Class XI Session 2024-25
Subject - Chemistry
Sample Question Paper - 1

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. -122°C in Fahrenheit scale is **[1]**

   a) 237.6°F b) -317.6°F

   c) 317.6 °F d) -187.6°F

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

   a) 3p b) 3d

   c) 3s d) 3f

3. The enthalpies of elements in their standard states are taken as zero. The enthalpy of formation of a compound is: **[1]**

   a) is never negative. b) may be positive or negative.

   c) is always negative. d) is always positive.

4. Maximum number of electrons in a subshell with l = 3 and n = 4 is _____. **[1]**

   a) 14 b) 32

   c) 16 d) 12

5. To vaporize 100.0 g carbon tetrachloride at its normal boiling point, 349.9 K, and P =1 atm, 19.5 kJ of heat is required. Calculate ΔH_{vap} for CCl_4? **[1]**

   a) 30.0 kJ b) 42.0 kJ

   c) 34.0 kJ d) 23.0 kJ

6. The energy associated with the first orbit in the hydrogen atom is -2.18×10^{-18} J/atom. Calculate the radius of **[1]**

Bohr's fifth orbit for hydrogen atom.

a) 1.3225 nm
b) 13.2250 nm
c) 2.3225 nm
d) 0.13225 nm

7. In the given reaction, **[1]**

$CH_2 = CH_2(g) + H_2(g) \rightarrow CH_3 - CH_3(g)$

ethene undergoes

a) reduction process
b) All of these
c) addition process
d) oxidation process

8. To which the terms stationary phase and mobile phase are associated? **[1]**

a) Chromatography
b) Spectroscopy
c) Differential Extraction
d) Distillation under reduced pressure

9. What product is obtained by heating ethylidene chloride with alcoholic KOH? **[1]**

a) Ethyne
b) Methane
c) Ethene
d) Ethane

10. The ionic radii of N^{3-}, O^{2-} and F^- are respectively given by: **[1]**

a) 1.36, 1.71, 1.40
b) 1.36, 1.40, 1.71
c) 1.71, 1.40, 1.36
d) 1.71, 1.36, 1.40

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. The number of possible conformational isomers of ethane is _____. **[1]**

a) infinite
b) zero
c) one
d) two

13. **Assertion (A):** The term tautomerism was introduced by Maxwell in order to explain the chemical reactivity of a substance according to two possible structures. **[1]**

Reason (R): Metamers can also be chain isomers or position isomers.

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):** C_6H_5F gives large amount of nitration products than all the other halides. **[1]**

Reason (R): F is most electronegative.

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.

15. **Assertion:** A spectral line will be seen for a $2p_x \rightarrow 2p_y$ transition. **[1]**

Reason: Energy is released in the form of waves of light when the electron drops from $2p_v$ to 2p orbital.

a) If both Assertion & Reason are true and the reason is the correct explanation of the assertion.

b) If both Assertion & Reason are true but the reason is not the correct explanation of the assertion.

c) If Assertion is true statement but Reason is false.

d) If both Assertion and Reason are false statements.

16. **Assertion (A):** Both 32 g of SO_2 and 8 g of CH_4 contain the same number of molecules. **[1]**

Reason (R): Equal moles of two compounds contain the same number of molecules.

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.

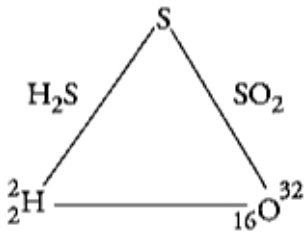
Section B

17. Calculate the solubility of A_2X_3 in pure water, assuming that neither kind of ion reacts with water. The solubility product of A_2X_3, $K_{sp} = 1.1 \times 10^{-23}$. **[2]**

18. The electron gain enthalpy of bromine is 3.36 eV. How much energy in kcal is released when 8 g of bromine is completely converted to Br^- ions in the gaseous state? **[2]**

(1 eV = 23.06 kcal mol^{-1}).

19. The element H and O combine separately with the third element S to form H_2S and SO_2 respectively, then show that they combine directly with each other to from H_2O. **[2]**



20. Write the structure and IUPAC names of different structural isomers of alkenes corresponding to C_5H_{10}. **[2]**

OR

Write hydrocarbon radicals that can be formed as intermediates during monochlorination of 2-methylpropane. Which of them is more stable? Give reasons.

21. Prove that the density of the nucleus is constant. **[2]**

Section C

22. Write Lewis symbols for the following atoms and ions: **[3]**

S and S^{2-}; Al and Al^{3+}; H and H^-

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

(a) Consider the same expansion, but this time against a constant external pressure of 1 atm. **[1]**

(b) What do you mean by entropy? **[1]**

(c) Air contains about 99% of N_2 and O_2 gases. Why they do not combine to form NO under the standard conditions? Standard Gibbs energy of formation of NO(g) is 86.7 kJ mol^{-1}. **[1]**

24. Assuming the water vapor to be a perfect gas, calculate the internal energy change when 1 mol of water at 100°C **[3]**

and 1 bar pressure is converted to the ice at 0°C. Given the enthalpy of fusion of ice is 6.00 kJ mol1 heat capacity of water is 4.2 J/g°C.

25. PbO and PbO_2 react with HCl according to the following chemical equations: **[3]**

$2PbO + 4HCl \rightarrow 2PbCl_2 + 2H_2O$

$PbO_2 + 4HCl \rightarrow PbCl_2 + Cl_2 + 2H_2O$

Why do these compounds differ in their reactivity?

26. Similar to electron diffraction, neutron diffraction microscope is also used for the determination of the structure of molecules. If the wavelength used here is 800 pm. Calculate the characteristic velocity associated with the neutron. **[3]**

27. How do atomic radius vary in a period and in a group? How do you explain the variation? **[3]**

28. A sugar syrup of weight 214.2 g contains 34.2 g of sugar ($C_{12}H_{22}O_{11}$). Calculate **[3]**

i. molal concentration, and

ii. mole fraction of sugar in the syrup

Section D

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

Chromatography is an important technique extensively used to separate mixtures into their components, purify compounds and also test the purity of compounds. Based on the principle involved, chromatography is classified into different categories. Two of these are Adsorption chromatography and Partition chromatography. Two main types of chromatographic techniques are based on the principle of differential adsorption column chromatography, and thin-layer chromatography. Adsorption chromatography is based on the fact that different compounds are adsorbed on an adsorbent to different degrees. Column chromatography involves the separation of a mixture over a column of adsorbent (stationary phase) packed in a glass tube. Thin-layer chromatography (TLC) is another type of adsorption chromatography, which involves the separation of substances of a mixture over a thin layer of an adsorbent coated on a glass plate. Partition chromatography is based on the continuous differential partitioning of components of a mixture between stationary and mobile phases.

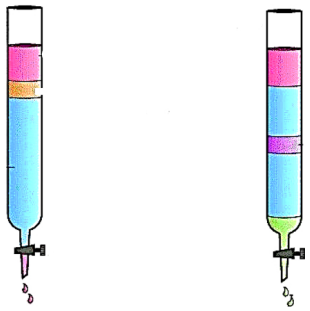
i. Which adsorbent is used in adsorption chromatography?

ii. How do you visualize colourless compounds after separation in Paper Chromatography?

iii. Why paper chromatography is a type of partition chromatography?

OR

Which chromatography is shown in following image?



30. **Read the following text carefully and answer the questions that follow:** **[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

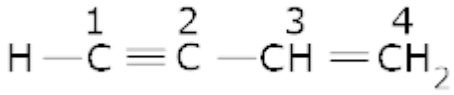
31. **Attempt any five of the following:** **[5]**

(a) Convert methane into ethane. **[1]**

(b) Write IUPAC name of the following: $CH_3\ (CH_2)_4\ CH\ (CH_2)_3\ CH_3CH_2 - CH\ (CH_3)_2$ **[1]**

(c) To which category of compounds does cyclohexane belong? **[1]**

(d) Name the type of hybridization in C (2) and C (3) in the following molecule **[1]**



(e) What are Arenes? **[1]**

(f) n-propylmagnesium bromide on hydrolysis gives propane. Is there any other Grignard reagent which also gives propane? If so, give its name, structure and equation for the reaction. **[1]**

(g) How will you distinguish between acetylene and ethylene? **[1]**

32. The pH of milk, black coffee, tomato juice, lemon juice, and egg white are 6.8, 5.0, 4.2, 2.2 and 7.8 respectively. Calculate corresponding hydrogen ion concentration in each. **[5]**

OR

A sample of pure PCl_5 was introduced into an evacuated vessel at 473 K. After equilibrium was attained, concentration of PCl_5 was found to be 0.5×10^{-1} mol L^{-1}. If value of K_c is 8.3×10^{-3}, what are the concentrations of PCl_3 and Cl_2 at equilibrium?

$PCl_5\ (g) \rightleftharpoons PCl_3\ (g) + Cl_2(g)$

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

(a) i. What is the general molecular formula of saturated monohydric alcohols? **[2.5]**

ii. Write structural formulae for compounds named as- **[2.5]**

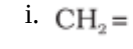
a. 1-Bromoheptane

b. 5-Bromoheptanoic acid

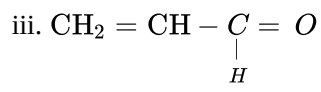
OR

i. Explain hyperconjugation effect. How does hyperconjugation effect explain the stability of alkenes? **[2.5]**

ii. Draw the resonance structures of the following compounds: **[2.5]**

i. 

ii. $CH_2 = CH — CH = CH_2$

iii. 

Solution

Section A

1. **(d)** -187.6°F

   Explanation: Substituting the given value for °C = (-122) in the following expression,

   °F = [1.8 (°C) + 32],

   = [1.8 $\times$ (-122) + 32]

   = [(-219.6) + 32]

   = - 187.6

   So , -122°C in Fahrenheit scale is - 187.6°F

2. **(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

3. **(b)** may be positive or negative.

   Explanation: Standard molar enthalpy of formation of a compound from its elements can be +ve or –ve.

   For example: $C + O_2(g) \rightarrow CO_2(g); \Delta_r H$ = 393.5 kJ mol^{-1}

   $N_2(g) + \frac{1}{2}O_2(g) \rightarrow N_2O(g);\ \Delta_r H$ = +92 k J mol^{-1}

4. **(a)** 14

   Explanation: Here l = 3 means the subshell is f.

   n = 4 means it is present in the 4th orbit. Finally, it is a 4f subshell.

   The number of orbital in f sub shell = 2l + 1 = 2 $\times$ 3 + 1 = 7

   Each orbital can accommodate 2 electrons = 7 $\times$ 2 = 14 electrons.

   Therefore, the maximum number of electrons in a subshell with l = 3 and n = 4 (4f) is 14 electrons.

5. **(a)** 30.0 kJ

   Explanation: Number of moles of CCl_4 = $\frac{100}{154}$ = 0.6493 moles.

   Heat required for 0.6493 moles = 19.5kJ

   $\Rightarrow$ Heat required for 1.00 moles = $\frac{19.5}{0.6493}$ = 30.032kJ

6. **(a)** 1.3225 nm

   Explanation: Radius of Bohr's nth orbit for hydrogen atom is given by:

   r_n = (0.0529 nm) n^2

   For, n = 5

   r_5 = (0.0529 nm) 5^2 = 1.3225 nm

7. **(a)** reduction process

   Explanation: $CH_2 = CH_2 + H - H \rightarrow H_3C - CH_3$

   (Addition of hydrogen)

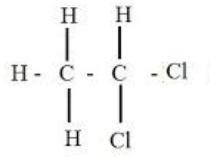
   Because of the addition of hydrogen, there occurs reduction of ethene.

8. **(a)** Chromatography

   Explanation: Chromatography is associated with the stationary phase and mobile phase.

9. **(a)** Ethyne

   Explanation: Ethylidene chloride is 1,1 - dichloroethane having the structural formula,



Structural formula of Ethylidene di chloride or 1,1-dichloro ethane

Ethylidene chloride, when treated with alcoholic KOH forms **ethyne**.

The reaction takes place in two steps giving vinyl chloride in the first step, which further undergoes an elimination reaction to form ethyne. as shown below,

$$\underset{(Ethylidene\ chloride)}{CH_3CHCl_2} \xrightarrow[alcoholicKOH]{} \underset{(VinylChloride)}{CH_2=CHCl} \xrightarrow[KOH(alc.)]{} \underset{(Ethyne)}{HC\equiv CH}$$

10.

(c) 1.71, 1.40, 1.36

Explanation: Order of size = $N^{3-} > O^{2-} > F^-$

$\frac{Z}{e} = \frac{7}{10}\ \frac{8}{10}\ \ \frac{9}{10}$

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. **(a)** infinite

Explanation: Conformational isomers are obtained by rotation about a carbon-carbon single bond. This results in an infinite number of momentary arrangements of atoms in space. Hence for ethane infinite number of conformations are possible.

13.

(c) A is true but R is false.

Explanation: Metamers differ in the nature of alkyl groups attached to the same functional group.

e.g. CH_3-O-C_3H_7 (Methyl propyl ether), C_2H_5-O-C_2H_5 (Diethyl ether)

14.

(d) A is false but R is true.

Explanation: Halogens deactivate benzene ring for further substitution due to inductive effect of halide groups. The negative inductive effect of F in halogens being maximum and thus deactivating nature in halogens is maximum for F. Thus nitration of C_6H_5F shows poor yield.

15.

(d) If both Assertion and Reason are false statements.

Explanation: No transition can take place between $2p_x \rightarrow 2p_y\ as\ 2p_x\ to\ 2p_y$ are degenerate orbitals.

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

Explanation: Both SO_2 and CH_4 represent 0.5 g mole have a same number of molecules.

Section B

17. $A_2X_3 \rightarrow 2A^{3+} + 3X^{2-}$

$K_{sp} = \left[A^{3+}\right]^2\left[X^{2-}\right]^3 = 1.1 \times 10^{-23}$

If S = solubility of A_2X_3, then

$\left[A^{3+}\right] = 2S; \left[X^2\right] = 3S$

therefore, $K_{sp} = (2S)^2(3S)^3 = 108S^5$

$= 1.1 \times 10^{-23}$

thus, $S^5 = 1 \times 10^{-25}$

$S = 1.0 \times 10^{-5}$ mol/L

18. According to the question, electron gain enthalpy of bromine is 3.36 eV.

Number of moles of Br = $\frac{\text{Given weight}}{\text{Molecular weight}} = \frac{8}{80} = 0.1\text{mol}$

Therefore, required energy = $0.1 \times 3.36 \times 23.06$= 7.748 kcal.

19. As shown in figure, the masses of H and O which combine with the fixed mass of S, i.e. 32 parts are 2 and 32 i.e. they are in the ratio 2 : 32 or 1 : 16. When H and O combine directly to form H_2O, the ratio of their combining , masses are 2:16 or 1 : 8.

These ratio are related to each other as $\frac{1}{16} : \frac{1}{8} = 1 : 2$

i.e. they are simple multiple of each other.

20.
- Pent-1-ene

  $CH_2 = CH - CH_2 - CH_2 - CH_3$
- Pent-2-ene

  $CH_3 - CH = CH - CH_2 - CH_3$
- 2-Methylbut-2-ene

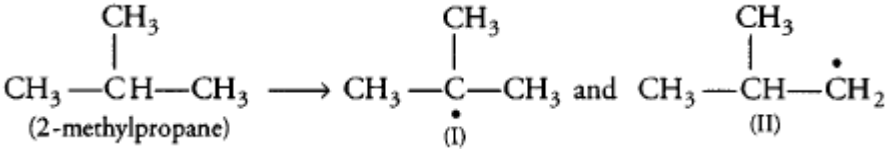
  $CH_3 - \underset{\underset{CH_5}{|}}{C} = CH - CH_3$
- 3-Methylbut-2-ene

  $CH_3 - \underset{\underset{CH_3}{|}}{C}H - CH = CH_2$
- 2-Methylbut-ene

  $CH_2 = \underset{\underset{CH_3}{|}}{C} - CH_2 - CH_3$

OR

During monochlorination of 2-methylpropane, 2-methylpropane gives two types of radicals:



Radical (II) is less stable because it is 1° and stabilised by one hyper conjugative structure (as it has only 1 α-hydrogen).

Radical (I) is more stable because it is 3° and stabilised by nine hyper conjugative structures (as it has 9 α-hydrogens).

Hence, Radical (I)is more stable.

21. Let the volume of nucleus = V = $\frac{4}{3}\pi r^3$, the mass of the nucleus = M.

Also, $r = r_\circ A^{\frac{1}{3}} \Rightarrow r^3 = r_\circ^3 A$

Now, Density$(\rho) = \frac{Mass\ (M)}{Volume\ (V)} = \frac{M}{\frac{4}{3}\pi r^3} = \frac{M}{\frac{4}{3}\pi r_\circ^3 A}$.

Since, M, $r_\circ$ and A for the given nucleus is constant . Therefore The density of nucleus is constant, independent of the element under consideration.

Section C

22.

Atoms and their ions	Atomic number	Electronic configuration	No. of valence electrons	Lewis symbol
S	16	2, 8, 6	6	$: \ddot{S} :$
S^{2-}	16 + 2 = 18	2, 8, 8	8	$[: \ddot{\underset{\cdot\cdot}{S}} :]^{2-}$
Al	13	2, 8, 3	3	$\cdot \dot{A}l \cdot$
Al^{3+}	13 - 3 = 10	2, 8	8	$[Al]^{3+}$
H	1	1	1	$H \cdot$
H^-	1 + 1 = 2	2	2	$\dot{H} \cdot$

23. Answer:

(i) We have q = -w = p_{ex} (8) = 8 litre-atm

(ii) Entropy is a measure of randomness of a system. The measure of the level of disorder in a closed but changing system, a system in which energy can only be transferred in one direction from an ordered state to a disordered state. Higher the entropy, higher the disorder and lower the availability of the system's energy to do useful work.

(iii) According to the question, Standard Gibbs energy of formation of NO(g) is 86.7 kJ mol^{-1}.

As the standard Gibbs energy of formation is +ve, the reaction is non-spontaneous.

Hence, N_2 and O_2 do not combine to form NO.

24. The change take place as follows:

Step - 1: 1 mol H_2O (1, 100°C) $\longrightarrow$ 1 mol (1, 0°C) Enthalpy change ΔH_1

Step - 2: 1 mol H_2O (1, 0°C) $\longrightarrow$ 1 mol H_2O(S, 0°C) Enthalpy change ΔH_2

Total enthalpy change will be -

$\Delta H = \Delta H_1 + \Delta H_2$

ΔH_1 = - (18 $\times$ 4.2 $\times$ 100) J mol^{-1}

= - 7560 J mol^{-1} = - 7.56 k J mol^{-1}

ΔH_2 = - 6.00 kJ mol^{-1}

Therefore,

ΔH = - 7.56 kJ mol^{-1} + (-6.00 kJ mol^{-1})

= -13.56 kJ mol^{-1}

There is negligible change in the volume during the change form liquid to solid state.

Therefore, $p\Delta v = \Delta ng\ RT = 0$

$\Delta H = \Delta U$ = - 13.56kJ mol^{-1}

25. a. $\overset{+2}{Pb}O + 4HCl \rightarrow \overset{+2}{Pb}Cl_2 + 2H_2O$

In reaction (a), the oxidation number of none of the atoms undergoes a change. Therefore, it is not a redox reaction. It is an acid-base reaction because PbO is a basic oxide that reacts with HCl acid.

b. $\overset{+4}{Pb}O_2 + 4HCl \rightarrow \overset{+2}{Pb}Cl_2 + \overset{0}{Cl}_2 + 2H_2O$

The reaction (b) is a redox reaction in which PbO_2 gets reduced and acts as an oxidizing agent.

26. λ = 800 pm = 800 $\times$ 10^{-12}m = 8 $\times$ 10^{-10}

m = 1.675 $\times$ 10^{-27}

$v = \frac{h}{m\lambda} = \frac{(6.626\times10^{-34}\text{kgm}^2\text{s}^{-1})}{(1.675\times10^{-27}\text{kg})(8\times10^{-10}\text{m})}$

$\frac{6.626}{1.675\times8} \times 10^{-34+37}\text{ms}^{-1} = \frac{6.626\times10^3}{1.675\times8}\text{ms}^{-1}$

= 0.494 $\times$ 10^3 ms^{-1} =494 ms^{-1}

27. Atomic radius increases down the group and decreases across the period. This is due to the continuous increase in the number of electronic shells or orbit numbers in the structure of atoms of the elements down the group.

From left to right across a period atomic radii generally decrease due to an increase in effective nuclear charge.

28. i. Weight of sugar syrup = 214.2 g

Weight of sugar in syrup = 34.2 g

weight of water in syrup = 214.2 - 34.2 = 180.0 g

Moles of sugar = $\frac{34.2}{342}$ = 0.1 (Molar mass = 342)

Molality = $\frac{0.1}{180} \times 1000$ = 0.56 m

ii. Moles of sugar = $\frac{34.2}{342}$ = 0.1

Moles of water = $\frac{180}{18}$ = 10

Mole fraction of sugar = $\frac{0.1}{10+0.1}$

= 0.0099

Section D

29. i. In column chromatography adsorbent is silica gel or alumina while in paper chromatography adsorbent is cellulose.

ii. In paper chromatography the spots of the separated colourless components may be observed either under ultra-violet light or by the use of an appropriate spraying agent.

iii. Partition chromatography is based on continuous differential partitioning of components of a mixture between stationary and mobile phases as doner in paper chromatography.

OR

Column chromatography.

30. 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) Conversion of methane into ethane:

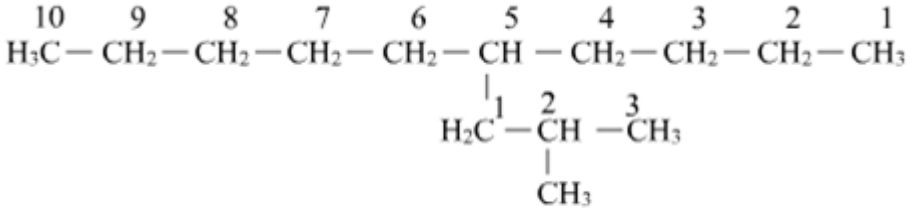
Step 1:

$$CH_4 \xrightarrow[\text{UV light}]{Cl_2} CH_3Cl$$

Step 2:

$$2\,CH_3Cl \xrightarrow[\text{Dry ether}]{2\,Na} \underset{\text{Ethane}}{CH_3—CH_3}$$

(ii) The IUPAC name of given compound is:



5—[2—Methylpropyl] - decane

(iii) Cyclohexane belongs to saturated alicyclic hydrocarbons.

(iv) At, C(2) two σ and two π - bonds are present. Therefore, C(2) is sp-hybridized and at C(3) three σ and one π -bond are present. Therefore, (C3) is sp^2 hybridized.

(v) Arenes are aromatic hydrocarbons

(vi) Iso-propylmagnesium bromide, $(CH_3)_2CHMgBr$,

$(CH_3)_2CHMgBr + H_2O \longrightarrow CH_3CH_2CH_3 + Mg(OH)Br$

(vii) Acetylene forms precipitate with ammoniacal silver nitrate solution, ethylene does not react with these reagents.

32. We can calculate the hydrogen ion concentration by applying the formula, pH = –log [H+]

i. pH of milk = 6.8

Since, pH = $-\log [H^+]$

$\Rightarrow$ $6.8 = -\log [H^+]$

$\Rightarrow$ $\log [H^+] = -6.8$

By taking antilog of both the sides, we get

$\Rightarrow$ $[H^+]$ = antilog (–6.8)

$\Rightarrow$ $[H^+] = 1.5 \times 19–7$ M

ii. pH of black coffee = 5.0

Since, pH = $-\log [H^+]$

$\Rightarrow 5.0 = -\log [H^+]$

$\Rightarrow \log [H^+] = -5.0$

By taking antilog of both the sides, we get

$\Rightarrow [H^+]$ = antilog (–5.0)

$\Rightarrow [H^+] = 10^{-5}$ M

iii. pH of tomato juice = 4.2

Since, pH = $-\log [H^+]$

$\Rightarrow$ $4.2 = -\log [H^+]$

$\Rightarrow$ $\log [H^+] = -4.2$

By taking the antilog of both the sides, we get

$\Rightarrow [H^+]$ = antilog (–4.2)

$\Rightarrow [H^+] = 6.31 \times 10^{-5}$ M

iv. pH of lemon juice = 2.2

Since, pH = –log $[H^+]$

$\Rightarrow$2.2 = –log $[H^+]$

$\Rightarrow$log [H+] = –2.2

By taking the antilog of both the sides, we get

$\Rightarrow [H^+]$ = antilog (–2.2)

$\Rightarrow [H^+] = 6.31 \times 10^{-3}$ M

v. pH of egg white = 7.8

Since, pH = –log $[H^+]$

$\Rightarrow$7.8 = –log $[H^+]$

$\Rightarrow$log $[H^+]$ = –7.8

By taking the antilog of both the sides, we get

$\Rightarrow [H^+]$ = antilog (–7.8)

$\Rightarrow [H^+] = 1.58 \times 10^{-8}$ M

OR

Let the initial molar concentration of PCl_5 per litre = x mol

Molar concentration of PCl_5 at equilibrium = 0.05 mol

Moles of PCl_5 decomposed = (x - 0.05) mol

Moles of PCl_3 formed = (x - 0.05) mol

Moles of Cl_2 formed = (x - 0.05) mol

The molar concentration./ litre of reactants and products before the reaction and at the equilibrium point are:

	PCl_5	$\rightleftharpoons$	PCl_3	+	Cl_2
Initial moles/litre	x		0		0.214 mol
Moles/litre at eqm. point	0.05		$(x - 0.05)$		$(x - 0.05)$

Equilibrium constant $(K_c) = 8.3 \times 10^{-3} = 0.0083$

Applying Law of chemical equilibrium,

$K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]} 0.0083 = \frac{(x-0.05)\times(x-0.05)}{0.05}$

$(x - 0.05)^2 = 0.0083 \times 0.05 = 4.15 \times 10^{-4}$

$(x - 0.05) = (4.15 \times 10^{-4})^{1/2} = 2.037 \times 10^{-2} = 0.02\ moles$

x = 0.05 + 0.02 = 0.07 mol

The molar concentration of PCl_3 at equilibrium. = x - 0.05 = 0.07 - 0.05 = 0.02 mol

The molar concentration of Cl_2 at equilibrium. = x - 0.05 = 0.07 - 0.05 = 0.02 mol

33. Answer:

(i) i. Monohydric alcohols are the compounds derived from an alkane by replacing one H by - OH group.

Example:

$$\underset{\text{Methane}}{CH_4} \xrightarrow{replacing\ H\ with\ OH} \underset{\text{Methanol}}{CH_3 - OH}$$

Therefore, the general molecular formula of saturated monohydric alcohols is $C_nH_{2n+1}OH$.

ii. i. Structural formula of 1-Bromoheptane:

CH_3-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2Br

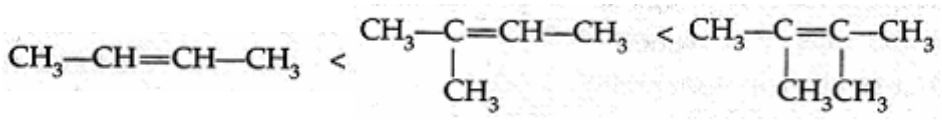
ii. Structural formula of 5-Bromoheptanoic acid:

CH_3-CH_2-CH(Br)-CH_2-CH_2-CH_2-COOH

OR

i. **Hyperconjugation:** The relative stability of various classes of carbonium ions may be explained by the number of no-bond resonance structures that can be written for them. Such structures are arrived by shifting the bonding electrons from an adjacent C - H bond to the electron - deficient carbon. In this way, the positive charge originally on

carbon is dispersed to the hydrogen. This manner of electron release by assuming no-bond character in the adjacent C - H bond is called Hyper conjugation or No-bond Resonance. The greater the hyperconjugation, the greater will be the stability of the compound. The increasing order of stability can be shown as:



ii. Resonance structure of the given compounds are as follows:

i. $CH_2 = CH - Cl \leftrightarrow {}^{+}CH_2 - CH = Cl^{+}$

ii. $CH_2 = CH - CH = CH_2 \leftrightarrow {}^{+}CH_2 - CH = CH \cdot CH_2^{-} \leftrightarrow CH_2 - CH = CH \cdot CH_2^{+}$

iii. $CH_2 = CH \cdot CHO \leftrightarrow {}^{+}CH_2 \cdot CH = CHO^{-}$