Class XI Session 2023-24
Subject - Chemistry
Sample Question Paper - 8

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. 30 mg is the same mass as: **[1]**

   a) 0.0003 kg b) 0.03 g

   c) 300 decigrams d) 0.3 grams

2. Cathode rays are deflected by: **[1]**

   a) electric and magnetic fields b) magnetic field only

   c) thin metal foils only d) electric field only

3. No work is done on the system, but q amount of heat is taken out from the system and given to the surrounding. The change in internal energy of a system is **[1]**

   a) ΔU = -q b) $\Delta U = W_{ad}$

   c) ΔU = +q d) ΔU = q - W

4. The product of the uncertainties of the exact position and exact momentum (or velocity) of an electron. The product of their uncertainties is always **[1]**

   a) equal to or greater than h/3π b) equal to or greater than h/4π.

   c) equal to or greater than h/2π d) equal to or greater than h/π

5. For a cyclic process, the change in internal energy of the system is_____. **[1]**

   a) always + ve b) always - ve

   c) none of these d) zero

6. Orbital angular momentum depends on _____. **[1]**

a) m and s

b) n and m

c) l

d) n and l

7. Choose the correct explanation regarding half-reaction such as $Cr_2O_7^{2-} \rightarrow Cr^{3+}$ from the following. **[1]**

a) $Cr_2O_7^{2-}$ is a good reducing agent

b) It is oxidation half-reaction

c) Chromium being reduced

d) Chromium being oxidised

8. The order of decreasing priority for some functional groups in the naming of an organic compound is: **[1]**

a) - COOR (R = alkyl group right), - COCl, - $CONH_2$, - CN, - HC = O, > C = O, - OH, - H_2

b) - CN, - HC = O, > C = O, - OH, - NH_2, - COOR (R = alkyl group), - COCl, - $CONH_2$

c) - $CONH_2$, - CN, - HC = O, > C = O, - OH, - NH_2, - COOR (R = alkyl group), - COCl

d) - COCl, - $CONH_2$, - CN, - HC = O, > C = O, - OH, - NH_2, - COOR (R = alkyl group)

9. The synthesis of 3-octyne is achieved by subsequent stepwise reactions of sodium amide with an alkyne, and a bromoalkane. The bromoalkane and the other alkyne respectively are: **[1]**

a) $BrCH_2CH_2CH_3$ and $CH_3CH_2CH_2C \equiv CH$

b) $BrCH_2CH_2CH_2CH_2CH_3$ and $CH_3C \equiv CH$

c) $BrCH_2CH_2CH_2CH_3$ and $CH_3CH_2C \equiv CH$

d) $BrCH_2CH_2CH_2CH_2CH_3$ and $CH_3CH_2C \equiv CH$

10. Choose one of the following in the order of increasing radii: **[1]**

a) $I^- < I^+ < I$

b) $I < I^+ < I^-$

c) $I^+ < I^- < I$

d) $I^- > I > I^+$

11. The equilibrium constant for a reaction is 10. What will be the value of ΔG^0? R = 8.314 JK^{-1}, T= 300 K, T = 300 K? **[1]**

a) -5.744 kJ mol^{-1}

b) -5.456 kJ mol^{-1}

c) -6.132 kJ mol^{-1}

d) -5.978 kJ mol^{-1}

12. The number of alkynes possible with molecular formula C_5H_8 is: **[1]**

a) 5

b) 4

c) 2

d) 3

13. **Assertion (A):** Electron deficient species that can accept lone pair of electrons known as an electrophile. **[1]**

Reason (R): $\overset{\oplus}{N}H_4$ is an electrophile.

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):** Ozonolysis of alkynes are faster than ozonolysis of alkenes. **[1]**

Reason (R): Reaction proceed by cyclic transition state are faster on alkynes.

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):** Energy of radiation is large if its wavelength is large. **[1]**

Reason (R): Energy = hν (ν = frequency, $\nu = \frac{c}{\lambda}$)

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):** Molarity of a solution represents its concentration. **[1]**

Reason (R): Molarity is the number of moles of solute per litre of solution.

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. A reaction between ammonia and boron trifluoride is given below: **[2]**

: $NH_3 + BF_3 \rightarrow H_3N : BF_3$

Identify the acid and base in this reaction. Which theory explains it? What is the hybridization of B and N in the reactants?

18. Which of the elements Na, Mg, Si and P would have the greatest difference between the first and second ionisation enthalpies. Briefly explain your answer. **[2]**

19. How many seconds are there in 2 days? **[2]**

20. Arrange the three isomers of pentane in increasing order of their boiling points. **[2]**

OR

Alkynes on reduction with sodium in liquid ammonia form trans alkenes. Will the butene thus formed on the reduction of the 2-butyne show the geometrical isomerism?

21. Write the electronic configuration of the following ions: **[2]**

i. H^-

ii. Na^+

iii. O^{2-}

iv. F^-

Section C

22. Predict the dipole moment of **[3]**

i. a molecule of the type AX_2 having a linear geometry.

ii. a molecule of the type AX_4 having tetrahedral geometry.

iii. a molecule of the type AX_2 having angular geometry.

iv. a molecule of the type AX_4 having square planar geometry.

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

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

(ii) If enthalpy of fusion and enthalpy of vaporisation of sodium metals are 2.6 and 98.2 kJ mol^{-1} **[1]**

respectively, what is the enthalpy of sublimation of sodium?

(iii) Why in some reactions heat is evolved while some reactions take place only on the absorption of heat? **[1]**

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

25. Consider the reactions : **[3]**

a. $6CO_2(g) + 6H_2O(I) \longrightarrow C_6H_{12}O_6(aq) + 6O_2(g)$

b. $O_3(g) + H_2O_2(I) \longrightarrow H_2O(I) + 2O_2(g)$

Why it is more appropriate to write these reactions as :

a. $6CO_2 + 12H_2O(I) \longrightarrow C_6H_{12}O_6(aq) + 6H_2O(I) + 6O_2(g)$

b. $O_3(g) + H_2O_2(I) \longrightarrow H_2O(I) + O_2(g) + O_2(g)$

Also suggest a technique to investigate the path of the above (a) and (b) redox reactions.

26. Emission transitions in the Paschen series end at orbit n = 3 and start from orbit n and can be represeted as v = 3.29×10^{15} (Hz) $[1/3^2 - 1/n^2]$ Calculate the value of n if the transition is observed at 1285 nm. Find the region of the spectrum. **[3]**

27. Give the name and an atomic number of the inert gas atom in which the total number of d-electrons is equal to the difference in numbers of total p and s electrons. **[3]**

28. The density of 3 M solution of NaCl is 1.25 g mL^{-1}. Calculate the molality of the solution. **[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]**

When anions and cations approach each other, the valence shell of anions are pulled towards the cation nucleus and thus, the shape of the anion is deformed. The phenomenon of deformation of anion by a cation is known as polarization and the ability of the cation to polarize the anion is called as polarizing power of cation. Due to polarization, sharing of electrons occurs between two ions to some extent and the bond shows some covalent

character.

The magnitude of polarization depends upon a number of factors.

(i) Out of $AlCl_3$ and AlI_3 which halides show maximum polarization?

(ii) Out of $AlCl_3$ and $CaCl_2$ which one is more covalent in nature?

(iii) The non-aqueous solvent like ether is added to the mixture of LiCl, NaCl and KCl. Which will be extracted into the ether?

OR

Out of CaF_2 and CaI_2 which one has a minimum melting point?

Section E

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

(i) What effect does branching of an alkene chain has on its boiling point? **[1]**

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

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

(iv) Why are alkanes called paraffins? **[1]**

(v) State Le chatelier's principle. **[1]**

(vi) What is decarboxylation? Give an example. **[1]**

(vii) Arrange the following: HCl, HBr, Hl, HF in order of decreasing reactivity towards alkenes. **[1]**

32. Write the expression for the equilibrium constant, K_c for each of the following reactions: **[5]**

a. $2NOCl\ (g) \rightleftharpoons 2NO\ (g) + Cl_2\ (g)$

b. $2Cu(NO_3)_2\ (s) \rightleftharpoons 2CuO\ (s) + 4NO_2\ (g) + O_2\ (g)$

c. $CH_3COOC_2H_5(aq) + H_2O(l) \rightleftharpoons CH_3COOH\ (aq) + C_2H_5OH\ (aq)$

d. $Fe^{3+}\ (aq) + 3OH^-\ (aq) \rightleftharpoons Fe(OH)_3\ (s)$

e. $I_2\ (s) + 5F_2 \rightleftharpoons 2IF_5$

OR

i. Describe the effect of

a. addition of H_2

b. addition of CH_3OH

c. removal of CO

d. removal of CH_3OH on the equilibrium of the reaction,

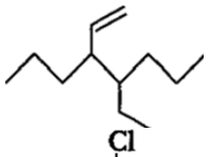
$2H_2(g) + CO(g) \rightleftharpoons CH_3OH(g)$

ii. What happens to an equilibrium in a reversible reaction if a catalyst is added to it?

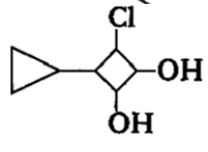
33. **Answer:** **[5]**

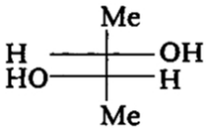
(i) i. Give IUPAC names of the following structures. **[2.5]**

i.



ii.



iii. 

ii. Benzoic acid is an organic compound. Its crude sample can be purified by crystallization from hot water. What characteristic differences in the properties of benzoic acid and the impurity make this process of purification suitable? **[2.5]**

OR

i. Identify the pairs of compounds which are functional group isomers. **[2.5]**

I. $CH_3 - CH_2 - CH_2 - CH_2 - OH$

II. $CH_3 - CH_2 - \underset{\displaystyle OH}{\underset{|}{CH}} - CH_3$

III. $CH_3 - \overset{\displaystyle CH_3}{\overset{|}{\underset{\displaystyle OH}{\underset{|}{C}}}}H - CH_3$

IV. $CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_2 - OH$

V. $CH_3 - CH_2 - O - CH_2 - CH_3$

VI. $CH_3 - O - CH_2 - CH_2 - CH_3$

VII. $CH_3 - O - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_3$

ii. Explain, how is the electronegativity of carbon atoms related to their state of hybridization in an organic compound. **[2.5]**

Solution

Section A

1.

(b) 0.03 g

Explanation: since 1000 mg = 1g

$\therefore$ 30 mg

= [(1/1000) $\times$ 30] g

= 0.03 g

2. **(a)** electric and magnetic fields

Explanation: When an electric field is applied to a stream of cathode rays, they get deflected towards the positive plate. On the application of a magnetic field perpendicular to the path of the cathode rays, they get deflected in the direction expected of negative particles.

3. **(a)** ΔU = -q

Explanation: ΔU = -q

4.

(b) equal to or greater than h/4π.

Explanation: The uncertainty principle says that we cannot measure the position (x) and the momentum (p) of a particle with absolute precision. The more accurately we know one of these values, the less accurately we know the other. Multiplying together the errors in the measurements of these values has to give a number greater than or equal to half of a constant called "h-bar". This is equal to Planck's constant (usually written as h) divided by 2π.

$\Delta x . \Delta p \geq \frac{h}{4\pi}$

5.

(d) zero

Explanation: For a cyclic process, the initial state is the same as that of the final state. As internal energy is a state function, its value at the initial point is the same as that at the final point and enthalpy change is zero.

6.

(c) l

Explanation: Azimuthal quantum number. 'I' also known as orbital angular momentum or subsidiary quantum number. It defines the three-dimensional shape of the orbital. For a given value of n,1 can have n values ranging from 0 to n-1, that is, for a given value of n, the possible values of 1 are: 1 = 0, 1, 2, ...(n - 1).

7.

(c) Chromium being reduced

Explanation: $\overset{6+}{Cr_2O_7^{2-}} \longrightarrow Cr^{3+}$

Gain of e^- (reduction)

8. **(a)** - COOR (R = alkyl group right), - COCl, - $CONH_2$, - CN, - HC = O, > C = O, - OH, - H_2

Explanation: COOR (R=alkyl group) > -COCl,> -$CONH_2$ > -CN > -HC=O> >C=O> -OH, -NH_2 is the decreasing order of priority

ester > acyl halide > acyl amide > nitrile > aldehyde > ketones > alcohol > amine

9.

(c) $BrCH_2CH_2CH_2CH_3$ and $CH_3CH_2C \equiv CH$

Explanation: 3 - Octyne can be synthesized as per the following stepwise conversion reactions:

Step 1. Formation of a Sodium alkynide, by the reaction of 1 -butyne with sodium amide

$CH_3CH_2C \equiv CH + NaNH_2 \rightarrow CH_3CH_2C \equiv CNa^+ + NH_3$

1-butyne sodium amide sodium butynide

Step 2. Reaction of the alkynide (sodium butynide) with 1 - bromobutane

$CH_3CH_2C \equiv CNa^+ + CH_3CH_2CH_2CH_2Br \rightarrow CH_3CH_2C \equiv CCH_2CH_2CH_2CH_3 + NaBr$

Sodium Butynide 1-bromobutane 3 - Octyne

10.

(d) $I^- > I > I^+$

Explanation: The size of the anion is greater than the size of the parent atom and the size of the cation. As the –ve charge of anion increases ionic radii increases due to a decrease in the effective nuclear charge and vice versa.

11. **(a)** -5.744 kJ mol^{-1}

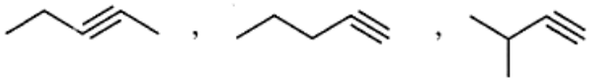
Explanation: Δ_rG^0 = -RTln K_c.

ΔG^0 = -2.303 × 8.314 × 300 × log10 = -5744.14 $Jmol^{-1}$ = -5.74414 $kJmol^{-1}$

12.

(d) 3

Explanation:



13.

(c) A is true but R is false.

Explanation: A is true but R is false.

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.

(d) A is false but R is true.

Explanation: Energy of radiation is small if its wavelength is large

$\because E = \frac{hc}{\lambda}$ (inverse relationship between E and λ).

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

Explanation: Concentration means how much amount of substance is present in a given volume of a solution. Now as amount can be measured in terms of moles, so molarity means concentration of the solution. According to Mole concept: 1 Mole of molecules = Gram molecular mass = 6.023 × 10^{23} molecules.

Section B

17. The acid is BF_3 and the base is NH_3. The Lewis theory of acids and bases explains it. The hybridization of B in BF_3 is sp^2 and the hybridization of N in NH_3 is sp^3.

18. Among the given elements Na being alkali metal has only one electron in the valence shell, therefore has very low Δ_iH_1.

However, after the removal of one electron, it acquires nearest inert gas or neon gas configuration, i.e. Na+ ($1s^2$, $2s^2$, $2p^2$). Therefore, its Δ_iH_2 is expected to be very high. Consequently, the difference in first and second ionisation enthalpies would be greatest in case of Na.

However, it may be noted here that in case of Mg, Si and P, although their Δ_iH_1 will be much higher than that of Na but their Δ_iH_2 be much lower than that of Na. As a result, the difference in their respectively, Δ_iH_1 and Δ_iH_2 would be much lower than that of Na.

19. Here, we know 1 day = 24 hours (h)

or $\frac{1day}{24h} = 1 = \frac{24h}{1day}$

then, 1h = 60 min

or $\frac{1h}{60min} = 1 = \frac{60min}{1h}$

so, for converting 2 days to seconds,

i.e., 2 days _____ = _____ seconds

The unit factors can be multiplied in series in one step only as follows:

2 day × $\frac{24h}{1day}$ × $\frac{60min}{1h}$ × $\frac{60s}{1min}$

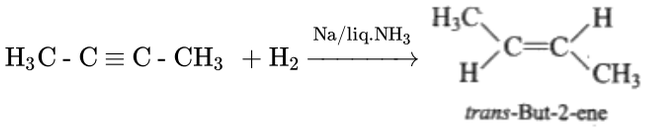
= 2 × 24 × 60 × 60 s

= 172800 s

20. 2, 2-Dimethylpropane < 2-mehtylbutane < pentane.

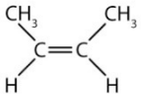
OR

Alkynes on reduction with sodium in liquid ammonia form trans alkenes

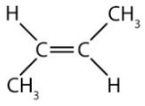


trans-But-2-ene

Yes, but - 2 - ene is capable of showing geometrical isomerism i.e cis and trans But-2-ene.



cis-2-butene



trans-2-butene

21. i. $1s^2$

ii. $1s^2\ 2s^2\ 2p^6$

iii. $1s^2\ 2s^2\ 2p^6$

iv. $1s^2\ 2s^2\ 2p^6$

Section C

22. i. In AX_2 molecule with a linear geometry, the individual bond moments of A-X bonds will cancel being equal in magnitude and opposite in direction. This will cause the overall dipole moment of the molecule to be 0.

ii. In AX_4 molecule having tetrahedral geometry, the individual dipole moments of A-X bonds will cancel out being equal in magnitude and opposite in direction. This will cause the overall dipole moment of the molecule to be zero.

iii. In AX_2 molecule having angular geometry, the individual bond moments of A-X bonds will add up and thus the molecule will have a net non-zero dipole moment.

iv. In AX_4 molecule having square planar geometry the individual dipole moments of A-X bonds will cancel out being equal in magnitude and opposite in direction. This will cause the overall dipole moment of the molecule to be zero.

23. Answer:

(i) 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.

(ii) According to the question, enthalpy of fusion and enthalpy of vaporisation of sodium metal is 2.6 kJ mol^{-1} and 98.2 kJ mol^{-1}.

We know that, enthalpy of sublimation = $\Delta_{sub}H^\circ = \Delta_{fus}H^\circ + \Delta_{vap}H^\circ$

= 2.6 + 98.2

= 100.8 kJ mol^{-1}

(iii) Every substance has energy stored in it in the form of heat content.

If the heat content of reactants (H_R) is greater than that of products (H_P), heat is evolved.

If the heat content of reactants (H_R) is less than that of products (H_P), heat is absorbed.

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 × 4.2 × 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. It is believed that the photosynthesis reaction occurs in two steps. In the first step, H_2O decomposes to give H_2 and O_2 in the presence of chlorophyll and the H_2 produced reduces CO_2, to $C_6H_{12}O_6$ in the second step. During the second step, some H_2O molecules are also produced and therefore, the reaction occurs as:

    a. i. $12H_2O\ (I) \longrightarrow 12H_2(g) + 6O_2\ (g)$

    ii. $6CO_2(g) + 12H_2(g) \longrightarrow C_6H_{12}O_6\ (s) + 6H_2O(I)$

    iii. $6CO_2(g) + 12H_2O(I) \longrightarrow C_6H_{12}O_6\ (s) + 6H_2O(I) + 6O_2(g)$

    Therefore, it is more appropriate to write the reaction for photosynthesis as (III) because it means that 12 molecules of H_2O are used per molecule of carbohydrate and $6H_2O$ molecules are produced per molecule of carbohydrate during the process.

    b. O_2 is written two times in the product which suggests that 0, is being obtained from the two reactants as:

    $O_3\ (g) \longrightarrow O_2(g) + O\ (g)$

    $$\frac{H_2O_2(l)+O(g)\longrightarrow H_2O(l)+O_2(g)}{O_3(g)+H_2O_2(l)\longrightarrow H_2O(l)+O_2(g)+O_2(g)}$$

    The path of the reaction can be studied by using H_2O^{18} in reaction (a) or by using H_2O^{18} or $O_3{}^{18}$ in reaction (b).

26. $v = (3.29 \times 10^{15}\ Hz)\left(\frac{1}{3^2} - \frac{1}{n^2}\right)$

    λ = 1285 nm = 1285 $\times$ 10^{-19} m = 1.285 $\times 10^{-16}$ m

    $v = \frac{c}{\lambda} = \frac{(3\times10^8 ms^{-1})}{(1.285\times10^{-6} m)}$ = 2.3346 $\times$ $10^{14}s^{-1}$

    $2.3346 \times 10^{14} = 3.29 \times 10^{15}\left[\frac{1}{3^2} - \frac{1}{n^2}\right]$

    $\frac{2.3346}{32.9} = \frac{1}{3^2} - \frac{1}{n^2}$ or $0.71 = \frac{1}{9} - \frac{1}{n^2}$

    $\frac{1}{n^2} = \frac{1}{9}$ - 0.071 = 0.111 - 0.071 = 0.04

    $n^2 = \frac{1}{0.04}$ = 25 or n = 5

    Paschen series lies in infrared region of the spectrum.

27. The Kr is the first Noble gas with atomic number 36 that contains electrons in d-orbit. The electronic configuration of Kr is: $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $3d^{10}$, $4s^2$, $4p^6$

    Total number of d-electrons = 10

    Total number of p-electrons = 18

    Total number of s-electrons = 8

    ∴ Difference in total number of p and s electrons =18 - 8 = 10

    Thus, the inert gas is krypton.

28. Given, Molarity of solution, M = 3 mol L^{-1}

    Mass of NaCl in 1 L solution = 3 $\times$ 58.5 = 175.5 g

    Mass of 1 L solution = Volume $\times$ density of solution = 1000 mL $\times$ 1.25 g/mL = 1250 g (since density = 1.25 g mL^{-1})

    Mass of water solution = 1250 -175.5 = 1074.5 g = 1.0745 kg.

    Now, Molality of solution = $\frac{\text{number of moles of solute}}{\text{mass of solvent in kg}} = \frac{3mol}{1.0745kg} = 2.79m$.

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:**

When anions and cations approach each other, the valence shell of anions are pulled towards the cation nucleus and thus, the shape of the anion is deformed. The phenomenon of deformation of anion by a cation is known as polarization and the ability of the cation to polarize the anion is called as polarizing power of cation. Due to polarization, sharing of electrons occurs between two ions to some extent and the bond shows some covalent character.

The magnitude of polarization depends upon a number of factors.

(i) AlI_3 halides show maximum polarization. The most covalent halide is AlI_3.

Since lesser, the electronegativity difference, the more covalent is the aluminum halide.

(ii) $AlCl_3$ is more covalent in nature.

(iii) LiCl will be extracted into the ether.

OR

CaI_2 has a minimum melting point.

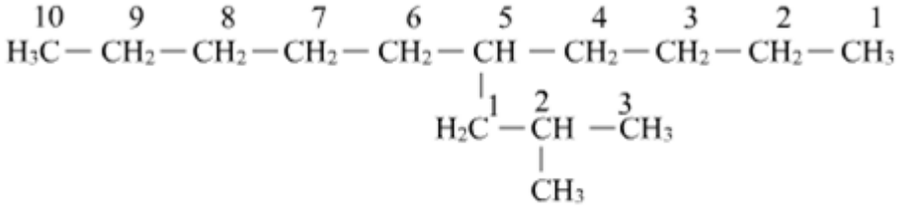
Section E

31. Attempt any five of the following:

(i) Branching of carbon atom chain decreases the boiling point of alkane.

(ii) Arenes are aromatic hydrocarbons

(iii) The IUPAC name of given compound is:



5—[2—Methylpropyl] - decane

(iv) Paraffins means little affinity. Alkanes due to strong **C-C** and **C-H** bonds are relatively chemically inert.

(v) **Le chatelier's principle:** If a system at equilibrium is subjected to change in the temperature, pressure or concentration of the reactants or the products that govern the equilibrium, then the equilibrium shifts in that direction in which this change is reduced or nullified.

(vi) The process by which carbon dioxide is removed from sodium acetate (or any sodium salt of acid) with the help of sodalime is called decarboxylation.

$CH_3COONa + NaOH \xrightarrow{heat} CH_4 + Na_2CO_3$

(vii) HI > HBr > HCl > HF

32. a. The expression for the equilibrium constant is $K_c = \frac{[NO(g)]^2[Cl_2(g)]}{[NOCl(g)]^2}$

b. The expression for the equilibrium constant is $K_c = \frac{[CuO(g)]^2[NO_2(g)]^4[O_2(g)]}{[Cu(NO_3)_2(s)]^2} = [NO_2(g)]^4\,[O_2(g)]$

c. The expression for the equilibrium constant is $K_c = \frac{[CH_3COOH(aq)][C_2H_5OH(aq)]}{[CH_3COOC_2H_5(aq)][H_2O(l)]} = \frac{[CH_3COOH(aq)][C_2H_5OH(aq)]}{[CH_3COOC_2H_5(aq)]}$

d. The expression for the equilibrium constant is $K_c = \frac{[Fe(OH)_3(s)]}{[Fe^{3+}(aq)]\,[OH^-(aq)]^3} = \frac{1}{[Fe^{3+}(aq)]\,[OH^-(aq)]^3}$

e. The expression for the equilibrium constant is $K_c = \frac{[IF_5(l)]^2}{[1_2(s)][F_2(g)]^5} = \frac{[IF_5(l)]^2}{[F_2(g)]^5}$

OR

i. $2H_2(g) + CO(g) \rightleftharpoons CH_3OH(g)$

According to Le-Chatelier's principle,

a. addition of H_2 (increase in concentration of reactants) shifts the equilibrium in forward direction (more product is formed).

b. addition of CH_3OH (increase in concentration of product) shifts the equilibrium in backward direction.

c. removal of CO also shifts the equilibrium in backward direction.

d. removal of CH_3OH shifts the equilibrium in forward direction.

ii. When catalyst is added, the state of equilibrium is not disturbed but equilibrium is attained quickly. This is because the catalyst increases the rate of forward and backward reaction to the same extent.

33. Answer:

(i) i. i. 4-ethyl-3-propylhept-1-ene

ii. 3-chloro-4-cyclopropyl-1,2 cyclobutandiol

iii. Butan-2,3-diol

ii. Benzoic acid is sparingly soluble in water at room temperature but appreciably soluble at higher temperature. The solution is concentrated to get a nearly saturated solution.

On cooling the solution, pure compound crystallises out.

OR

i. All the seven compounds given have the same molecular formula, so each alcohol is a functional group isomer of each ether given and visa-versa. Functional group isomers are a type of structural isomers having the same molecular formula but different functional groups. In the given structures, I, II, III, IV represent alcohols and V, VI, VII are ethers. Hence, I and V, I and VI, I and VII, II and V, II and VI, II and VII, III and V, III and VI, etc.

ii. If C is sp hybridized then S character is 50%.

If C is sp^2 hybridized then S character is 33%.

If C is sp^3 hybridized then S character is 25%.

Electronegativity of carbon is directly proportional to 's' character.

Hence, sp hybridized carbon has strong S character.

We know that, s electrons are more strongly attracted by nucleus than p-electrons as they lie closer to nucleus..

Thus, electronegativity of carbon increases with increase in 's' character.