Class XI Session 2023-24
Subject - Chemistry
Sample Question Paper - 2

Time Allowed: 3 hours **Maximum Marks: 70**

General Instructions:

1. There are 33 questions in this question paper with internal choice.
2. SECTION A consists of 16 multiple-choice questions carrying 1 mark each.
3. SECTION B consists of 5 very short answer questions carrying 2 marks each.
4. SECTION C consists of 7 short answer questions carrying 3 marks each.
5. SECTION D consists of 2 case-based questions carrying 4 marks each.
6. SECTION E consists of 3 long answer questions carrying 5 marks each.
7. All questions are compulsory.
8. The use of log tables and calculators is not allowed

Section A

1. To solve the food problem of the country, which along the following is necessary? **[1]**

a) All of these
b) Each access of people to the food grain
c) Increased production and storage of food grains
d) People should have money to purchase the grains

2. Absorption spectrum, seen as dark lines in an otherwise continuous spectrum, for the given material results from the material's (atom or molecules): **[1]**

a) absorbing selected wavelengths and returning to normal ground state
b) absorbing selected wavelengths from an input of continuous spectrum
c) absorbing all wavelengths and returning to normal ground state
d) absorbing all wavelengths from an input of continuous spectrum

3. $\Delta U^{\ominus}$of combustion of methane is -X kJ mol^{-1}. The value of $\Delta H^{\ominus}$ is **[1]**

a) = $\Delta U^{\ominus}$
b) > $\Delta U^{\ominus}$
c) $<$ $\Delta U^{\ominus}$
d) = 0

4. Calculate the energy required for the process $He^{+}(g) \rightarrow He^{2+}(g) + e^{-}$ (Hint: The ionization energy of the lowest state, also called the ground state is 2.18×10^{-18}J atom^{-1})? **[1]**

a) 5.72×10^{-18}J atom^{-1}
b) 3.72×10^{-18}J atom^{-1}
c) 8.72×10^{-18}J atom^{-1}
d) 7.72×10^{-18}J atom^{-1}

5. Which of the following properties is the measure of the degree of randomness or disorder in the system? **[1]**

a) Entropy
b) Gibbs free energy
c) Internal energy
d) Enthalpy

6. The orbital with n = 3 and l = 2 is **[1]**

a) 3p
b) 3d
c) 3s
d) 3f

7. The highest value of oxidation number changes from 1 to 7 is: **[1]**

a) across the third period in the periodic table.
b) the first three groups.
c) in the atoms of transition elements.
d) In alkaline earth metals.

8. Which of the following statements is not correct for a nucleophile? **[1]**

a) Nucleophiles are not electron seeking.
b) Nucleophiles attack low electron density sites.
c) Ammonia is a nucleophile.
d) Nucleophile is a Lewis acid.

9. Which one of the following alkenes when treated with HCl yields majorly an anti-Markownikov product? **[1]**

a) $F_3C - CH = CH_2$
b) $CH_3O - CH = CH_2$
c) $Cl - CH = CH_2$
d) $H_2N - CH = CH_2$

10. The correct order of electronegativity of Na, O and F is **[1]**

a) Na > O > F
b) O > F > Na
c) O > Na > F
d) F > O > Na

11. In a closed system, which of the following take place? **[1]**

a) The boundaries permit the flow of matter into it but not vice versa.
b) The boundaries permit the flow of matter into or out of it.
c) The boundaries prevent the flow of matter into or out of it.
d) The boundaries prevent the flow of matter out of it but not vice versa.

12. Vinylcarbinol is: **[1]**

a) $CH_3CH(OH) = CH_2$
b) $CH_3 - C(CH_2OH) = CH_2$
c) $CH_3 - CH = CH - OH$
d) $HO - CH_2 - CH = CH_2$

13. **Assertion (A):** Components of a mixture of red and blue inks can be separated by distributing the components between stationary and mobile phases in paper chromatography. **[1]**

Reason (R): The coloured components of inks migrate at different rates because paper selectively retains different components according to the difference in their partition between the two phases.

a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true but R is not the correct explanation of A.
c) A is true but R is false.
d) A is false but R is true.

14. **Assertion (A):** Buta-1, 3-diene and but-1-yne can be distinguished with Tollen's reagent. **[1]**

Reason (R): But-1-dyne gives ppt. with Tollen's reagent but buta-1, 3-diene does not.

a) Both A and R are true and R is the correct
b) Both A and R are true but R is not the

explanation of A. correct explanation of A.

c) A is true but R is false.
d) A is false but R is true.

15. **Assertion (A):** Ten distinct set of four quantum numbers are possible for d-subshell. **[1]**

Reason (R): d-subshell splits into five orbitals.

a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true but R is not the correct explanation of A.
c) A is true but R is false.
d) A is false but R is true.

16. **Assertion (A):** S.I. unit of atomic mass and molecular mass is kg. **[1]**

Reason (R): It is equal to the mass of 6.023×10^{23} atoms.

a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true but R is not the correct explanation of A.
c) A is true but R is false.
d) A is false but R is true.

Section B

17. What is meant by conjugate acid base pair? Find the conjugate acid/ base for the following species: **[2]**

HNO_2, CN^-, $HClO_4$, F^-, OH^-, CO_3^{2-}, S^{2-}

18. Write the name and atomic number of the following elements. **[2]**

i. The third alkali metal
ii. The fourth alkaline earth metal
iii. The sixth element of second transition series
iv. The second inner transition element
v. The fifth noble gas.

19. Calculate the concentration of nitric acid in moles per litre in a sample which has a density 1.41 g mL^{-1} and the mass per cent of nitric acid in it is being 69%. **[2]**

20. How is phenol reduced to benzene? **[2]**

OR

Convert:

i. Propene to 2, 3-dimethyl butane
ii. Ethane to ethyne

21. Calculate (a) wavenumber and (b) frequency of yellow radiation having wavelength 5800 $\overset{o}{A}$. **[2]**

Section C

22. Interpret the non-linear shape of H_2S molecule and non-planar shape of PCI_3 using valence shell electron pair repulsion (VSEPR) theory. **[3]**

23. **Answer:** **[3]**

(i) Define reaction enthalpy. **[1]**
(ii) Define standard enthalpy. **[1]**
(iii) Define intensive properties. **[1]**

24. How will you calculate work done on an ideal gas in a compression, when the change in pressure is carried out in infinite steps? **[3]**

25. Write correctly the balanced equations for the following redox reactions using half-reactions. **[3]**

i. $H_2S + Fe^{3+} \longrightarrow Fe^{2+} + S + H^+$

ii. $I^- + IO_3^- + H^+ \longrightarrow I_2 + H_2O$

iii. $Bi(s) + NO_3^- + H^+ \longrightarrow NO_2 + Bi^{3+} + H_2O$

State what is oxidised to what and what is reduced to what in the reactions expressed by the equations?

26. The electronic energy in hydrogen atom is given by $E_n = (-2.18 \times 10^{-18})/n^2 J$.Calculate the energy required to remove an electron completely from the n = 2 orbit. What is the longest wavelength of light in cm that can be used to cause this transition? **[3]**

27. The outer electronic configurations of some elements are: **[3]**

i. $3s^2\ 3p^4$

ii. $3d^{10}\ 4s^2$

iii. $3s^2\ 3p^6\ 4s^2$

iv. $6s^2\ 4f^3$

State to which block in the periodic table each of these elements belong.

28. Two oxides of a metal contain 27.6% and 30.0% of oxygen respectively. If the formula of the first oxide is M_3O_4, find that of the second. **[3]**

Section D

29. **Read the text carefully and answer the questions:** **[4]**

The phenomenon of the existence of two or more compounds possessing the same molecular formula but different properties is known as isomerism. Such compounds are called isomers. Compounds having the same molecular formula but different structures (manners in which atoms are linked) are classified as structural isomers. Structural isomers are classified as chain isomer, position isomer, functional group isomer. Meristematic arises due to different alkyl chains on either side of the functional group in the molecule and stereoisomerism and can be classified as geometrical and optical isomerism. Hyperconjugation is a general stabilising interaction. It involves delocalisation of σ electrons of the C-H bond of an alkyl group directly attached to an atom of an unsaturated system or to an atom with an unshared p orbital. This type of overlap stabilises the carbocation because electron density from the adjacent σ bond helps in dispersing the positive charge.

(i) Why Isopentane, pentane and Neopentane are chain isomers?

OR

Why hyperconjugation is a permanent effect?

(ii) The molecular formula C_3H_8O represents which isomer?

(iii) What type of isomerism is shown by Methoxypropane and ethoxyethane?

30. **Read the text carefully and answer the questions:** **[4]**

In order to explain the characteristic geometrical shapes of polyatomic molecules, Pauling introduced the concept of hybridisation. The orbitals undergoing hybridisation should have nearly the same energy. There are various type of hybridisations involving s, p and d-type of orbitals. The type of hybridisation gives the characteristic shape of the molecule or ion.

(i) Why all the orbitals in a set of hybridised orbitals have the same shape and energy?

(ii) Out of XeF_2 and SF_2 which molecule has the same shape as NO_2^+ ion?

(iii) Out of XeF_4 and XeF_2 which molecule doesn't have the same type of hybridisation as P(Phosphorus) has in PF_5?

OR

Unsaturated compounds undergo additional reactions. Why?

Section E

31. **Attempt any five of the following:** **[5]**

(i) Which of the two trans-but-2-ene or trans-pent-2-ene is non-polar? **[1]**

(ii) What is the number of σ and π bond in $N \equiv C - CH = CH - C \equiv N$? **[1]**

(iii) What are cycloalkanes? **[1]**

(iv) Write IUPAC name: $CH_3CH - C(CH_3)_2$ **[1]**

(v) What do you mean by delocalization? **[1]**

(vi) What is hydrogenation? **[1]**

(vii) Give the IUPAC name of the lowest molecular weight alkane that contains a quaternary carbon. **[1]**

32. Calculate the pH of a 0.10M ammonia solution. Calculate the pH after 50.0 mL of this solution is treated with 25.0 mL of 0.10M HCl. The dissociation constant of ammonia, $K_b = 1.77 \times 10^{-5}$ **[5]**

OR

On the basis of Le Chatelier principle explain how temperature and pressure can be adjusted to increase the yield of ammonia in the following reaction:

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

ΔH = -92.38 kJmol^{-1}

What will be the effect of the addition of argon to the above reaction mixture at constant volume?

33. **Answer:** **[5]**

(i)

i. Write resonance structures of CH_3COO^- and show the movement of electrons by curved arrows. **[2.5]**

ii. Explain, why an organic liquid vaporizes at a temperature below its boiling point in its steam distillation? **[2.5]**

OR

i. What are electrophiles and nucleophiles? Explain with examples. **[2.5]**

ii. Give three points of differences between inductive effect and resonance effect. **[2.5]**

Solution

Section A

1. **(a)** All of these
   Explanation: All of these

2.
   (b) absorbing selected wavelengths from an input of continuous spectrum
   Explanation: In an absorption spectrum, portions of a continuous spectrum (light containing all wavelengths) are missing because they have been absorbed by the medium through which the light has passed; the missing wavelengths appear as dark lines or gaps. Black lines indicating where no light gets through to the element.

3.
   (c) $< \Delta U^{\ominus}$
   Explanation: $CH_{4\,(g)} + 2O_{2}\,(g) \rightarrow CO_{2\,(g)} + 2H_{2}O\,(l)$
   We know, $\Delta H^{\ominus} = \Delta U^{\ominus} + \Delta n_g$ RT
   Δn_g is negative as product water in combustion reaction is in liquid state.
   $\Delta H^{\ominus} = -X - \Delta n_g RT$
   This implies $\Delta H \ominus$ will be more negative than $\Delta U \ominus$
   Hence, $\Delta H \ominus < \Delta U \ominus$

4.
   (c) 8.72×10^{-18} J atom^{-1}
   Explanation: He^{+} ion is a single electron species which resembles like hydrogen. Therefore, the energies of the stationary states of hydrogen-like ions are given by the expression
   $E_n = 2.18 \times 10^{-18} \times \frac{Z^2}{n^2}$
   Here n = 1 and Z = 2
   $E_n = 2.18 \times 10^{-18} \times \frac{2^2}{1^2}$ = 8.72×10^{-18} J atom^{-1}

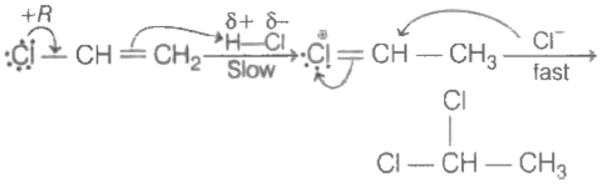
5. **(a)** Entropy
   Explanation: Entropy

6.
   (b) 3d
   Explanation: For n = 3 the possible values of *l* are *l* = 0, the s orbital
   l = 1, the p orbital and *l* = 2, the d orbital

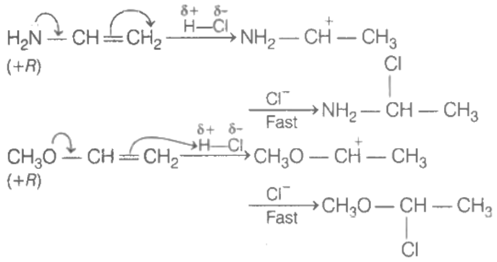
7. **(a)** across the third period in the periodic table.
   Explanation: The highest value of oxidation number exhibited by an atom of an element generally increases across the period in the periodic table.

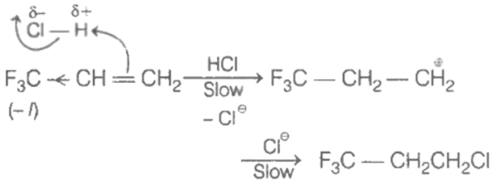
8.
   (d) Nucleophile is a Lewis acid.
   Explanation: A nucleophile is a Lewis base because it is electron-rich species that can donate its electron-pair to another species.

9. **(a)** $F_3C - CH = CH_2$
   Explanation:
   Attachment of electron-donating group (+R or +I) with sp^2-carbon of an unsymmetrical alkene supports Markownikov's addition rule through electrophilic-addition-pathway.
   But, attachment of electron-withdrawing group (-R or -I) for the same will follow anti-Markownikov's pathway (even in absence of organic peroxide which favours free radical addition) through electrophilic addition pathway.
   The product formed by given alkenes when treated with HCl.



Similarly,





10.

(d) F > O > Na

Explanation: The order of EN of Na, O and F is F > O > Na.

11.

(c) The boundaries prevent the flow of matter into or out of it.

Explanation: In a closed system, there is no flow of matter from system to surrounding or vice versa. For example, a certain quantity of fluid bounded within a closed cylinder constitutes a closed system.

12.

(d) HO - CH_2 - CH = CH_2

Explanation: HO - CH_2 - CH = CH_2

13. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation: In paper chromatography, a special quality paper known as chromatography paper is used. Chromatography paper contains water trapped in it, which acts as the stationary phase. A strip of chromatography paper spotted at the base with the solution of the mixture is suspended in a suitable solvent or a mixture of solvents. This solvent acts as the mobile phase. The solvent rises up the paper by capillary action and flows over the spot. The paper selectively retains different components according to their differing partition in the two phases. The paper strip so developed is known as a chromatogram. The spots of the separated coloured compounds are visible at different heights from the position of the initial spot on the chromatogram.

14. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation: Both A and R are true and R is the correct explanation of A.

15. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation: For each subshell (2l + 1) orbitals are possible where l = azimuthal quantum number. I for d-orbital is 2; $\therefore 2 \times 2 + 1 = 5$ orbitals are possible. Each orbital can accommodate two electrons and both electrons present in an orbital will have four different quantum numbers (Pauli exclusion principle). Thus in total ten distinct sets of four quantum numbers are possible.

16.

(d) A is false but R is true.

Explanation: Atomic mass and molecular mass are the ratios and have no. units.

Mol. Mass = $\frac{\text{Wt. of one molecule of the substnace}}{1/12 \times \text{wt. of one atom of C-12}}$

Section B

17. An acid base pair which differs by a proton only $(HA \rightleftharpoons A^- + H^+)$ is known as conjugate acid-base pair.

As, Base + H^+ = conjugate acid. Therefore, Conjugate acid of CN^-, OH^-, CO_3^{2-}, F^- and S^{2-} are : HCN, H_2O, HCO_3^-, HF, HS^-

respectively.

As, Acid - H^+ = conjugate base. Therefore, Conjugate base of HNO_2, $HClO_4$ and OH^- are NO_2^-, ClO_4^- and O^{2-} respectively.

18. i. Potassium, K (Z= 19)
    ii. Strontium, Sr (Z = 38)
    iii. Ruthenium, Ru (Z =44)
    iv. Praseodymium, Pr (Z = 59)
    v. Xenon, Xe(Z = 54)

19. Calculations: Mass per cent of 69% means that 100 g of nitric acid solution contains 69 g of nitric acid by mass

Step 1: Molar mass of nitric acid

$HNO_3 = (1 + 14 + 48) = 63\ g\ mol^{-1}$

∴Moles in 69 g of

$HNO_3 = \frac{69\,g}{63\,g\,mol^{-1}}$

= 1.095 mole

Step 2: Volume of 100 g nitric acid solution

$= \frac{100\,g}{1.41\,g\,mL^{-1}}$

= 70.92 mL

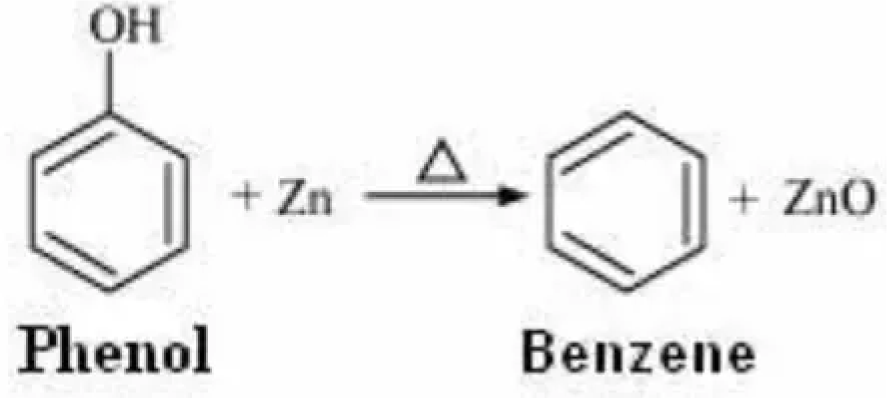
= 0.07092 L

∴ Conc. of HNO_3 in moles per litre

$= \frac{1.095\,mole}{0.07092\,L}$

= 15.44 M

20. Phenol can be converted into benzene by passing its vapours over strong reducing agent like zinc dust with strong heat. Zinc forms zinc oxide and phenyl radical thus produced forms a bond with H radical and thus the required product benzene is obtained.



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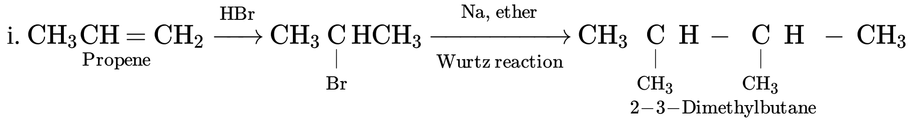
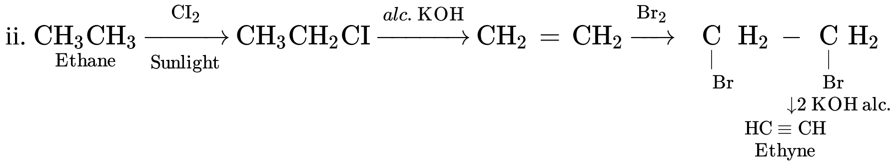


$$\text{i. } \underset{\text{Propene}}{CH_3CH=CH_2} \xrightarrow{HBr} CH_3\underset{\underset{Br}{|}}{C}HCH_3 \xrightarrow[\text{Wurtz reaction}]{\text{Na, ether}} \underset{2-3-\text{Dimethylbutane}}{CH_3\ \underset{\underset{CH_3}{|}}{C}H - \underset{\underset{CH_3}{|}}{C}H - CH_3}$$



$$\text{ii. } \underset{\text{Ethane}}{CH_3CH_3} \xrightarrow[\text{Sunlight}]{CI_2} CH_3CH_2CI \xrightarrow{alc.\ KOH} CH_2 = CH_2 \xrightarrow{Br_2} \underset{\underset{Br}{|}}{C}H_2 - \underset{\underset{Br}{|}}{C}H_2 \xrightarrow{2\ KOH\ alc.} \underset{\text{Ethyne}}{HC \equiv CH}$$

21. a. Calculation of wavenumber $(\bar{v})$

λ = 5800 Å = 5800 × 10^{-8} cm

= 5800 × 10^{-10} m

$\bar{v} = \frac{1}{\lambda} = \frac{1}{5800\times10^{-10}m}$

= 1.724 × 10^6 m^{-1}

= 1.724 × 10^4 m^{-1}

b. Calculation of the frequency (v)

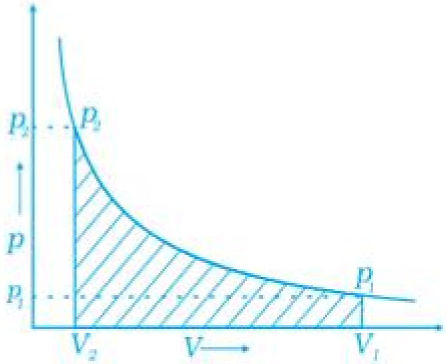
$\bar{v} = \frac{c}{\lambda} = \frac{3\times10^8 ms^{-1}}{5800\times10^{-10}m}$ = 5.172 × 10^{14} s^{-1}

Section C

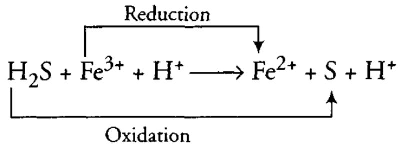
22. In H_2S, two bonded pairs and two lone pairs are present, i.e., sulphur is in sp^3 hybridized state. The angle is less than $109^o28'$ as contraction occurs due to the presence of lone pairs. Thus, H_2S has a V-shaped structure. In PCl_3, three bonded pairs and one lone pair are present, i.e., phosphorus is also in sp^3 hybridized state but it has pyramidal structure.

23. Answer:
    (i) **Reaction enthalpy:** The enthalpy change accompanying a reaction is called the reaction enthalpy.
    The enthalpy change of a chemical reaction, is given by the symbol Δ_rH.
    (ii) **Standard enthalpy:** The standard enthalpy of reaction is the enthalpy change for a reaction when all the participating substances are in their standard states.
    Standard conditions are denoted by adding the superscript $\ominus$ to the symbol ΔH, e.g., $\Delta H^\ominus$
    (iii) Properties which depend on the nature of the substance and not on the amount of the substance are called intensive properties.

24. When compression is carried out in infinite steps with the change in pressure, it is a reversible process.
Work done can be calculated from pV-plot when pressure is not constant.
A pV plot of the work of compression which is carried out by the change in pressure in infinite steps during compression from the initial volume, V_i to the final volume, V_f is shown in the figure. The work done on the gas is represented by the shaded area.



25. i.

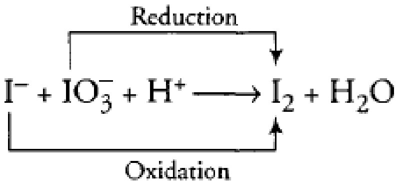


$$H_2S + Fe^{3+} + H^+ \longrightarrow Fe^{2+} + S + H^+$$

Here, oxidation state of S gets changed from -2 (H_2S) to 0 (S), and Fe^{3+} changed to Fe^{2+}. So oxidation of Sulphur atom takes place while Fe get reduced.
The balanced reaction is:

$2Fe^{3+} + H_2S \longrightarrow 2Fe^{2+} + S + 2H^+$

ii.

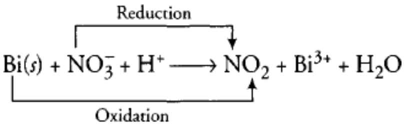


$$I^- + IO_3^- + H^+ \longrightarrow I_2 + H_2O$$

Here, oxidation state of I^- changes from -1 to 0 in I_2 and IO_3^- is reduced to I_2 . On solving, we get following balanced equations

$2IO_3^- + 12\ I^- + 12H^+ \longrightarrow 7I_2 + 6H_2O$

iii.



$$Bi(s) + NO_3^- + H^+ \longrightarrow NO_2 + Bi^{3+} + H_2O$$

Here, Bi(s) is oxidised to Bi^{3+} while NO_3^- is reduced to NO_2. The balanced reaction is:

$Bi(s) + 3NO_3^- + 6H^+ \longrightarrow 3NO_2 + Bi^{3+} + 3H_2O$

26. Step I. Calculation of energy required

The energy required is the difference in the energy when the electron jumps from orbit with n = ∞ to orbit with n = 2

The energy required (ΔE) = $E_\infty - E_2$

$= 0 - \left(-\frac{2.18 \times 10^{-18}}{4} J\right) = 5.45 \times 10^{-19}$ J

Step II. Calculation of the longest wavelength of light in cm used to cause the transition

$\Delta E = hv = hc/\lambda$

$\lambda = \frac{hc}{\Delta E} = \frac{(6.626 \times 10^{-34} Js) \times (3 \times 10^8 ms^{-1})}{(5.45 \times 10^{-19} J)}$

$= 3.644 \times 10^{-7}$ m $= 3.644 \times 10^{-7} \times 10^{-7} = 3.645 \times 10^{-5}$ cm

27. i. p block
   ii. d block
   iii. s block
   iv. f block

28. Ratio of metal and oxygen in first oxide, M_3O_4 = 72.4 : 27.6

Ratio of metal and oxygen in second oxide = 70:30

Let molecular mass of metal =M

Therefore, the percentage by weight of the metal in the oxide = $\frac{3 \times M \times 100}{3 \times M + 4 \times O} = 72.4$

$\frac{3 \times M \times 100}{3 \times M + 4 \times 16} = \frac{72.4}{1}$

$300M = 217.2 M + 4633.6$

$\Rightarrow 300M - 217.2M = 82.8M = 4633.6$

$\Rightarrow M = \frac{4633.6}{82.8} = 55.96 \approx 56$

Moles of of metal in second oxide = 70/56=1.25

Moles of oxygen in second oxide =30/16= 1.875

Ratio of moles of metal and oxygen in second oxide =1.25 : 1.875 = 1 :1.5 =2:3

Hence, Formula of second oxide =M_2O_3.

Section D

29. **Read the text carefully and answer the questions:**

The phenomenon of the existence of two or more compounds possessing the same molecular formula but different properties is known as isomerism. Such compounds are called isomers. Compounds having the same molecular formula but different structures (manners in which atoms are linked) are classified as structural isomers. Structural isomers are classified as chain isomer, position isomer, functional group isomer. Meristematic arises due to different alkyl chains on either side of the functional group in the molecule and stereoisomerism and can be classified as geometrical and optical isomerism. Hyperconjugation is a general stabilising interaction. It involves delocalisation of σ electrons of the C-H bond of an alkyl group directly attached to an atom of an unsaturated system or to an atom with an unshared p orbital. This type of overlap stabilises the carbocation because electron density from the adjacent σ bond helps in dispersing the positive charge.

(i) Isopentane, pentane and Neopentane are chain isomers because they have a similar molecular formula but a different carbon skeleton.

OR

The σ electrons of C-H bond of the alkyl group enter into partial conjugation with the attached unsaturated system or with the unshared p orbital therefore hyperconjugation is permanent effect.

(ii) The molecular formula C_3H_8O represents positional isomers because they differ in the position of substituent functional group(OH) on the carbon skeleton.

(iii)Methoxypropane and ethoxyethane are metamers because none of its side are similar to each other.

30. **Read the text carefully and answer the questions:**

In order to explain the characteristic geometrical shapes of polyatomic molecules, Pauling introduced the concept of hybridisation. The orbitals undergoing hybridisation should have nearly the same energy. There are various type of hybridisations involving s, p and d-type of orbitals. The type of hybridisation gives the characteristic shape of the molecule or ion.

(i) Hybrid orbitals are formed after combining atomic orbitals and have the equivalent shape and energy in the given set of hybridised orbitals.

(ii) XeF_2 molecule has the same shape as NO_2^+ ion.

(iii) XeF_4 molecule doesn't have the same type of hybridisation as P(Phosphorus) has in PF_5.

OR

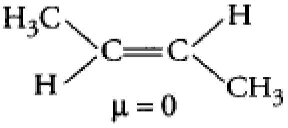
Unsaturated hydrocarbon molecules include two- or three-fold bonds of carbon. The π -bond is a multiple bond, which becomes unstable and hence adds across numerous bonds.

Section E

31. Attempt any five of the following:

(i) In trans-but-2-ene, the dipole moments of the two $C—CH_3$ bonds are equal and opposite and therefore, they cancel out each other.

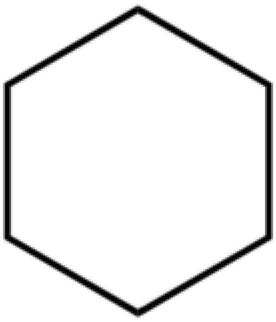
Hence, trans-2-butene is non-polar.



(ii) In Triple bond, there are two π-bonds and one σ bond and in double bond, one is σ bond and one π-bond. Therefore, in this compound there are 7σ bonds and 5 π-bonds.

(iii) **Cycloalkanes:** When carbon atoms form a closed chain or ring structures, they are known as cycloalkanes.

Example: Cyclohexane

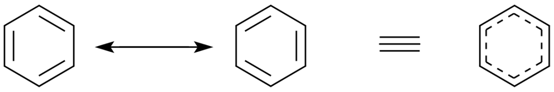


(iv) 2-methylbutane

(v) Delocalisation implies that pairs of bonding electrons extend over three or more atoms and belong to the whole molecule.

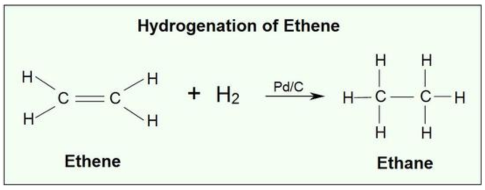
Due to delocalization, compound becomes stable.

Example: Delocalization in benzene



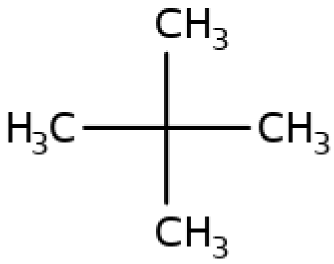
(vi) **Hydrogenation:** Addition of hydrogen to alkenes and alkenes in the presence of finely divided catalysts like Pt, Pd or Ni to form alkanes is known as hydrogenation.

Example:



(vii) IUPAC name of the lowest molecular weight alkane that contains a quaternary carbon is 2,2 -dimethyl propane.

Structure:



32. $NH_3 + H_2O \longrightarrow NH_4^+ + OH^-$

$Kb = [NH_4^+][OH^-] / [NH_3] = 1.77 \times 10^{-5}$

Before neutralization,

$[NH_3] = 0.10 - x = 0.10$

$x^2 / 0.10 = 1.77 \times 10^{-5}$

Thus, $x = 1.33 \times 10^{-3} = [OH^-]$

Therefore,

$[H^+] = K_w/[OH^-] = 10^{-14} / (1.33 \times 10^{-3}) = 7.51 \times 10^{-12}$

$pH = -\log(7.5 \times 10^{-12}) = 11.12$

On addition of 25 mL of 0.1M HCl solution (i.e., 2.5 mmol of HCl) to 50 mL of 0.1M ammonia solution (i.e., 5 mmol of NH_3), 2.5 mmol of ammonia molecules are neutralized. The resulting 75 mL solution contains the remaining unneutralized 2.5 mmol of NH_3 molecules and 2.5 mmol of NH_4^+

NH_3	+	HCl	→	NH_4^+	+	Cl^-
2.5		2.5		0		0
At equilibrium						
0		0		2.5		2.5

The resulting 75 mL of solution contains 2.5 mmol of NH_4^+ ions (i.e., 0.033 M) and 2.5 mmol (i.e., 0.033 M) of neutralised NH_3 molecules. This NH_3 exists in the following equilibrium:

NH_4OH	$\rightleftharpoons$	NH_4^+	+	OH^-
$0.033M - y$		y		y

where, $y = [OH^-] = [NH_4^+]$

The final 75 mL solution after neutralization already contains 2.5 m mol NH_4^+ ions (i.e. 0.033M), thus total concentration of NH_4^+ ions is given as:

$[NH_4^+] = 0.033 + y$

As y is small, $[NH_4OH] \simeq 0.033$ M and $[NH_4^+] \simeq 0.033$M.

We know,

$K_b = [NH_4^+][OH] / [NH_4OH]$

$= y(0.033)/(0.033) = 1.77 \times 10^{-5}$ M

Thus, $y = 1.77 \times 10^{-5} = [OH^-]$

$[H^+] = 10^{-14}/1.77 \times 10^{-5} = 0.56 \times 10^{-9}$

Hence, pH = 9.24

OR

We have $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$, $\Delta H = -92.38 \text{ kJ mol}^{-1}$.

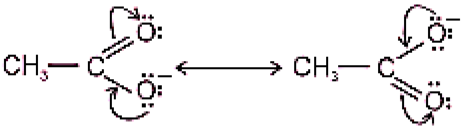
Hence in accordance with Le Chatelier’s principle, raising the temperature will shift the equilibrium to the backward direction and decreases the equilibrium concentration of ammonia. Similarly, an increase in pressure shifts the equilibrium in the forward direction. In other words, low temperature and high pressure are favorable for high yield of ammonia. Hence for better yield of ammonia, an optimum condition of temperature and pressure of 500^oC and 200 atm respectively is used in the presence of suitable catalysts.

There will be no change in equilibria on the addition of argon (Ar) at constant volume to the above mixture at equilibrium because the addition of Ar at constant volume doesn't change the partial pressure of the substances involved in the reaction.

33. Answer:

(i)

i. First, write the structure and put unshared pairs of valence electrons on appropriate atoms. Then draw the arrows(half headed curved arrow) one at a time moving the electrons to get the other structures.



ii. It is because in steam distillation the sum of vapour pressure of organic compound and steam should be equal to atmospheric pressure.

OR

i. **Electrophiles:** The name electrophiles means electron loving. Electrophiles are electron defficient. They may be positive ions or neutral molecules.
Ex: $H^+, Cl^+, Br^+, NO_2^+, R_3C^+, RN_2^+, AlCl_3, BF_3$
Nucleophiles: The name nucleophiles means 'nucleus loving' and indicates that it attacks the region of low electron density (positive centres) in a subtracts molecule. They are electron rich they may be negative ions or neutral molecules.
Ex: $Cl^-, Br^-, CN^-, OH^-, RCH_2^-, NH_3, RNH_2, H_2O, ROH$ etc.

ii.

S.No.	**Inductive effect**	**Resonance effect**
1.	It involves displacement of σ electrons in saturated compounds.	It involves displacement of π electrons or lone pair of electrons in unsaturated and conjugated compounds.
2.	Inductive effect can move only upto 3 to 4 carbons.	In this case, movement of electrons all along the length of conjugated system takes place.
3.	In inductive effect, there is slight displacement of σ electrons and partial +ve or-ve charge develops.	In this effect, there is complete transfer of π electrons and as a result, complete +ve or -ve charge develops.