Class XI Session 2024-25
Subject - Chemistry
Sample Question Paper - 6

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. If the density of a solution is 3.12 g mL^{-1}, the mass of 1.5 mL solution in significant figures is _____. **[1]**

   a) 4680×10^{-3}g
   b) 4.7g
   c) 47.80g
   d) 4.680g

2. The reduction in the attractive interaction of an electron in the outer shell and the nucleus due to the presence of electrons in the inner shells is known as _____. **[1]**

   a) Aufbau rule
   b) exchange energy
   c) Hund's rule
   d) screening effect

3. Standard Gibbs energy change $\Delta_r G^0$ is related to the equilibrium constant of the reaction as follows: **[1]**

   a) $\Delta_r G^0$ = -Rln K
   b) $\Delta_r G^0$ = -nRTln K
   c) $\Delta_r G^0$ = -RTln K
   d) $\Delta_r G^0$ = -Tln K

4. The energy associated with the first orbit in the hydrogen atom is -2.17 $\times 10^{-18}$ J/atom. What is the energy associated with the fifth orbit? **[1]**

   a) 8.68×10^{-20}Js
   b) 3.72×10^{-20}Js
   c) 5.72×10^{-20}Js
   d) 7.72×10^{-20}Js

5. Calculate the heat and the work associated with a process in which 5.00 mol of gas expands reversibly at constant temperature $T = 298k$ from a pressure of 10.00 to 1.00 atm **[1]**

   a) 27.0 kJ, -28.5 kJ
   b) 28.5 kJ, -28.5 kJ
   c) 25.5 kJ, -28.5 kJ
   d) 30.5 kJ, -28.5 kJ

6. Consider the ground state of Cr atom (Z = 24). The numbers of electrons with the azimuthal quantum numbers, l = 1 and 2 are, respectively: **[1]**

a) 12 and 4
b) 16 and 4
c) 12 and 5
d) 16 and 5

7. Consider the elements: Cs, Ne, I and F. Identify the element(s) which exhibits neither the negative nor does the positive oxidation state. **[1]**

a) Ne
b) Cs
c) Ne and F

8. CH_3 - MgBr and $(C_2H_5)_2$ CuLi are _____. **[1]**

a) electrophiles
b) lewis acids
c) nucleophiles
d) both electrophiles and nucleophiles

9. Addition of cold conc. H_2SO_4 with alkenes is an example of **[1]**

a) nucleophilic addition reaction
b) electrophilic substitution reaction
c) electrophilic addition reaction
d) nucleophilic substitution reaction

10. Eka-aluminium is known as _____. **[1]**

a) Aluminium
b) Germanium
c) Iron
d) Gallium

11. The enthalpy change of a chemical reaction $\Delta_r H$ equals (a_i and b_i are stoichiometric coefficients)? **[1]**

a) $\sum_i a_i H_{products} \pm \sum_i b_i H_{reactants}$
b) $\sum_i a_i H_{products} + \sum_i b_i H_{reactants}$
c) $\sum_i a_i H_{products}$
d) $\sum_i a_i H_{products} - \sum_i b_i H_{reactants}$

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):** Each carbon in ethylene molecule is sp^2 hybridised. **[1]**

Reason (R): The H-C-H bond angle in ethylene molecule is 120^o.

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):** Both cyclopropane and propene give addition reactions readily. **[1]**

Reason (R): Cyclopropane and propene are isomers of each other.

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):** Splitting of the spectral lines in the presence of a magnetic field is known as the Stark effect. **[1]**

Reason (R): The line spectrum is simplest for the hydrogen 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.

16. **Assertion (A):** Law of conservation of mass hold good for nuclear reaction. **[1]**

Reason (R): Law states that mass can be neither created nor destroyed in a chemical reaction.

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. Predict if the solutions of the following salts are neutral, acidic or basic: **[2]**

NaCl, KBr, NaCN, NH_4NO_3, $NaNO_2$ and KF

18. How does electronegativity and non – metallic character related to each other? **[2]**

19. How many significant figures should be present in the answer of the following calculations? **[2]**

i. $\frac{0.02856 \times 298.15 \times 0.112}{0.5785}$

ii. 5×5.364

iii. 0.0125 + 0.7864 + 0.0215

20. Which of the following compounds will show cis-trans isomerism? **[2]**

i. $(CH_3)_2C = CH - C_2H_5$

ii. $CH_2 = CBr_2$

iii. $C_6H_5CH = CH - CH_3$

iv. $CH_3CH = CCl\ CH_3$

OR

What do you understated by Resonance energy?

21. Among the following pairs of orbitals which orbital will experience the larger effective nuclear charge? **[2]**

i. 2s and 3s

ii. 4d and 4f

iii. 3p and 3f.

Section C

22. Write the Lewis dot structure of the CO molecule. **[3]**

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

(a) Define reaction enthalpy. **[1]**

(b) How can you say that universe is going towards chaos? **[1]**

(c) Neither q nor W is a state function but q + W is a state function. Explain why? **[1]**

24. For the reaction, $2A(g) + B(g) \longrightarrow 2D\ (g)$; ΔU^o = -10.5 kJ and ΔS^o = -44.1 JK^{-1}. Calculate ΔG^o for the reaction and predict whether the reaction may occur spontaneously. ($R = 8.314 \times 10^{-3}$ kJ $K^{-1}mol^{-1}$, T = 298K) **[3]**

25. Which of the following species, do not show a disproportionation reaction and why? **[3]**

ClO^-, ClO_2^-, ClO_3^- and ClO_4^-

Also, write the reaction for each of the species that disproportionate.

26. Lifetimes of the molecules in the excited states are often measured by using pulsed radiation source of duration nearly in the nano second range. If the radiation source has the duration of 2 ns and the number of photons emitted during the pulse source is 2.5×10^{15}, calculate the energy of the source. **[3]**

27. The first (IE) and second (IER) ionization enthalpy: (KJ mol^{-1}) of three elements A, B and C are given below: **[3]**

	A	**B**	**C**
IE_1	403	549	1142
IE_2	2640	1060	2080

Identify the element which is likely to be

i. a non-metal

ii. an alkali metal

iii. an alkaline earth metal

28. 10 mL of H_2 combine with 5 mL of O_2 to form water. When 200 mL of H_2 at STP is passed over heated CuO, the CuO loses 0.144 g of its weight. Does the above data correspond to the law of constant composition? **[3]**

Section D

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

The existing large number of organic compounds and their ever-increasing numbers has made it necessary to classify them on the basis of their structures. Organic compounds are broadly classified as open-chain compounds which are also called aliphatic compounds. Aliphatic compounds further classified as homocyclic and heterocyclic compounds. Aromatic compounds are special types of compounds. Alicyclic compounds, aromatic compounds may also have heteroatom in the ring. Such compounds are called heterocyclic aromatic compounds. Organic compounds can also be classified on the basis of functional groups, into families or homologous series. The members of a homologous series can be represented by general molecular formula and the successive members differ from each other in a molecular formula by a $–CH_2$ unit.

i. The successive members of a homologous series differ by which mass of amu? (1)

ii. Does Pyridine, pyrrole, thiophene are all heteroaromatic compounds (1)

iii. Difference between heterocyclic and homocyclic compound. (2)

OR

Is tetrahydrofuran is aromatic compounds? (2)

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

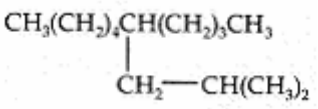
Unsaturated compounds undergo additional reactions. Why?

Section E

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

(a) What is electrophile in sulphonation? **[1]**

(b) Write IUPAC name of following: **[1]**



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

(d) Methane does not react with chlorine in dark. Why? **[1]**

(e) How would you convert ethene to ethane molecule? **[1]**

(f) What is Huckel rule? **[1]**

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

32. Ethyl acetate is formed by the reaction of ethanol and acetic acid and the equilibrium is represented as: **[5]**

$CH_3COOH(l) + C_5H_5OH(l) \rightleftharpoons CH_3COOC_2H_5(l) + H_2O(l)$

a. Write the concentration ratio (reaction quotient), Q_c, for this reaction (note: water is not in excess and is not a solvent in this reaction)

b. At 293 K, if one starts with 1.00 mol of acetic acid and 0.18 mol of ethanol, there is 0.171 mol of ethyl acetate in the final equilibrium mixture. Calculate the equilibrium constant.

c. Starting with 0.5 mol of ethanol and 1.0 mol of acetic acid and maintaining it at 293 K, 0.214 mol of ethyl acetate is found after some time. Has equilibrium been reached?

OR

What is the pH of 0.001 M aniline solution? The ionisation constant of aniline is 4.27×10^{-10}.

Calculate the degree of ionisation of aniline in the solution. Also calculate the ionisation constant of the conjugate acid of aniline.

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

(a) i. During estimation of nitrogen present in an organic compound by Kjeldahl's method, the ammonia evolved from 0.5 g of the compound in Kjeldahl's estimation of nitrogen, neutralized 10 mL of 1 M H_2SO_4. Find out the percentage of nitrogen in the compound. **[2.5]**

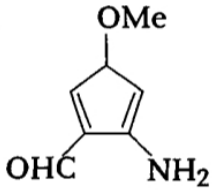
ii. Explain why $(CH_3)_3\overset{+}{C}$ is more stable than $CH_3\overset{+}{C}H_2$ and $\overset{+}{C}H_3$ is the least stable cation. **[2.5]**

OR

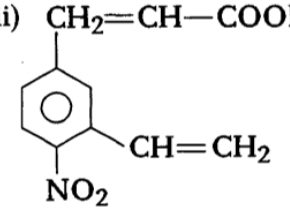
i. Will CCl_4 give a white precipitate of AgCl on heating it with $AgNO_3$? **[2.5]**

ii. Identify the functional groups present in the following compounds. **[2.5]**

(i)



(ii) $CH_2=CH-COOH$



(iii) $CH_3-CH_2-CO-CH_2$

CH_2-COCl

(iv) $CH_2=CH-CH_2-\overset{\overset{O}{\|}}{C}-NH_2$

Solution

Section A

1. **(b)** 4.7g

   Explanation: Mass = Density × Volume

   = 3.12 g mL^{-1} × 1.5 mL = 4.68 g = 4.7 g

   significant figures as that of the least given number. Therefore, correct answer is 4.7 g

2. **(d)** screening effect

   Explanation: The effective nuclear charge experienced by an electron depends upon the shell and the orbital in which the electron is present. The electrons in the outer shell are shielded from the nucleus by the electrons in the inner shells.

3. **(c)** $\Delta_r G^0$ = -RTln K

   Explanation: $\Delta_r G^0$ = -RTln K

   where $\Delta_r G^0$ is standard Gibbs energy change, K is the equilibrium constant, R is the universal gas constant and T is the temperature in kelvin scale.

4. **(a)** 8.68 × 10^{-20}Js

   Explanation: The energy of first (Bohr) orbit in hydrogen atom = -2.17 × $10^{-18}$$Jatom^{-1}$

   The energy of the fifth orbit will be given by $E_n = E_1 \times \frac{Z^2}{N^2}$

   $E_5 = \frac{-2.17 \times 10^{-18}}{5^2} =$ 8.68 × $10^{-20}$$Jatom^{-1}$

5. **(b)** 28.5 kJ, -28.5 kJ

   Explanation: At constant T, $\frac{P_1}{P_2} = \frac{10atm}{1atm} = 10$; n = 5 mol, T = 298K

   Thus, work $w = -2.303nRT \log \frac{P_1}{P_2} = -2.303 \times 5 \times 8.314 \times 298 \times \log 10 = -2.85 \times 10^4 J = -28.5kJ$

   Here, heat $\Delta U = 0; \Rightarrow q = -w = +28.5kJ$

6. **(c)** 12 and 5

   Explanation: Azimuthal quantum number l = 1 is for p and l = 2 is for d.

   Now Cr has configuration $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^5, 4s^1$

   Hence there are 12, p-electrons and 5, d-electrons

7. **(a)** Ne

   Explanation: Since, Ne is noble gas having stable electronic configuration i.e. $1s^2$ $2s^2$ $2p^6$. So it do not show any positive or negative oxidation state.

8. **(c)** nucleophiles

   Explanation: CH_3 - Mgl $\longrightarrow \underset{\text{Nucleophile}}{\overset{-}{C}H_3} + \overset{+}{M}gl$

   $(C_2H_5)_2CuLi \xrightarrow{-R-X} \underset{\text{Nucleophile}}{(C_2H_5)\overset{-}{C}u}$ + LiX + R - C_2H_5

9. **(c)** electrophilic addition reaction

   Explanation: The electrophilic addition reaction between ethene and sulfuric acid. Alkenes react with concentrated sulfuric acid in the cold to produce alkyl hydrogensulphates. For example, ethene reacts to give ethyl hydrogensulphate.

10. **(d)** Gallium

Explanation: Gallium

11.

(d) $\sum_i a_i H_{products} - \sum_i b_i H_{reactants}$

Explanation: The enthalpy of reaction ($\Delta_r H$) = (Sum of enthalpies of products)- (sum of enthalpies of reactants) = $\sum a_i H_{(product)} - \sum b_i H_{(reactant)}$

12.

(d) HO - CH_2 - CH = CH_2

Explanation: HO - CH_2 - CH = CH_2

13.

(b) Both A and R are true but R is not the correct explanation of A.

Explanation: Each carbon atom in ethylene is attached to two hydrogen atoms by single covalent bonds and to another carbon atom by a double bond. Since each carbon is attached to three other atoms, it uses sp^2 hybrid orbitals and an unhybridised p_z orbital to form its bond. Each C-H bond is a σ bond resulting from the overlap of 1 s orbital of hydrogen atom and sp^2 orbital of a carbon atom. One C-C results from linear overlap of sp2 orbitals one from each carbon atom. One π bond results from the lateral overlap o f two unhybridised p_z orbitals, one from each carbon atom.

14.

(b) Both A and R are true but R is not the correct explanation of A.

Explanation: Propene being unsaturated undergoes addition reactions. In contrast, cyclopropane being strained readily undergoes ring cleavage to yield addition products.

15.

(d) A is false but R is true.

Explanation: Splitting of the spectral lines in the presence of a magnetic field is known as the Zeeman effect and in an electric field is known as the Stark effect. The splitting of spectral lines is due to different orientations which the orbitals can have in the presence of the magnetic field.

16.

(d) A is false but R is true.

Explanation: Law of conservation of mass does not hold good for nuclear reaction due to mass defect.

Section B

17. NaCN, $NaNO_2$, KF solutions are basic, as they are salts of strong base, weak acid. NaCl, KBr solutions are neutral, as they are salts of strong acid, strong base. NH_4NO_3 solution is acidic as it is a salt of strong acid, weak base. This can be sumarized as follows:

S.No.	Salt	Acid	Base	Hydrolysis Reaction	Nature of solution
1.	NaCl	HCl	NaOH	$H_2O \leftrightarrow H^+ + OH^-$ No Hydrolysis	Neutral
2.	KBr	HBr	KOH	No Hydrolysis	Neutral
3.	NaCN	HCN	NaOH	$CN^- + H_2O \leftrightarrow HCN + OH^-$	Basic
4.	NH_4NO_3	HNO_3	NH_4OH	$NH_4^+ + H_2O \leftrightarrow NH_4OH + H^+$	Acidic
5.	$NaNO_2$	HNO_2	NaOH	$NO_2^- + H_2O \leftrightarrow HNO_2 + OH^-$	Basic
6.	KF	HF	KOH	$F^- + H_2O \leftrightarrow HF + OH^-$	Basic

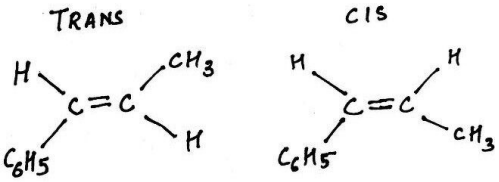
18. Electronegativity is directly related to the non – metallic character of elements.
Therefore, the rise in electronegativities across the period is followed by an increase in non – metallic properties of elements.
Consequently, the decrease in electronegativities down the group is accompanied by an decrease in non – metallic properties of elements.

19. i. The least precise term has 3 significant figures (i.e. in 0.112). Hence, the answer should have 3 significant figures.

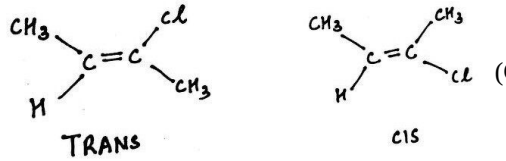
ii. Leaving the exact number (5), the second term has 4 significant figures. Hence, the answer should have 4 significant figures.

iii. In the given addition, the least number of decimal places in the term is 4. Hence, the answer should have 4 significant figures.

20. (iii) and (iv) show cis-trans isomerism. In structures (i) and (ii), two identical groups are attached to one of the doubly bonded carbon atoms.



($C_6H_5CH = CH - CH_3$)



($CH_3CH = CCl\ CH_3$)

OR

Resonance energy: The difference between the energy of the most stable contributing structure and the energy of the resonance hybrid is known as resonance energy.

Example: The resonance energy of benzene is 147KJ/mole.

21. Nuclear charge is defined as the net positive charge experienced by an electron in the orbital of a multi-electron atom. The closer the orbital, the greater is the nuclear charge experienced by the electron (s) in it.

i. 2s is closer to the nucleus than 3s.Hence 2s will experience larger effective nuclear charge.

ii. 4d will experience greater nuclear charge than 4f since 4d is closer to the nucleus than 4f.

iii. 3p will experience greater nuclear charge since it is closer to the nucleus than 3f because 3p is closer to nucleus than 3f.

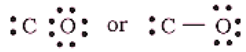
Section C

22. **Step 1.** Count the total number of valence electrons of carbon and oxygen atoms. The outer (valence) shell configurations of carbon and oxygen atoms are:

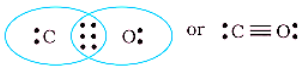
$2s^2\ 2p^2$ and $2s^2\ 2p^4$, respectively. The valence electrons available are 4 + 6 =10.

Step 2. The skeletal structure of CO is written as: CO

Step 3. Draw a single bond (one shared electron pair) between C and O and complete the octet on O, the remaining two electrons are the lone pair on C.



This does not complete the octet on carbon and hence we have to resort to multiple bonding (in this case a triple bond) between C and O atoms. This satisfies the octet rule condition for both atoms.



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 $\Delta_r H$.

(ii) Most of the naturally occurring processes are accompanied by increase of randomness. Hence, randomness of the universe is continuously increasing. Thus, we are going towards chaos

(iii) q and W are not state functions. But as we know that,
q + W = ΔU, which is a state function.
Hence, q + W is a state function.

24. According to the question, ΔU^o = - 10.5 kJ and ΔS^o = - 44.1 JK^{-1}, R = 8.314 $\times$ 10^{-3} kJ mol^{-1}, T = 298 K.

Reaction:

$2A(g) + B(g) \longrightarrow 2D(g)$

$\Delta n_g = n_p - n_r = 2 - 3 = -1$

We know that, $\Delta H^o = \Delta U^o + \Delta n_g RT$

ΔH^o = - 10.5 + (- 1 $\times$ 8.314 $\times$ 10^{-3} $\times$ 298)

= - 12.977 kJ mol^{-1}

Now, $\Delta G^o = \Delta H^o - T\Delta S^o$

ΔG^o = -12.977 - (298 $\times$ - 44.1 $\times$ 10^{-3})

= 0.165 kJ mol^{-1}

The reaction will not occur spontaneously because ΔG^o is positive.

25. Among the oxoanions of chlorine listed above, ClO_4^- does not disproportionate because in this oxoanion chlorine is present in its highest oxidation state that is, +7. The disproportionation reactions for the other three oxoanions of chlorine are as follows:

$$3\overset{+1}{Cl}O^- \rightarrow 2\overset{-1}{Cl}^- + \overset{+5}{Cl}O_3^-$$

$$6\overset{+3}{Cl}O_2^- \xrightarrow{h\nu} 4\overset{+5}{Cl}O_3^- + 2\overset{-1}{Cl}^-$$

$$4\overset{+5}{Cl}O_3^- \rightarrow \overset{-1}{Cl}^- + 3\overset{+7}{Cl}O_4^-$$

26. Frequency = $\frac{1}{2\times10^{-9}s}$ = 0.5 $\times$ 10^9 s^{-1}

Energy = Nhv

= (2.5 $\times 10^5$) (6.26 $\times$ 10^{-39} Js) (0.5 $\times$ 10^9 s^{-1})

= 8.28 $\times 10^{-10}$ J

27. i. C is non-metal
    ii. A is alkali metal
    iii. B is alkaline earth metal

28. $CuO + H_2 \rightarrow Cu + H_2O$

For First experiment;

Ratio of hydrogen to oxygen = 10:5 = 2:1

For Second Experiment:

Here, 0.144g is lost from CuO.

Therefore, 0.144g of oxygen combines with 200mL of hydrogen

32g oxygen occupies volume at STP. = 22400mL

So 0.144g oxygen occupies volume at STP = $\frac{22400\ \times 0.144}{32} 100.8\ mL$ oxygen

Now, The ratio of hydrogen to oxygen = 200 :100.8 =2:1

As the ratios are same , Therefore, Law of constant proportion is obeyed.

Section D

29. i. The successive members of a homologous series are differ by a -CH_2 group. The molecular mass of a -CH_2 group is 14 amu. Hence, each successive homologue of a homologous series differ by a mass of 14 amu.
    ii. Heterocyclic compounds are a major class of organic compounds characterized by the fact that some or all of the atoms in their molecules are joined in rings containing at least one atom of an element other than carbon and follow Huckels rule, the most common heterocycles are those having five or six-membered rings and containing hetero members of Nitrogen, oxygen, sulphur. Pyridine, pyrrole, thiophene are all heteroaromatic compounds
    iii. A cyclic compound in which the ring includes at least one atom of an element different from the rest is called heterocyclic compound. A homocyclic compound is a cyclic compound in which all the ring atoms are the same.

    OR

    Tetrahydrofuran is non-aromatic, due to absence of conjugation in π electrons, and it does not follow Huckel's rule.

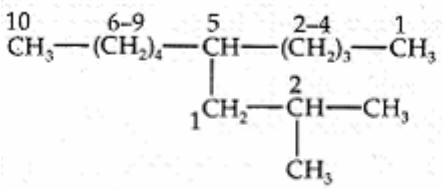
30. i. Hybrid orbitals are formed after combining atomic orbitals and have the equivalent shape and energy in the given set of hybridised orbitals.
    ii. XeF_2 molecule has the same shape as NO_2^+ ion.
    iii. XeF_4 molecule doesn't have the same type of hybridisation as P(Phosphorus) has in PF_5.

    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) SO_3

(ii) 

5–(2– Methylpropyl)decane

(iii) 2-methylbutane

(iv) Chlorination of methane is a free radical substitution reaction and the initiation step involves the formation of free radical $Cl_2 \rightarrow 2Cl^{\cdot}$. This requires more energy than is available at ambient temperatures and light of enough high energy will break the bond and initiate the reaction. In dark, chlorine is unable to be converted into free radicals, hence the reaction does not occur.

(v) Unsaturated alkene (ethene) is get converted into saturated alkane (ethane) by the process of reduction in the presence of reducing agents like Pt/Pd/Ni etc.

$CH_2 = CH_2$ (ethene) + $H_2 \xrightarrow{Pt/Pd/Ni} CH_3 - CH_3$ (ethane)

(vi) Huckel rule states that a compound is said to be aromatic if it has (4n + 2) π electrons delocalized where n = an integer 0, 1, 2, 3, ...

(vii) 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.

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

32. a. The concentration ratio (concentration quotient) Q_c for the reaction is:

$$Q_c = \frac{[CH_3COOC_2H_5(l)][H_2O(l)]}{[CH_3COOH(l)][C_2H_2OH(l)]}$$

b.

	$CH_3COOH(l) +$	$C_2H_5OH(l) \rightleftharpoons$	$CH_3COOC_2H_2(l) +$	$H_2O(l)$
$Initial\ molar\ conc.$	$1.0\ mol$	$0.18\ mol$	0	0
$Molar\ conc.\ at\ equilibrium\ point$	$(1 - 0.171)$ $= 0.829\ mol$	$(0.18 - 0.171)$ $= 0.009$	$0.171\ mol$	$0.171\ mol$

Applying Law of Chemical equilibrium

$$K_c = \frac{[CH_3COOC_2H_3](l)[H_2O(l)]}{[CH_3COOH](l)[C_2H_3OH(l)]}$$

$$= \frac{(0.171\ mol) \times (0.171\ mol)}{(0.829\ mol)(0.009\ mol)} = 3.92$$

Therefore, the equilibrium constant is 3.92.

c.

	$CH_3COOH(l) +$	$C_2H_5OH(l) \rightleftharpoons$	$CH_3COOC_2H_5(l) +$	$H_2O(l)$
$Initial\ molar\ conc.$	$1.0\ mol$	$0.5\ mol$	0.214	$0.214 mol$
$Molar\ conc.\ at\ equilibrium$	$1.0 - 0.214$ $= 0.786$	$0.5 - 0.214$ $= 0.286\ mol$		

$$Q_c = \frac{[CH_3COOC_2H_5(l)][H_2O(l)]}{[CH_3COOH(l)][C_2H_2OH(l)]}$$

$$= \frac{(0.214 mol) \times (0.214\ mol)}{(0.286\ mol)(0.786\ mol)} = 0.204$$

Since Q_c value 0.204 is less than K_c, value 3.92 this means that the equilibrium has not been reached. The reactants are still taking part in the reaction to form the products.

OR

$C_6H_5NH_2 + H_2O \rightleftharpoons C_6H_5NH_3^+ + OH^-$

$$K_b = \frac{[C_6H_5NH_3^+][OH^-]}{[C_6H_5NH_2]}$$

$$= \frac{[OH^-]^2}{[C_6H_5NH_2]}$$

$[OH^-] = \sqrt{K_b \cdot C} = \sqrt{4.27 \times 10^{-10} \times 0.001}$

$[OH^-] = 6.534 \times 10^{-7}$

$pOH = -\log[OH^-] = -\log[6.534 \times 10^{-7}]$

$pOH = -0.8152 + 7 = 6.18$

From, $pH + pOH = 14$

$pH = 14 - 6.18 = 7.82$

$C_6H_5NH_2 + H_2O \rightleftharpoons C_6H_5NH_3^+ + OH^-$

Initial conc.	C	0	0
Equili. conc.	$C - C\alpha$	$C\alpha$	$C\alpha$

$K_b = \frac{C\alpha \cdot C\alpha}{C(1-\alpha)}$ $[(1-\alpha) \approx 1$ for weak base]

$K_b = C\alpha^2 = \alpha = \sqrt{\frac{K_b}{C}}$

Degree of ionisation,

$\alpha = \sqrt{\frac{4.27 \times 10^{-10}}{0.001}}$ = 6.53×10^{-4}

K_a of conjugate acid of aniline,

$K_a = \frac{K_w}{K_b}$

$= \frac{10^{-14}}{4.27 \times 10^{-10}}$ = 2.34×10^{-5}

33. Answer:

(i) i. 1 M of 10 mL H_2SO_4 = 1 M of 20 mL NH_3

100 mL of 1 M ammonia contains nitrogen = 14 g

20mL of 1 M ammonia will contain nitrogen $= \frac{14 \times 20}{1000}$g

$\therefore$ Percentage of nitrogen $= \frac{14 \times 20 \times 100}{1000 \times 0.5}$ = 56.0%

ii. Hyperconjugation interaction in $(CH_3)_3\overset{+}{C}$ is greater than in $CH_3\overset{+}{C}H_2$ as the $(CH_3)_3\overset{+}{C}$ has nine C-H bonds. In $\overset{+}{C}H_3$, vacant p orbital is perpendicular to the plane in which C-H bonds lie; hence cannot overlap with it. Thus, $\overset{+}{C}H_3$ lacks hyperconjugative stability. Therefore, $(CH_3)_3\overset{+}{C}$ is more stable than $CH_3\overset{+}{C}H_2$ and $\overset{+}{C}H_3$ is the least stable cation.

OR

i. Carbon tetrachloride contains chlorine but it is bonded to carbon by covalent bond. Hence, it is not in ionic form. So, it does not combine with $AgNO_3$ solution.

Therefore, CCl_4 does not give white precipitate with silver nitrate solution.

$CCl_4 + AgNO_3 \rightarrow$ No reaction.

ii. i. Functional groups are $-NH_2$ (amino), -OMe (methoxy) and -CHO (aldehydic)

ii. Carbon-carbon double bond, $-NO_2$ (nitro) and -COOH (carboxylic)

iii. -CO- (keto), -COCl (acylchloride)

iv. $-\overset{|}{C}=\overset{|}{C}-$ ((carbon-carbon double bond), $-\overset{O}{\overset{||}{C}}-NH_2$ (acitamide).