



$$A = \frac{m}{(m^2 + c)^2}$$



NIOS PYQ's SOLUTIONS

$$\sqrt{a} = bc^2$$

PREVIOUS YEARS' QUESTIONS & ANSWERS

$$\sqrt{h-x^2}$$



APRIL 2026

Your Path to Success

(SET – A)

SECTION-A

Q1. The mass number of an atom of an element is

- (A) number of protons + number of electrons
- (B) number of protons + number of neutrons
- (C) atomic number – number of neutrons
- (D) atomic number + number of electrons

Ans. (B) number of protons + number of neutrons

Q2. Which of the following will not form a sigma bond if X-axis is the internuclear axis?

- (A) 1s and 1s
- (B) 1s and 2px
- (C) 2py and 2py
- (D) 1s and 2s

Ans. (C) 2py and 2py

Q3. Which of the following species have the same number of electrons?

- (A) ${}_{11}\text{Na}^+$ and ${}_{19}\text{K}^+$
- (B) ${}_{20}\text{Ca}^{2+}$ and ${}_{16}\text{S}^{2-}$
- (C) ${}_{12}\text{Mg}^{2+}$ and ${}_{20}\text{Ca}^{2+}$
- (D) ${}_{12}\text{Mg}^{2+}$ and ${}_{16}\text{S}^{2+}$

Ans. (B) ${}_{20}\text{Ca}^{2+}$ and ${}_{16}\text{S}^{2-}$

Q4. The number of moles of carbon atoms in three moles of ethane is

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

Ans. (D) 6

Q5. Which is not affected by temperature?

- (A) Molarity
- (B) Molality
- (C) Normality
- (D) Mass percentage

Ans. (B) Molality

Q6. The enthalpies of elements in their standard states are taken as zero. The enthalpy of formation of a compound

- (A) is always positive
- (B) is always negative
- (C) is never negative
- (D) may be positive or negative

Ans. (D) may be positive or negative



Q7. Which of the following statements is incorrect in the case of heavy water?

- (A) It is used as a moderator in nuclear reactor.
- (B) It is used in the study of the mechanism of chemical reactions involving hydrogen.
- (C) It is more effective as solvent than ordinary water.
- (D) Heavy water is more associated than ordinary water.

Ans. (C) It is more effective as solvent than ordinary water.

Q8. Which of the following bonds is the strongest?

- (A) F—F
- (B) Cl—Cl
- (C) Br—Br
- (D) I—I

Ans. (B) Cl—Cl

Q9. Which of the following d-block element shows the minimum number of oxidation states?

- (A) Sc
- (B) Ti
- (C) Cu
- (D) Zn

Ans. (A) Sc

Q10. The groups with –I effect are

- (A) —H, —NO₂
- (B) —OH, —I
- (C) —H, —CH₃
- (D) —(CH₃)₃C, —CH₃

Ans. (B) —OH, —I

Q11. Oxidation of ethyne with cold alkaline KMnO₄ produces

- (A) ethanoic acid
- (B) ethane
- (C) ethanedioic acid
- (D) ethene

Ans. (C) ethanedioic acid

Q12. The organometallic compound of magnesium with an alkyl halide is called

- (A) Schiff's reagent
- (B) Baeyer's reagent
- (C) Grignard reagent
- (D) Tollen's reagent

Ans. (C) Grignard reagent

Q13. In Lucas' test, turbidity does not appear for

- (A) primary alcohols
- (B) secondary alcohols
- (C) tertiary alcohols
- (D) both primary and secondary alcohols

Ans. (A) primary alcohols



Q14. Ethanoic acid on treatment with P_2O_5 produces

- (A) propanoic acid (B) ethene
(C) ethanoic anhydride (D) ethanol

Ans. (C) ethanoic anhydride

Q15. Clemmensen reduction is carried out with

- (A) $LiAlH_4$ in ether (B) H_2 in the presence of Pd
(C) NH_2NH_2 /glycol and KOH (D) Zn-Hg and HCl

Ans. (D) Zn-Hg and HCl

Q16. Carboxylic acids react with alcohols to form

- (A) esters (B) anhydrides
(C) substituted acids (D) acid chlorides

Ans. (A) esters

Q17. Complete the following by the given options: Options: 4s, 4p, 3s, 1s

- (a) According to Aufbau principle, 3d has lower energy than _____. **4p**
(b) Two spherical nodes will be present in _____ orbital. **3s**

Q18. Read the passage given below and answer the following questions:

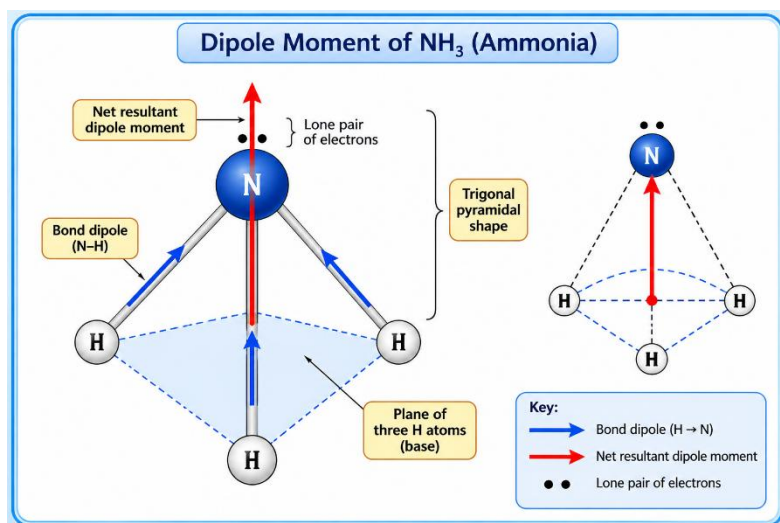
" NH_3 has a pyramidal structure which makes the arrangement of three N—H bonds unsymmetrical. In each N—H bond, nitrogen is the negative centre and hydrogen is the positive centre."

(a) How many lone pairs of electrons are present in NH_3 molecule?

Ans. One (1) lone pair.

(b) Draw a diagram of NH_3 molecule depicting the direction of net dipole of the molecule.

Ans.


Q19. Write True (T) for correct statement and False (F) for incorrect statement:


(a) In acetylene molecule, the two carbon atoms are joined by one sigma bond and two pi bonds.

True

(b) Be_2 molecule does not exist because its bond order is a fraction. **False**

Q20. Read the passage given below and answer the following questions:

"In sodium chloride molecule, the positively charged sodium ion and the negatively charged chloride ion are held together by electrostatic attractions. The bond so formed is called an ionic bond."

(a) State the signs of ΔH for formation of both Na^+ and Cl^- ions.

Ans. Explanation: Formation of Na^+ from Na atom requires removal of an electron, which requires energy input (ionization enthalpy), so ΔH is positive for the formation of Na^+ .

Formation of Cl^- from Cl atom involves addition of an electron, which releases energy (electron gain enthalpy), so ΔH is negative for the formation of Cl^- .

(b) Why are Na^+ and Cl^- ions formed?

Ans. Explanation: Sodium (Na , electronic configuration 2,8,1) loses its single valence electron to achieve the stable, completely filled electronic configuration of the nearest noble gas (neon, 2,8), forming Na^+ . Chlorine (Cl , electronic configuration 2,8,7) gains one electron to complete its octet and achieve the stable configuration of argon (2,8,8), forming Cl^- . Although forming Na^+ requires energy, the overall process is energetically favourable because the electrostatic attraction between the oppositely charged Na^+ and Cl^- ions releases a large amount of lattice energy, which more than compensates for the energy spent in ionization.

Q21. Complete the following by the given options: Options: diamagnetic, paramagnetic, coloured, colourless

(a) $[\text{Fe}(\text{CN})_6]^{3-}$ molecule is _____. **paramagnetic**

(b) Transition metal ions are _____. **coloured**

Q22. Read the passage given below and answer the following questions:

"In the crystal lattice of the elements of the transition series, elements can easily replace another element forming solid solutions and smooth alloys."

(a) State the essential condition for the formation of alloys.

Ans. The essential condition for the formation of alloys (solid solutions) among transition metals is that the atomic sizes (atomic radii) of the two metals should be similar (comparable, generally within about 15% of each other). This allows atoms of one metal to easily replace atoms of another metal in the crystal lattice without significantly distorting the structure.

(b) What is the percentage composition of brass?



Ans. Brass is an alloy of copper and zinc. Its typical percentage composition is approximately Copper (Cu): 60–80% and Zinc (Zn): 20–40% (a common composition being roughly Cu 70% and Zn 30%).

Q23. Complete the following by the given options: Options: oxygen, ozone, hydrogen peroxide, zinc oxide, nitric oxide

(a) Mercury sticks to the glass when it is exposed to _____. **ozone**

(b) _____ is an amphoteric oxide. **zinc oxide**

Q24. Match the items in Column-I with Column-II:

Column-I	Column-II
(a) $\text{Li} > \text{Na}$	(i) Atomic property
(b) $\text{Be} < \text{Mg}$	(ii) Density
(c) $\text{Mg} > \text{Na}$	(iii) Ionization energy
(d) $\text{Li} < \text{Na} > \text{K}$	(iv) Melting points

Ans.

(a) → **(iii) Ionization energy**

(b) → **(ii) Density**

(c) → **(iv) Melting points**

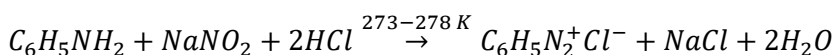
(d) → **(i) Atomic property**

Q25. Read the passage given below and answer the following questions:

"Benzenediazonium salt is formed by treating an aromatic primary amine with NaNO_2 and dil. HCl at low temperature."

(a) Name the process stated in the above passage.

Ans. Diazotisation (Diazotization) reaction: The process of converting an aromatic primary amine into a diazonium salt using nitrous acid (generated in situ from NaNO_2 and dilute HCl) at low temperature ($273 - 278 \text{ K}$, i.e., $0-5^\circ\text{C}$) is called diazotisation.

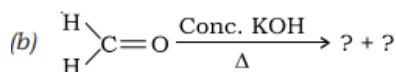
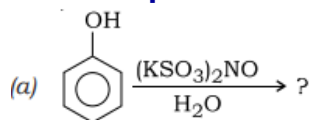


(b) Write the chemical equation for Gattermann reaction.

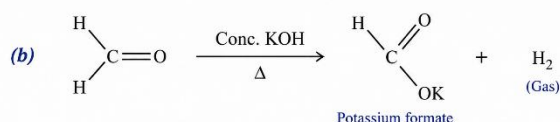
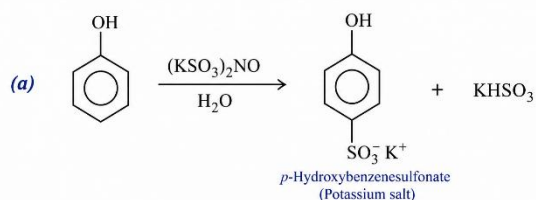
Ans. Gattermann reaction: $\text{C}_6\text{H}_5\text{N}_2^+\text{Cl}^- + \text{HCl} \xrightarrow{\text{Cu}/\Delta} \text{C}_6\text{H}_5\text{Cl} + \text{N}_2$ In the Gattermann reaction, the diazonium salt is treated with the corresponding halogen acid (such as HCl) in the presence of copper powder (instead of a cuprous salt as in the Sandmeyer reaction) to replace the diazonium group with a halogen atom, releasing nitrogen gas.



Q26. Complete the following reactions:



Ans.



Q27. Write True (T) for correct statement and False (F) for incorrect statement:

(a) Butyl rubber is obtained on co-polymerization of butadiene and isobutylene. **False**

(b) Natural rubber has higher tensile strength than vulcanised rubber. **False**

Q28. Read the passage given below and answer the following questions:

"Biodegradable polymers can be broken into small segments by enzyme-catalyzed reactions. The required enzymes are produced by microorganisms."

(a) How can non-biodegradable polymers be converted into biodegradable polymers?

Ans. Non-biodegradable polymers can be made biodegradable by introducing degradable linkages (such as ester or amide linkages) into their backbone during synthesis, or by copolymerizing/blending them with naturally occurring biodegradable polymers (such as starch). These modifications make the polymer chain susceptible to attack by microbial enzymes, allowing it to be broken down into smaller segments in the environment.

(b) Give full name of a biodegradable polymer.

Ans. Example: PHBV Poly(3-hydroxybutyrate-co-3-hydroxyvalerate) PHBV is a biodegradable copolymer obtained by the copolymerization of 3-hydroxybutanoic acid and 3-hydroxypentanoic acid. It is used in specialty packaging, orthopaedic devices, and in controlled drug release, and is broken down by microorganisms in the environment.

SECTION B



Q29. How much copper can be obtained from 100 g of copper sulphate? (Atomic mass of Cu = 63.6, S = 32.0, O = 16.0)

Ans. Molar mass of $CuSO_4 = 63.6 + 32.0 + 4(16.0) = 63.6 + 32.0 + 64.0 = 159.6 \text{ g/mol}$

$$\text{Moles of } CuSO_4 = \frac{100}{159.6} = 0.6266 \text{ mol}$$

Since 1 mole of $CuSO_4$ contains 1 mole of Cu , moles of $Cu = 0.6266 \text{ mol}$.

$$\text{Mass of } Cu = 0.6266 \times 63.6 = 39.85 \text{ g} \approx 39.86 \text{ g}$$

Hence, approximately 39.86 g of copper can be obtained from 100 g of copper sulphate.

OR

Calculate the amount of carbon dioxide that could be produced when 1 mole of carbon is burnt in air.

Ans. $C(s) + O_2(g) \rightarrow CO_2(g)$

From the balanced equation, 1 mole of carbon produces 1 mole of CO_2 .

$$\text{Molar mass of } CO_2 = 12 + 2(16) = 44 \text{ g/mol}$$

Hence, burning 1 mole of carbon in air produces 44 g (1 mole) of carbon dioxide.

Q30. State Raoult's law for solutions. Give its mathematical expression.

Ans. Raoult's Law (for a solution of two volatile liquids): At a given temperature, for a solution of volatile liquids, the partial vapour pressure of each component of the solution is directly proportional to its mole fraction present in the solution.

Mathematically, for a binary solution of components A and B: $p_A = p_A^0 x_A$ and $p_B = p_B^0 x_B$

where p_A^0 and p_B^0 are the vapour pressures of pure A and pure B respectively, and x_A , x_B are their mole fractions in solution.

Total vapour pressure of the solution: $p_{total} = p_A + p_B = p_A^0 x_A + p_B^0 x_B$

For a solution containing a non-volatile solute, Raoult's law states that the relative lowering of vapour pressure of the solvent is equal to the mole fraction of the solute: $\frac{p_1^0 - p_1}{p_1^0} = x_2$

Q31. What is the value of van't Hoff factor for a dilute solution of K_2SO_4 in water?

Ans. K_2SO_4 dissociates completely in dilute aqueous solution as: $K_2SO_4 \rightarrow 2K^+ + SO_4^{2-}$

Since 1 formula unit of K_2SO_4 produces 3 ions (2 K^+ ions + 1 SO_4^{2-} ion) in a dilute solution (where dissociation is essentially complete), the van't Hoff factor: $i \approx 3$

OR

Why does the vapour pressure of a liquid decrease when a non-volatile solute is added to it?



Ans. When a non-volatile solute is added to a liquid (solvent), some solute particles occupy positions at the surface of the liquid, in place of solvent molecules. This reduces the number of solvent molecules present at the surface that can escape into the vapour phase. Since fewer solvent molecules vaporize per unit time, the equilibrium vapour pressure of the solution becomes lower than that of the pure solvent. This is why the vapour pressure of a liquid decreases on adding a non-volatile solute.

Q32. Define the term 'enthalpy of fusion' with an example.

Ans. Enthalpy of fusion ($\Delta_{fus}H$) is defined as the enthalpy change (heat absorbed) accompanying the melting of one mole of a solid substance into its liquid state at its melting point, at constant temperature and pressure (usually under standard conditions).

Example: For ice melting into water at 273 K and 1 atm pressure: $H_2O(s) \rightarrow H_2O(l)$ $\Delta_{fus}H^\circ = 6.00 \text{ kJ mol}^{-1}$

OR

Define the term isolated system. Give an example.

Ans. An isolated system is a thermodynamic system that can exchange neither matter nor energy with its surroundings. Both the boundary of the system is sealed and insulated, so no mass transfer and no heat/work transfer takes place across it.

Example: A substance enclosed in an ideal (perfectly insulated) thermos flask, or a sealed and thermally insulated container, approximates an isolated system.

Q33. Describe the composition of a standard hydrogen electrode.

Ans. A Standard Hydrogen Electrode (SHE) consists of a platinum electrode (a small platinum foil/plate coated with finely divided platinum black to increase surface area for adsorption of gas) dipped into a solution containing H^+ ions at unit concentration (1 M HCl solution). Pure hydrogen gas at 1 atmosphere pressure is continuously bubbled around the platinum electrode at a temperature of 298 K. The platinum metal itself does not take part in the reaction; it acts as an inert electrical conductor and a catalytic surface on which the reaction $H^+(aq) + e^- \rightleftharpoons \frac{1}{2}H_2(g)$ takes place. It is represented as: $Pt(s), H_2(g, 1 \text{ atm}) | H^+(aq, 1 M)$, and its standard electrode potential is arbitrarily fixed as 0.00 V.

Q34. Which atoms in the following pairs of atoms are expected to have higher ionization enthalpy?

(a) ${}_4\text{Be}$ and ${}_5\text{B}$

(b) ${}_2\text{He}$ and ${}_{10}\text{Ne}$



Ans. (a) Be has higher ionization enthalpy than B.

Beryllium has the electronic configuration $1s^2 2s^2$, which is a fully filled and hence extra stable configuration. Removing an electron from this stable $2s^2$ orbital requires more energy. Boron ($1s^2 2s^2 2p^1$) has its outermost electron in the $2p$ orbital, which is slightly higher in energy and less tightly held (also, there is some shielding of the $2p$ electron by the $2s^2$ electrons), so it is easier to remove. Hence, Be has a higher ionization enthalpy than B.

(b) He has higher ionization enthalpy than Ne.

Helium is the smallest atom with only 2 electrons very close to and strongly attracted by the nucleus, giving it the highest ionization enthalpy of all elements in the periodic table. Neon, though also a noble gas with a stable configuration, is a larger atom (more shells, more shielding) than helium, so its ionization enthalpy while still very high compared to neighbouring elements is lower than that of helium.

Q35. What is meant by conjugate acid-base pair? Find the conjugate acid-base in the following reaction: $NH_3(aq) + H_2O(l) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$

Ans. Conjugate acid-base pair: Two species that differ from each other by the presence or absence of a single proton (H^+) are called a conjugate acid-base pair. When an acid donates a proton, it forms its conjugate base; when a base accepts a proton, it forms its conjugate acid.

For the given reaction:

- NH_3 (base) accepts a proton to form NH_4^+ (its conjugate acid) $\rightarrow$ conjugate pair: NH_4^+/NH_3
- H_2O (acid) donates a proton to form OH^- (its conjugate base) $\rightarrow$ conjugate pair: H_2O/OH^-

OR

A basic buffer is made by mixing ammonium hydroxide and ammonium nitrate in water. Explain how this buffer will resist change in its pH on addition of a small amount of an acid or a base.

Ans. The buffer solution contains a large reservoir of the weak base NH_4OH and its salt NH_4NO_3 (providing a large amount of common NH_4^+ ion), i.e., $NH_4OH \rightleftharpoons NH_4^+ + OH^-$.

- On addition of a small amount of acid:** The added H^+ ions react with the excess free NH_4OH present in the buffer, forming NH_4^+ and water: $NH_4OH + H^+ \rightarrow NH_4^+ + H_2O$. Since the added H^+ ions are consumed by NH_4OH , the H^+ (and hence pH) of the solution changes only very slightly.
- On addition of a small amount of base:** The added OH^- ions react with the excess NH_4^+ ions already present (from the salt), reforming NH_4OH : $NH_4^+ + OH^- \rightarrow NH_4OH$. Since the added OH^- ions are consumed, they do not cause a significant increase in the pH.



In this way, the large reserves of both NH_4OH and NH_4^+ allow the buffer to neutralize small additions of acid or base, keeping the pH nearly constant.

Q36. Write the chemical equations of the reactions which take place in Castner-Kellner cell for the manufacture of sodium hydroxide.

Ans. In the Castner-Kellner cell, brine (concentrated $NaCl$ solution) is electrolyzed using a flowing mercury cathode and a graphite/titanium anode.

At the cathode (mercury): $Na^+ + e^- \rightarrow Na$ (Na dissolves in Hg to form sodium amalgam, $Na-Hg$)

At the anode (graphite): $2Cl^- \rightarrow Cl_2(g) + 2e^-$

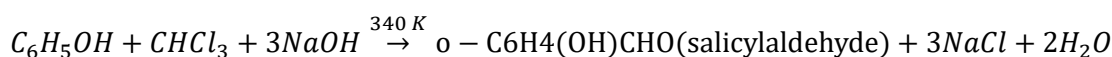
In the decomposer (denuder): The sodium amalgam formed is then made to react with water (in the presence of iron, which acts as a catalyst) to give sodium hydroxide, hydrogen gas, and regenerate mercury (which is recirculated to the cell): $2Na-Hg + 2H_2O \rightarrow 2NaOH + H_2(g) + 2Hg$

Q37. Write chemical equations for

(a) Reimer-Tiemann reaction;

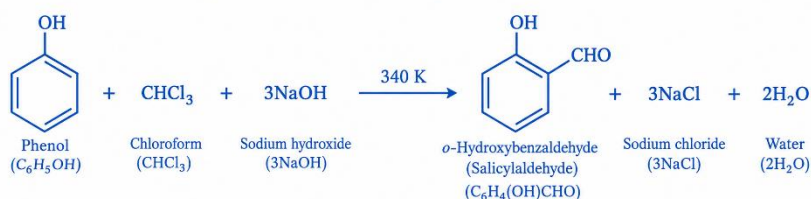
(b) coupling reaction.

Ans. (a) **Reimer-Tiemann reaction:** Phenol reacts with chloroform ($CHCl_3$) in the presence of aqueous sodium hydroxide at 340 K to give, after hydrolysis, ortho-hydroxybenzaldehyde (salicylaldehyde) as the major product.

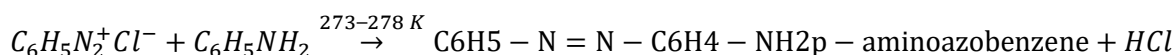


Reimer-Tiemann Reaction

Formylation of Phenol (to give Salicylaldehyde)

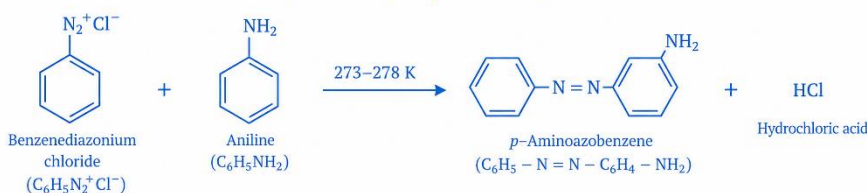


(b) **Coupling reaction:** Benzenediazonium chloride reacts with aniline (or phenol) at low temperature (273–278 K) in a coupling reaction to form an azo compound (azo dye).



Formation of Aminoazobenzene

(Azo Coupling Reaction)



Q38. A solution contains 0.8960 g of K_2SO_4 in 500 ml. Its osmotic pressure is found to be 0.69 atm at 27 °C. Calculate its molecular mass ($R = 0.0821 \text{ L atm K}^{-1}\text{mol}^{-1}$).

Ans. Given: $w = 0.8960 \text{ g}$, $V = 500 \text{ mL} = 0.5 \text{ L}$, $\pi = 0.69 \text{ atm}$, $T = 27^\circ\text{C} = 300 \text{ K}$, $R = 0.0821 \text{ L atm K}^{-1}\text{mol}^{-1}$

The osmotic pressure formula: $\pi = \frac{w}{M} \cdot \frac{RT}{V}$

Rearranging for molar mass M : $M = \frac{wRT}{\pi V}$

Substituting values: $M = \frac{0.8960 \times 0.0821 \times 300}{0.69 \times 0.5}$

$$M = \frac{22.0685}{0.345} = 63.97 \text{ g/mol} \approx 64 \text{ g/mol}$$

Hence, the molecular mass of K_2SO_4 calculated from this osmotic pressure data is approximately 64 g/mol.

Q39. Enthalpies of formation of $CO(g)$, $CO_2(g)$, $N_2O(g)$ and $N_2O_4(g)$ are -110 , -393 , 81 and 9.7 kJ mol^{-1} respectively. Find the value of $\Delta_r H$ for the reaction: $N_2O_4(g) + 3CO(g) \rightarrow N_2O(g) + 3CO_2(g)$

Ans. Using Hess's law:

$$\Delta_r H = \sum \Delta_f H(\text{products}) - \sum \Delta_f H(\text{reactants})$$

$$\Delta_r H = [\Delta_f H(N_2O) + 3\Delta_f H(CO_2)] - [\Delta_f H(N_2O_4) + 3\Delta_f H(CO)]$$

$$\Delta_r H = [81 + 3(-393)] - [9.7 + 3(-110)]$$

$$\Delta_r H = [81 - 1179] - [9.7 - 330]$$

$$\Delta_r H = -1098 - (-320.3) = -1098 + 320.3$$

$$\Delta_r H = -777.7 \text{ kJ mol}^{-1}$$

OR

Enthalpy of combustion of carbon to CO_2 is $-393.5 \text{ kJ mol}^{-1}$. Calculate the heat released upon formation of 35.2 g of CO_2 from carbon and dioxygen gas.

Ans. $C(s) + O_2(g) \rightarrow CO_2(g)$ $\Delta_c H = -393.5 \text{ kJ mol}^{-1}$

This means 1 mole (44 g) of CO_2 formed releases 393.5 kJ of heat.

$$\text{Moles of } CO_2 \text{ formed from 35.2 g: } n = \frac{35.2}{44} = 0.8 \text{ mol}$$

$$\text{Heat released: } Q = 0.8 \times 393.5 = 314.8 \text{ kJ}$$

Hence, 314.8 kJ of heat is released upon the formation of 35.2 g of CO_2 .

Q40. Define the term 'solubility product' and explain.



Ans. Solubility product (K_{sp}) is defined as the product of the molar concentrations of the constituent ions of a sparingly soluble ionic compound in its saturated solution, each concentration raised to the power equal to the number of ions produced per formula unit of the compound, at a given (constant) temperature.

For a sparingly soluble salt AB that dissociates as: $AB(s) \rightleftharpoons A^+(aq) + B^-(aq)$

the solubility product is: $K_{sp} = [A^+][B^-]$

K_{sp} is a constant at a given temperature for a particular sparingly soluble salt. It is used to predict whether precipitation will occur: if the ionic product (calculated from actual ion concentrations at any instant) exceeds K_{sp} , precipitation occurs until the solution becomes saturated again; if the ionic product is less than K_{sp} , the solution is unsaturated and no precipitation occurs (more solid can dissolve); if it equals K_{sp} , the solution is exactly saturated (in equilibrium with the solid).

Q41. Calculate Λ_m^∞ for acetic acid, given:

$$\Lambda_m^\infty(HCl) = 426 \Omega^{-1}cm^2mol^{-1}$$

$$\Lambda_m^\infty(NaCl) = 126 \Omega^{-1}cm^2mol^{-1}$$

$$\Lambda_m^\infty(CH_3COONa) = 91 \Omega^{-1}cm^2mol^{-1}$$

Ans. By Kohlrausch's law of independent migration of ions: $\Lambda_m^\infty(CH_3COOH) = \Lambda_m^\infty(CH_3COONa) + \Lambda_m^\infty(HCl) - \Lambda_m^\infty(NaCl)$

Substituting the given values:

$$\Lambda_m^\infty(CH_3COOH) = 91 + 426 - 126$$

$$\Lambda_m^\infty(CH_3COOH) = 391 \Omega^{-1}cm^2mol^{-1}$$

OR

Calculate the reduction potential of the following half-cell at 298 K: $Ag^+(0.1 M) + e^- \rightarrow Ag(s)$ $E^\circ = 0.80 V$

Ans. Using the Nernst equation for this single electrode (reduction) half-cell, where $n = 1$: $E = E^\circ -$

$$\frac{0.0591}{n} \log \frac{1}{[Ag^+]}$$

Substituting values ($E^\circ = 0.80 V$, $[Ag^+] = 0.1 M$, $n = 1$): $E = 0.80 - \frac{0.0591}{1} \log \frac{1}{0.1}$

$$E = 0.80 - 0.0591 \times \log(10)$$

$$E = 0.80 - 0.0591 \times 1$$

$$E = 0.80 - 0.0591 = 0.7409 V \approx 0.741 V$$

Hence, the reduction potential of the half-cell is approximately 0.741 V.



Q42. (a) How is potassium dichromate manufactured from chromite ore? Give chemical equations.

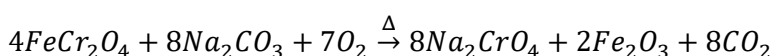
(b) Give IUPAC names of the following complexes:



Ans.

(a) Manufacture of potassium dichromate from chromite ore:

Step 1: Oxidative (fusion) roasting of chromite ore: Chromite ore ($FeCr_2O_4$) is fused with sodium carbonate in presence of air (or a suitable oxidizing agent) to convert it into sodium chromate:



Step 2: Acidification: The yellow solution of sodium chromate is filtered and acidified with sulphuric acid to convert it into sodium dichromate: $2Na_2CrO_4 + H_2SO_4 \rightarrow Na_2Cr_2O_7 + Na_2SO_4 + H_2O$

Step 3: Conversion to potassium dichromate: Sodium dichromate solution is treated with potassium chloride. Since potassium dichromate is less soluble than sodium dichromate, it crystallizes out on cooling: $Na_2Cr_2O_7 + 2KCl \rightarrow K_2Cr_2O_7 \downarrow + 2NaCl$

(b) IUPAC names:



OR

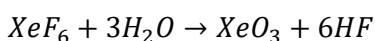
(a) How does sulphur dioxide act as a reducing agent? Illustrate it with an example.

(b) How can XeO_3 be prepared? Give its chemical equation. Also draw the structure for XeO_3 and state its shape.

Ans. (a) Sulphur dioxide as a reducing agent: In sulphur dioxide (SO_2), sulphur is in the +4 oxidation state, which is an intermediate state and can be further oxidized to the +6 state (as in sulphate/ H_2SO_4). Because of this, SO_2 readily gets oxidized by strong oxidizing agents, and in doing so, itself acts as a reducing agent (it reduces the oxidizing agent while it itself gets oxidized).

Example: SO_2 decolorizes acidified potassium permanganate solution by reducing Mn^{7+} to Mn^{2+} , while SO_2 itself is oxidized to sulphate: $2KMnO_4 + 5SO_2 + 2H_2O \rightarrow K_2SO_4 + 2MnSO_4 + 2H_2SO_4$
Here, SO_2 (S: +4) is oxidized to H_2SO_4/SO_4^{2-} (S: +6), while Mn^{7+} in $KMnO_4$ is reduced to Mn^{2+} — hence SO_2 acts as the reducing agent.

(b) Preparation of XeO_3 : XeO_3 is prepared by the hydrolysis of xenon hexafluoride (XeF_6) with water:



Structure and shape: In XeO_3 , the central xenon atom is bonded to three oxygen atoms and has one lone pair of electrons. With 3 bond pairs and 1 lone pair around Xe (total 4 electron pairs, sp^3 hybridization), the electron-pair geometry is tetrahedral, but since one position is occupied by a lone pair, the actual molecular shape is pyramidal (trigonal pyramidal), similar to NH_3 .

Q43. (a) Give chemical equation for halogenation reaction in alkanes.

(b) How will you distinguish between haloalkane and haloarene?

(c) Mention two uses of methanol.

Ans. (a) Halogenation of alkanes: Alkanes undergo halogenation (substitution of a hydrogen atom by a halogen atom) via a free-radical mechanism when reacted with chlorine or bromine in the presence of sunlight or UV light. $CH_4 + Cl_2 \xrightarrow{\text{sunlight}} CH_3Cl + HCl$

(Further substitution can continue to give CH_2Cl_2 , $CHCl_3$, and CCl_4 under excess chlorine.)

(b) Distinguishing haloalkane from haloarene:

Test: Treat the given compound with alcoholic silver nitrate ($AgNO_3$) solution and warm gently.

- A haloalkane reacts readily (via nucleophilic substitution) to give a white/pale yellow precipitate of the corresponding silver halide (AgX) even on mild warming.
- A haloarene does not give a precipitate under similar mild conditions, because the carbon-halogen bond in haloarenes has partial double-bond character (due to resonance/conjugation of the halogen's lone pair with the aromatic ring), making the C-X bond stronger and much less reactive towards nucleophilic substitution.

(c) Two uses of methanol:

1. Methanol is used as an industrial solvent (e.g., in paints, varnishes, and shellac).
2. Methanol is used as an antifreeze in automobile radiators (added to water in radiators to lower the freezing point).

OR

(a) Name the reaction in which aldehydes having α -hydrogen atoms on reaction with dil.

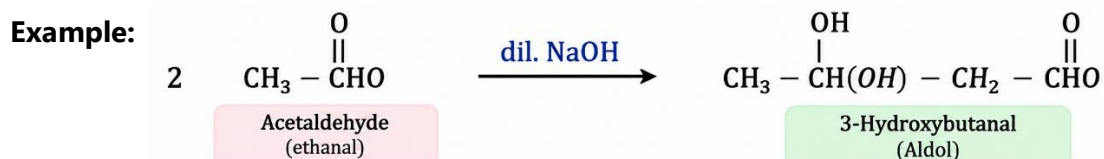
NaOH give aldols. Illustrate with an example.

(b) Which dehydrating agent produces an anhydride from a carboxylic acid? Write a chemical equation for it.

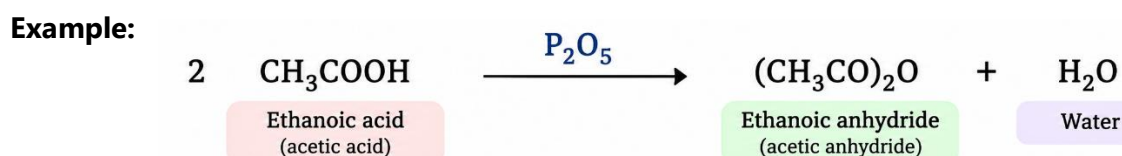
Ans.



(a) Aldol condensation: Aldehydes (or ketones) possessing at least one α -hydrogen atom undergo self-condensation in the presence of dilute base (such as dilute NaOH) to form a β -hydroxy aldehyde (or ketone), called an "aldol." This reaction is called Aldol condensation.



(b) Dehydrating agent for anhydride formation: Phosphorus pentoxide (P_2O_5) is a strong dehydrating agent that removes a molecule of water from two molecules of a carboxylic acid to form the corresponding acid anhydride.





Thank you!



We hope you found this material helpful. We wish you the very best for your examination.



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