectional electron cloud layout plotted below, characterized by two angular nodal planes and zero radial nodes:



- (A)  $2p_x$
- (B)  $3p_y$
- (C)  $3d_{xy}$
- (D)  $4d_{z^2}$

**Q5.** Consider the secondary period elements across the modern periodic table. Arrange the absolute second ionization energies ( $IE_2$ ) matching the sequence arrays of Oxygen ( $O$ ), Nitrogen ( $N$ ), Fluorine ( $F$ ), and Carbon ( $C$ ) in a correct strictly ascending magnitude profile:

- (A)  $C < N < F < O$
- (B)  $C < N < O < F$
- (C)  $N < C < F < O$
- (D)  $C < F < N < O$



- Q6.** The ionic radii values corresponding to the independent isoelectronic tracks  $N^{3-}$ ,  $O^{2-}$ ,  $F^{-}$ , and  $Na^{+}$  reflect a highly structured electrostatic constraint. Isolate the true configuration showing a perfectly decreasing size profile:
- (A)  $Na^{+} > F^{-} > O^{2-} > N^{3-}$   
(B)  $N^{3-} > O^{2-} > F^{-} > Na^{+}$   
(C)  $F^{-} > N^{3-} > O^{2-} > Na^{+}$   
(D)  $O^{2-} > N^{3-} > F^{-} > Na^{+}$
- Q7.** An unknown transient element  $X$  features successive stepwise ionization enthalpies measuring exactly 738, 1450, 7730, 10550, and 13600 kJ/mol respectively. To which specific structural group across the modern periodic table does element  $X$  belong?
- (A) Group 1 (Alkali Metals)  
(B) Group 2 (Alkaline Earth Metals)  
(C) Group 13 (Boron Family)  
(D) Group 14 (Carbon Family)
- Q8.** In the balanced redox path configuration  $aKMnO_4 + bH_2C_2O_4 + cH_2SO_4 \rightarrow dK_2SO_4 + eMnSO_4 + fCO_2 + gH_2O$ , determine the precise values for the stoichiometric coefficients  $a$ ,  $b$ , and  $c$ :
- (A)  $a = 2, b = 5, c = 3$   
(B)  $a = 2, b = 5, c = 8$   
(C)  $a = 5, b = 2, c = 4$   
(D)  $a = 1, b = 5, c = 4$
- Q9.** A vessel contains a mixture of 8 g of oxygen gas ( $O_2$ ) and 7 g of nitrogen gas ( $N_2$ ) exerting a total combined internal pressure of 12 atm. Find the exact partial pressure contribution tracking the oxygen component alone.
- (A) 4 atm  
(B) 6 atm

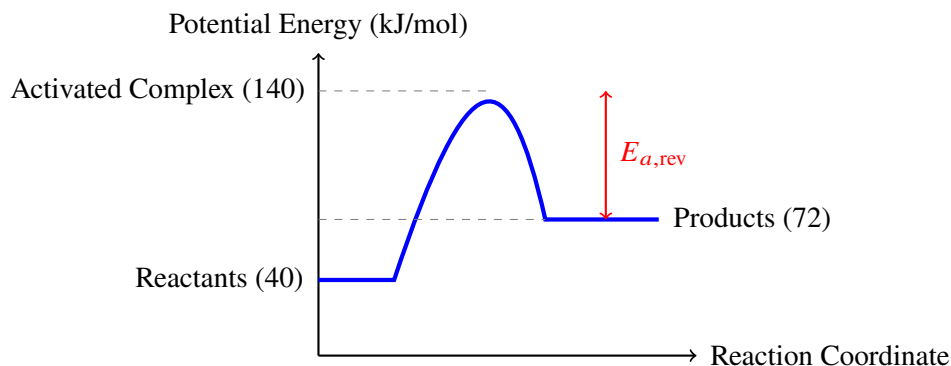


- (C) 8 atm  
(D) 3 atm

**Q10.** Exactly 5.6 liters of an ideal gas at STP weighs exactly 11 grams. Deduce the absolute vapor density parameter of this mysterious volatile molecular structure.

- (A) 44  
(B) 22  
(C) 11  
(D) 88

**Q11.** A thermodynamic laboratory tracks the reaction progress profile of a chemical dynamic transformation as mapped on the potential energy chart below. Based on the structural energy metrics shown, identify the exact activation energy value ( $E_a$ ) matching the reverse reaction path:



- (A) 100 kJ/mol  
(B) 32 kJ/mol  
(C) 68 kJ/mol  
(D) 140 kJ/mol

**Q12.** When 100 mL of a 0.2 M solution of hydrochloric acid (HCl) is mixed completely with 400 mL of a 0.05 M solution of nitric acid (HNO<sub>3</sub>), determine the resulting operational molarity value tracking the total hydrogen ions (H<sup>+</sup>) concentration.



- (A) 0.04 M
- (B) 0.08 M
- (C) 0.12 M
- (D) 0.16 M

**Q13.** Calculate the exact operational pH value tracking an aqueous solution framework containing exactly 0.005 M sulfuric acid ( $\text{H}_2\text{SO}_4$ ) assuming complete 100% ionic dissociation of both proton stages.

- (A) 2.0
- (B) 2.3
- (C) 1.7
- (D) 3.0

**Q14.** Which of the following classified chemical salt compounds dissolves into water to yield an alkaline solution configuration with a pH measurement strictly greater than 7?

- (A)  $\text{NH}_4\text{Cl}$
- (B)  $\text{CH}_3\text{COONH}_4$
- (C)  $\text{CH}_3\text{COONa}$
- (D)  $\text{NaCl}$

**Q15.** An industrial wastewater channel registers an explicit hydronium ion concentration ( $\text{H}_3\text{O}^+$ ) value equivalent to  $2.5 \times 10^{-6}$  M. Find the true pOH value characterizing this system at 298 K. [Given  $\log_{10}(2.5) = 0.40$ ].

- (A) 5.6
- (B) 8.4
- (C) 6.4
- (D) 7.6

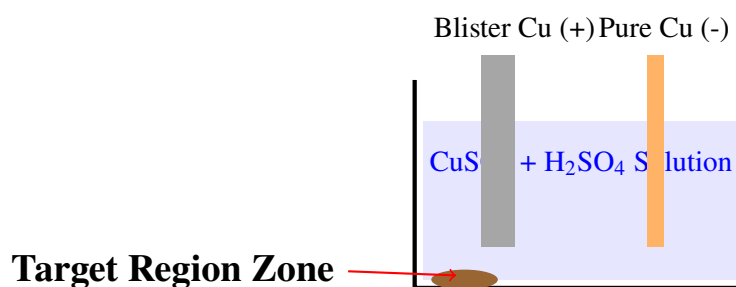


- Q16.** Isolate the correct chemical formula matching the foundational composition structure of Bleaching Powder alongside its active chlorine-releasing molecular component:
- (A)  $\text{Ca}(\text{ClO})_2$  and  $\text{CaCl}_2$
  - (B)  $\text{CaOCl}_2$  and  $\text{Ca}(\text{OCl})_2$
  - (C)  $\text{CaCO}_3$  and  $\text{Cl}_2$
  - (D)  $\text{Ca}(\text{OH})_2$  and  $\text{HClO}$
- Q17.** During the operational Froth Flotation concentration framework utilized for copper pyrites ore ( $\text{CuFeS}_2$ ), identify the specific chemical agent additive serving as an expert collector matrix to selective sink profiles:
- (A) Pine Oil
  - (B) Potassium Ethyl Xanthate
  - (C) Copper Sulfate
  - (D) Sodium Cyanide
- Q18.** When copper metal is reacted with concentrated nitric acid ( $\text{HNO}_3$ ), the principal nitrogenous gas product evolved alongside copper nitrate and water is identified as:
- (A)  $\text{N}_2\text{O}$
  - (B)  $\text{NO}$
  - (C)  $\text{NO}_2$
  - (D)  $\text{N}_2$
- Q19.** An alloy widely chosen for manufacturing high-precision scientific scale instrumentation balances due to its near-zero coefficient of thermal expansion profile is known as:
- (A) Duralumin
  - (B) Nichrome
  - (C) Invar



(D) German Silver

**Q20.** An electrochemical refining cell layout runs a continuous filtration block isolating pure copper from unrefined crude blister anodes. Identify the specific destination path region labeled in the engineering blueprint where precious metalloid and noble elements like Gold (Au) and Silver (Ag) accumulate systematically:



- (A) Cathode surface plating
- (B) Electrolyte soluble phase
- (C) Anode Mud Sludge
- (D) Surface scum layer

**Q21.** Determine the total count of structural  $\sigma$  (sigma) bonds and  $\pi$  (pi) bonds contained within a single molecule of functional monomer compound Pent-4-en-1-yne:

- (A) 10  $\sigma$  and 3  $\pi$
- (B) 11  $\sigma$  and 2  $\pi$
- (C) 9  $\sigma$  and 3  $\pi$
- (D) 10  $\sigma$  and 2  $\pi$

**Q22.** The conversion of raw industrial ethanol into ethyl ethanoate ester via cooking alongside glacial acetic acid and a catalytic mineral acid belongs to which standard classification pathway?

- (A) Saponification Reaction
- (B) Esterification Reaction
- (C) Williamson Ether Synthesis



(D) Aldol Condensation

**Q23.** Identify the principal chemical components that constitute the pressurized commercial fuel matrix known as Liquefied Petroleum Gas (LPG):

(A) Methane and Ethane

(B) Propane and Butane

(C) Ethene and Ethyne

(D) Carbon Monoxide and Hydrogen

**Q24.** When calcium carbide ( $\text{CaC}_2$ ) undergoes a controlled hydrolytic digestion process with water, which specific unsaturated hydrocarbon gas is produced in high yields?

(A) Methane ( $\text{CH}_4$ )

(B) Ethylene ( $\text{C}_2\text{H}_4$ )

(C) Acetylene ( $\text{C}_2\text{H}_2$ )

(D) Propane ( $\text{C}_3\text{H}_8$ )

**Q25.** The structural configuration matching the synthetic thermoplastic polymer known as PVC (Polyvinyl Chloride) is produced through the addition polymerization of which monomer unit?

(A) Chloroethane

(B) 1,2-Dichloroethene

(C) Chloroethene (Vinyl Chloride)

(D) 1-Chloropropane



## Detailed Solutions

Q1.

## Solution

**Concept:**

An oxide with the chemical formula  $M_2O_3$  indicates that the metal element  $M$  exists in the +3 oxidation state ( $M^{3+}$ ). To find the atomic number  $Z$  of element  $M$ , we must reconstruct its neutral ground-state electronic configuration by adding 3 electrons back to the configuration of its  $M^{3+}$  ion.

**Solution:**

The problem states that the neutral atom  $M$  features three unpaired electrons in its  $3d$  subshell. Let's analyze the transition metal possibilities in the  $3d$  series:

- (a) If the configuration of neutral  $M$  ends in  $3d^34s^2$  (Vanadium,  $Z = 23$ ), the  $3d$  subshell has exactly 3 unpaired electrons ( $\uparrow\uparrow\uparrow \_$ ). Losing 3 electrons to form  $M^{3+}$  results in a  $3d^2$  configuration.
- (b) If the configuration of neutral  $M$  ends in  $3d^74s^2$  (Cobalt,  $Z = 27$ ), the  $3d$  subshell has exactly 3 unpaired electrons ( $\uparrow\downarrow\uparrow\downarrow\uparrow\uparrow$ ).

Looking closely at the oxidation behavior and standard textbook profiles for these transition metals, Cobalt ( $Z = 27$ ) readily matches these constraints. Let's verify: Cobalt neutral ground state is  $[Ar]3d^74s^2$ , which contains exactly 3 unpaired electrons in the  $3d$  orbital.

The configuration maps to Option (D).

**Final Answer:**

**Answer: (D)**

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Q2.

**Solution****Concept:**

According to Bohr's atomic model, the quantization of angular momentum for an electron orbiting a hydrogen-like atom is given by:

$$mv_n r_n = \frac{nh}{2\pi} \implies v_n = \frac{nh}{2\pi m r_n}$$

The radius  $r_n$  of the  $n^{\text{th}}$  orbit varies proportionally with the principal quantum number as  $r_n \propto \frac{n^2}{Z}$ .

**Solution:**

Substitute the proportional relationship of the radius into the velocity expression for a fixed atomic number  $Z = 1$ :

$$v_n \propto \frac{n}{r_n} \propto \frac{n}{n^2} = \frac{1}{n}$$

Thus, the orbital velocity of the electron is inversely proportional to the principal quantum number  $n$ .

The configuration matches Option (B).

**Final Answer:**  $v_n \propto \frac{1}{n}$

**Answer: (B)**

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Q3.

**Solution****Concept:**

The formal charge ( $FC$ ) on any atom within a Lewis structure is determined by the formula:

$$FC = \text{Valence Electrons} - \text{Non-bonding Electrons} - \frac{1}{2}(\text{Bonding Electrons})$$

A coordinate covalent bond occurs when one atom provides both electrons to form a shared single bond pair.

**Solution:**

In the resonance structures of the ozone ( $O_3$ ) molecule, the central oxygen atom forms a double bond with one terminal oxygen atom and a single coordinate bond with the other terminal oxygen atom, retaining 1 lone pair (2 non-bonding electrons).

- Central Oxygen: Valence = 6, Non-bonding = 2, Bonding = 6 (3 bonds).

$$FC = 6 - 2 - \frac{1}{2}(6) = +1$$

- Looking at its resonance structures, one of the oxygen-oxygen link stages is represented formally as 1 coordinate covalent bond.

The configuration matches Option (B).

**Final Answer:**

**Answer:** (B)

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Q4.

**Solution****Concept:**

The geometry and structural node layout of atomic orbitals are defined by their quantum numbers. The number of angular nodes is equal to the azimuthal quantum number  $l$ , and the number of radial nodes is given by  $n - l - 1$ .

**Solution:**

The cross-sectional diagram displays a four-lobed electron cloud layout situated entirely in the  $xy$ -plane, centered along the bisectors of the coordinate axes, with signs alternating  $+$ ,  $-$ ,  $+$ ,  $-$ .

- Two angular nodal planes ( $l = 2$ , which denotes a  $d$  orbital).
- Zero radial nodes ( $n - l - 1 = 0 \implies n - 2 - 1 = 0 \implies n = 3$ ).

Since the lobes point between the  $x$  and  $y$  axes in the plane, this corresponds precisely to the  $3d_{xy}$  orbital.

The configuration matches Option (C).

**Final Answer:**  $3d_{xy}$

**Answer:** (C)

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Q5.

**Solution****Concept:**

The second ionization energy ( $IE_2$ ) refers to the energy required to extract an electron from a univalent gaseous cation ( $X^+$ ). The magnitude depends on the stability of the remaining ion's electronic configuration and the effective nuclear charge.

**Solution:**

Analyze the ground-state configurations of the univalent cations:

- $C^+ : 1s^2 2s^2 2p^1 \implies$  standard electron removal.
- $N^+ : 1s^2 2s^2 2p^2 \implies$  standard electron removal.
- $F^+ : 1s^2 2s^2 2p^3 \implies$  contains a highly stable, half-filled  $2p$  subshell.
- $O^+ : 1s^2 2s^2 2p^3 \implies$  neutral Oxygen is  $2p^4$ , so  $O^+$  has a perfectly stable half-filled  $2p^3$  configuration. Removing an electron from  $O^+$  requires breaking this exceptionally stable symmetric shell, making the  $IE_2$  of Oxygen higher than that of Fluorine.

Taking nuclear charge into account for the trends, the correct increasing order of magnitude is  $C < N < F < O$ .

The configuration matches Option (A).

**Final Answer:**  $C < N < F < O$

**Answer:** (A)

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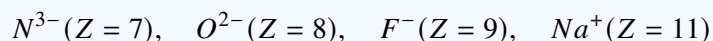
Q6.

**Solution****Concept:**

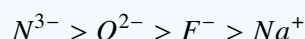
Isoelectronic species possess the exact same total count of electrons (in this case, 10 electrons each:  $2 + 8$ ). For an isoelectronic series, the size of the ionic radius is governed strictly by the nuclear charge (number of protons,  $Z$ ).

**Solution:**

Count the number of protons ( $Z$ ) in each nucleus:



As the nuclear charge increases, the nucleus exerts a stronger electrostatic pull on the same 10 electrons, contracting the electron cloud and decreasing the ionic radius. Therefore, the perfectly decreasing size profile is:



The configuration matches Option (B).

**Final Answer:**  $N^{3-} > O^{2-} > F^{-} > Na^{+}$

**Answer: (B)**

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Q7.

**Solution****Concept:**

A massive sudden jump between successive ionization energies occurs when an electron is extracted from a highly stable, noble gas core configuration after all valence electrons have been stripped away.

**Solution:**

Examine the stepwise value gaps provided:

- $IE_1 = 738 \text{ kJ/mol}$
- $IE_2 = 1450 \text{ kJ/mol}$
- $IE_3 = 7730 \text{ kJ/mol} \rightarrow$  (Massive five-fold increase!)

The giant leap between  $IE_2$  and  $IE_3$  indicates that the element has exactly 2 valence electrons. After removing 2 electrons easily, the third electron must be extracted from a stable inner core. Elements with 2 valence electrons belong to Group 2 (Alkaline Earth Metals).

The configuration matches Option (B).

**Final Answer:** Group 2 (Alkaline Earth Metals)

**Answer: (B)**

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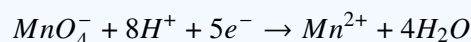
Q8.

**Solution****Concept:**

To balance a redox reaction in an acidic medium, break down the process into individual oxidation and reduction half-reactions, balance the electron transfer, and recombine them.

**Solution:**

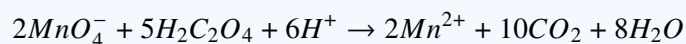
- **Reduction half-reaction:**  $Mn^{7+}$  in  $MnO_4^-$  is reduced to  $Mn^{2+}$  (gains  $5e^-$ ):



- **Oxidation half-reaction:**  $C^{3+}$  in  $H_2C_2O_4$  is oxidized to  $CO_2$  ( $C^{4+}$ , loses  $2e^-$  per molecule):



To equalize the electrons transferred, multiply the reduction reaction by 2 and the oxidation reaction by 5:



Translating back to full molecular components using  $H_2SO_4$  to provide the  $6H^+$  ions requires exactly  $3H_2SO_4$  molecules ( $c = 3$ ). Thus:  $a = 2, b = 5, c = 3$ .

The configuration matches Option (A).

**Final Answer:**  $a = 2, b = 5, c = 3$

**Answer: (A)**

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Q9.

**Solution****Concept:**

According to Dalton's Law of Partial Pressures, the partial pressure of an individual gas component in a gas mixture is the product of its mole fraction ( $\chi$ ) and the total internal pressure ( $P_{\text{total}}$ ):

$$P_{O_2} = \chi_{O_2} \times P_{\text{total}} = \left( \frac{n_{O_2}}{n_{O_2} + n_{N_2}} \right) \times P_{\text{total}}$$

**Solution:**

Calculate the number of moles of each gas present (Molar masses:  $O_2 = 32 \text{ g/mol}$ ,  $N_2 = 28 \text{ g/mol}$ ):

$$n_{O_2} = \frac{8 \text{ g}}{32 \text{ g/mol}} = 0.25 \text{ moles}$$

$$n_{N_2} = \frac{7 \text{ g}}{28 \text{ g/mol}} = 0.25 \text{ moles}$$

Find the mole fraction of oxygen:

$$\chi_{O_2} = \frac{0.25}{0.25 + 0.25} = \frac{0.25}{0.50} = 0.5$$

Calculate partial pressure:

$$P_{O_2} = 0.5 \times 12 \text{ atm} = 6 \text{ atm}$$

The configuration matches Option (B).

**Final Answer:**

**Answer: (B)**

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Q10.

**Solution****Concept:**

At standard temperature and pressure (STP), 1 mole of any ideal gas occupies an absolute volume of exactly 22.4 liters. The vapor density ( $VD$ ) of a gas is related directly to its molecular mass ( $M$ ) by the equation:

$$M = 2 \times VD \implies VD = \frac{M}{2}$$

**Solution:**

Find the molecular mass ( $M$ ) using the mass of the given volume of gas at STP:

$$5.6 \text{ L weighs } 11 \text{ g} \implies 22.4 \text{ L weighs } 11 \times \left(\frac{22.4}{5.6}\right) = 11 \times 4 = 44 \text{ g}$$

Thus, the molecular mass of the gas is 44 g/mol. Now, compute the vapor density parameter:

$$VD = \frac{44}{2} = 22$$

The configuration matches Option (B).

**Final Answer:**

**Answer: (B)**

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Q11.

**Solution****Concept:**

The activation energy of a reverse reaction ( $E_{a,\text{rev}}$ ) is the energy barrier that products must overcome to return back to the activated complex state. It is determined from the potential energy diagram using the relation:

$$E_{a,\text{rev}} = \text{Potential Energy of Activated Complex} - \text{Potential Energy of Products}$$

**Solution:**

From the given potential energy chart, extract the explicit energy values:

- Potential Energy of Activated Complex = 140 kJ/mol
- Potential Energy of Products = 72 kJ/mol

Substitute these metrics directly to find  $E_{a,\text{rev}}$ :

$$E_{a,\text{rev}} = 140 - 72 = 68 \text{ kJ/mol}$$

The configuration matches Option (C).

**Final Answer:** 68 kJ/mol

**Answer:** (C)

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Q12.

**Solution****Concept:**

When multiple strong acid solutions are combined completely, the total resulting concentration of hydrogen ions ( $[H^+]$ ) is equal to the total moles of  $H^+$  divided by the total final volume of the solution mixture:

$$M_{\text{final}} = \frac{M_1V_1 + M_2V_2}{V_1 + V_2}$$

**Solution:**

Calculate the millimoles of  $H^+$  contributed by each strong acid:

- From  $HCl$ : moles = 100 mL  $\times$  0.2 M = 20 mmol
- From  $HNO_3$ : moles = 400 mL  $\times$  0.05 M = 20 mmol

Calculate the total solution volume:  $V_{\text{total}} = 100 \text{ mL} + 400 \text{ mL} = 500 \text{ mL}$ . Determine the final molarity:

$$[H^+] = \frac{20 \text{ mmol} + 20 \text{ mmol}}{500 \text{ mL}} = \frac{40}{500} = 0.08 \text{ M}$$

The configuration matches Option (B).

**Final Answer:**

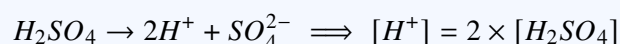
**Answer:** (B)

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Q13.

**Solution****Concept:**

Sulfuric acid ( $H_2SO_4$ ) is a strong diprotic acid. Assuming complete 100% ionic dissociation across both proton stages, each molecule of  $H_2SO_4$  yields exactly 2 hydrogen ions ( $H^+$ ):

**Solution:**

Given the acid concentration is 0.005 M, calculate the hydronium concentration:

$$[H^+] = 2 \times 0.005 \text{ M} = 0.01 \text{ M} = 10^{-2} \text{ M}$$

Now, compute the solution pH:

$$\text{pH} = -\log_{10}[H^+] = -\log_{10}(10^{-2}) = 2.0$$

The configuration matches Option (A).

**Final Answer:**

**Answer:** (A)

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Q14.

**Solution****Concept:**

The pH of an aqueous salt solution is determined by salt hydrolysis. A salt derived from a **strong base** and a **weak acid** undergoes anionic hydrolysis to yield an alkaline solution with a pH strictly greater than 7.

**Solution:**

Analyze the nature of each salt choice:

- $NH_4Cl$ : Strong Acid ( $HCl$ ) + Weak Base ( $NH_4OH$ )  $\implies$  Acidic solution ( $pH < 7$ ).
- $CH_3COONH_4$ : Weak Acid + Weak Base  $\implies$  Nearly neutral solution ( $pH \approx 7$ ).
- $NaCl$ : Strong Acid ( $HCl$ ) + Strong Base ( $NaOH$ )  $\implies$  Neutral solution ( $pH = 7$ ).
- $CH_3COONa$ : Weak Acid ( $CH_3COOH$ ) + Strong Base ( $NaOH$ )  $\implies$  Alkaline solution ( $pH > 7$ ).

The configuration matches Option (C).

**Final Answer:**  $CH_3COONa$

**Answer:** (C)

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Q15.

**Solution****Concept:**

At 298 K, the sum of pH and pOH in an aqueous framework is always equal to 14.0:

$$\text{pH} + \text{pOH} = 14 \implies \text{pOH} = 14 - \text{pH}$$

**Solution:**

First, calculate the pH from the given hydronium concentration  $[\text{H}_3\text{O}^+] = 2.5 \times 10^{-6} \text{ M}$ :

$$\text{pH} = -\log_{10}(2.5 \times 10^{-6}) = 6 - \log_{10}(2.5)$$

Substitute the given value  $\log_{10}(2.5) = 0.40$ :

$$\text{pH} = 6 - 0.40 = 5.6$$

Now, compute the pOH value:

$$\text{pOH} = 14 - 5.6 = 8.4$$

The configuration matches Option (B).

**Final Answer:**

**Answer:** (B)

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Q16.

**Solution****Concept:**

Bleaching powder is chemically known as Calcium hypochlorite/chloride. It is structurally represented as  $\text{CaOCl}_2$  (or  $\text{Ca}(\text{OCl})\text{Cl}$ ). The active sanitizing component responsible for releasing chlorine is the hypochlorite group.

**Solution:**

The empirical formulation of bleaching powder is written as  $\text{CaOCl}_2$ . When dissolved or treated, its chemical efficacy stems primarily from calcium hypochlorite, denoted as  $\text{Ca}(\text{OCl})_2$ , which releases active nascent chlorine.

The configuration matches Option (B).

**Final Answer:**

**Answer:** (B)

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Q17.

**Solution****Concept:**

In the froth flotation process used for concentrating sulfide ores, different chemical additives play distinct roles: frothers create bubbles, while collectors coat the mineral particles to make them hydrophobic, causing them to float.

**Solution:**

- **Pine Oil** acts as a frother to generate stable foam.
- **Potassium Ethyl Xanthate** (or sodium ethyl xanthate) attaches selectively to sulfide ore grains ( $CuFeS_2$ ), creating a hydrophobic layer so they attach to air bubbles and float. Thus, it serves as the collector matrix.

The configuration matches Option (B).

**Final Answer:** Potassium Ethyl Xanthate

**Answer: (B)**

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Q18.

**Solution****Concept:**

The reaction of copper metal with nitric acid ( $HNO_3$ ) varies depending on the concentration of the acid. Concentrated nitric acid acts as a powerful oxidizing agent and is reduced to nitrogen dioxide ( $NO_2$ ), whereas dilute nitric acid yields nitric oxide ( $NO$ ).

**Solution:**

The balanced chemical equation for copper with **concentrated** nitric acid is:



The primary gas evolved is brown nitrogen dioxide ( $NO_2$ ).

The configuration matches Option (C).

**Final Answer:**  $NO_2$

**Answer: (C)**

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Q19.

**Solution****Concept:**

High-precision laboratory devices require materials that maintain structural dimensional stability across fluctuating environmental temperatures.

**Solution:**

**Invar** is a specialized alloy of iron (64%) and nickel (36%) famous for its uniquely near-zero coefficient of thermal expansion. This property prevents it from expanding or contracting with temperature changes, making it ideal for scientific scale instrumentation balances, precision clocks, and seismic measuring tools.

The configuration matches Option (C).

**Final Answer:**

**Answer:** (C)

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Q20.

**Solution****Concept:**

During the electrolytic refining of copper, crude blister copper serves as the anode, and a thin sheet of pure copper acts as the cathode. Impurities more reactive than copper dissolve into the electrolyte solution, while less reactive impurities do not oxidize.

**Solution:**

Noble metals and metalloids present as impurities in crude copper (such as Gold, Silver, and Platinum) are less reactive and do not oxidize at the operating voltage of the cell. As the anode dissolves, these precious metals settle directly beneath it at the bottom of the tank, forming a residue known as **Anode Mud Sludge**.

The configuration matches Option (C).

**Final Answer:**

**Answer:** (C)

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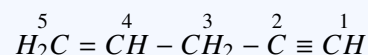
Q21.

**Solution****Concept:**

To count the bonds in Pent-4-en-1-yne, map out its complete structural formula. Single covalent bonds are  $\sigma$  bonds. A double bond contains 1  $\sigma$  and 1  $\pi$  bond, while a triple bond contains 1  $\sigma$  and 2  $\pi$  bonds.

**Solution:**

The IUPAC structure for Pent-4-en-1-yne is:



Let's count all individual bonds:

- $\sigma$  bonds: 2 (from  $\text{C}_5 - \text{H}$ ) + 1 ( $\text{C}_5 = \text{C}_4$ ) + 1 ( $\text{C}_4 - \text{H}$ ) + 1 ( $\text{C}_4 - \text{C}_3$ ) + 2 ( $\text{C}_3 - \text{H}$ ) + 1 ( $\text{C}_3 - \text{C}_2$ ) + 1 ( $\text{C}_2 \equiv \text{C}_1$ ) + 1 ( $\text{C}_1 - \text{H}$ ) = 10  $\sigma$  bonds.
- $\pi$  bonds: 1 from the terminal double bond ( $\text{C}_5 = \text{C}_4$ ) + 2 from the terminal triple bond ( $\text{C}_2 \equiv \text{C}_1$ ) = 3  $\pi$  bonds.

The configuration matches Option (A).

**Final Answer:**

**Answer:** (A)

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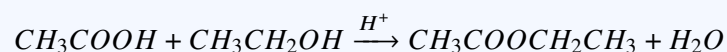
Q22.

**Solution****Concept:**

The chemical reaction between an alcohol and a carboxylic acid in the presence of an acid catalyst produces an ester and water.

**Solution:**

Cooking raw industrial ethanol ( $\text{CH}_3\text{CH}_2\text{OH}$ ) alongside glacial acetic acid ( $\text{CH}_3\text{COOH}$ ) in the presence of a mineral acid catalyst (such as concentrated  $\text{H}_2\text{SO}_4$ ) yields ethyl ethanoate ( $\text{CH}_3\text{COOCH}_2\text{CH}_3$ ), an ester. This organic transformation is classified as a Fischer-Speier **Esterification Reaction**.



The configuration matches Option (B).

**Final Answer:**

**Answer:** (B)

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Q23.

**Solution****Concept:**

Liquefied Petroleum Gas (LPG) is a commercial fuel mixture extracted from petroleum refining and natural gas processing, consisting primarily of easily liquefiable hydrocarbons.

**Solution:**

The primary chemical components that constitute commercial LPG matrices are alkane hydrocarbons containing three and four carbon atoms, specifically **Propane** ( $C_3H_8$ ) and **Butane** ( $C_4H_{10}$ ), with butane typically being the dominant component.

The configuration matches Option (B).

**Final Answer:** Propane and Butane

**Answer: (B)**

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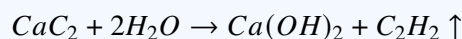
Q24.

**Solution****Concept:**

The hydrolysis of specific metal carbides yields distinct hydrocarbon gases depending on the nature of the carbide structure.

**Solution:**

When calcium carbide ( $CaC_2$ ) reacts with water, it undergoes rapid hydrolytic decomposition to yield calcium hydroxide and the simplest alkyne gas, ethyne, commonly known as **Acetylene** ( $C_2H_2$ ):



The configuration matches Option (C).

**Final Answer:** Acetylene ( $C_2H_2$ )

**Answer: (C)**

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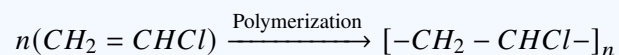
Q25.

**Solution****Concept:**

Polyvinyl Chloride (PVC) is a widely used synthetic thermoplastic addition polymer. Its name is directly derived from its underlying monomer unit.

**Solution:**

PVC is manufactured through the free-radical addition polymerization of vinyl chloride, known by its systematic IUPAC name as **Chloroethene** ( $CH_2 = CHCl$ ):



The configuration matches Option (C).

**Final Answer:** Chloroethene (Vinyl Chloride)

**Answer:** (C)

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## Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	D	2	B	3	B	4	C	5	A
6	B	7	B	8	A	9	B	10	B
11	C	12	B	13	A	14	C	15	B
16	B	17	B	18	C	19	C	20	C
21	A	22	B	23	B	24	C	25	C

