Class XI Session 2024-25
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. A measured temperature on Fahrenheit scale is 200 °F. What will this reading be on Celsius scale? **[1]**

a) 93.3 °C b) 97.3 °C

c) 40 °C d) 30 °C

2. Elements with 4-7 valence electrons are referred to as **[1]**

a) inert gases b) transition metals

c) metals d) non-metals

3. Which of the following relationship is true? **[1]**

a) $C_p = C_v$ b) $C_p > C_v$

c) $C_p = C_v = 0$ d) $C_v > C_p$

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 $h/3\pi$ b) equal to or greater than $h/4\pi$.

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

5. For the reaction at 298 K, $2A + B \rightarrow C$, $\Delta H = 400\ \text{kJ mol}^{-1}$ and $\Delta S = 0.2\ \text{kJ K}^{-1}\text{mol}^{-1}$. At what temperature will the reaction become spontaneous considering ΔH and ΔS to be constant over the temperature range. **[1]**

a) 3500 K b) 2000 K

c) 1500 K d) 2500 K

6. Among the following pairs of orbitals which orbital will experience the larger effective nuclear charge? (i) 2s **[1]**

and 3s, (ii) 4d and 4f, (iii) 3d and 3p:

a) 4f, 3d, and 3s respectively
b) 2s, 4d and 3p respectively
c) 2s, 4d and 3d respectively
d) 4d, 3p and 2s respectively

7. Which of the following elements does not show disproportionation tendency? **[1]**

a) Br
b) F
c) I
d) Cl

8. Which of the following carbocation is most stable? **[1]**

a) $(CH_3)_3\overset{\oplus}{C}$
b) $(CH_3)_3C\overset{\oplus}{C}H_2$
c) $CH_3\overset{\oplus}{C}HCH_2CH_3$
d) $CH_3CH_2\overset{\oplus}{C}H_2$

9. When two hydrogen atoms in benzene are replaced by two similar or different monovalent atoms or groups, how many different position isomers are possible? **[1]**

a) 6
b) 5
c) 2
d) 3

10. General electronic configuration of s-block elements is: **[1]**

a) $3s^2 3p^4$
b) $6s^2 4f^3$
c) $3d^{10} 4s^2$
d) $ns^{1\text{-}2}$

11. First law of thermodynamics is a restatement of: **[1]**

a) law of conservation of parity.
b) law of conservation of energy.
c) law of conservation of mass.
d) law of conservation of charge.

12. The treatment of CH_3MgX with $CH_3C \equiv C - H$ gives ________. **[1]**

a) $CH_3 - CH = CH_2$
b) $CH_3C \equiv C - CH_3$
c) $H_3C\text{-}CH_3$
d) CH_4

13. **Assertion (A):** Carbanion has an octet of electrons. **[1]**

Reason (R): In carbanion, carbon atom is sp^3 hybridised.

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):** Phenanthrene is an aromatic compound. **[1]**

Reason (R): Phenanthrene has benzenoid structure.

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):** Cathode rays consist of negatively charged particles, called electrons. **[1]**

Reason (R): In the pesence of electrical/magnetic field, the behaviour of cathode rays is similar to the negatively charged particles

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):** Empirical formula of glucose is HCHO. **[1]**

Reason (R): Molecular formula of glucose will also be equal to HCHO.

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

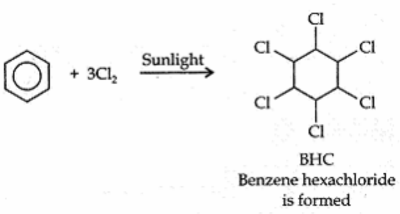
17. What is meant by conjugate acid base pair? Find the conjugate acid/ base for the following species: **[2]**

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

18. The size of an atom can be expressed by three radii. Name them. Which of these given the highest, and the lowest value of the atomic radius of an element? **[2]**

19. Convert 35^0C to ^oF & K. **[2]**

20. What happens when benzene is treated with an excess of **[2]**



in the presence of sunlight? Give chemical reaction.

OR

What are electrophilic substitution reactions?

21. What transition in the hydrogen spectrum would have the same wavelength as the Balmer transition n = 4 to n = 2 of He^+ spectrum? **[2]**

Section C

22. The dipole moment of a molecule AB is 0.54 D and the bond distance is 1.41 $\overset{o}{A}$. Calculate the fractional change δ on A and B atom in AB molecule (electronic charge, e = 4.8 $\times$ 10^{-10} esu. **[3]**

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

(a) If the combustion of 1 g of graphite produces 20.7 kJ of heat, what will be molar enthalpy change? Give the significance of the sign also. **[1]**

(b) Define Heat capacity. **[1]**

(c) Given that $\Delta H = 0$ for mixing of two gases. Explain whether the diffusion of these gases into each other in a closed container is a spontaneous process or not? **[1]**

24. Give reason for the following: **[3]**

i. Neither q nor w is a state function but q + w is a state function.
ii. A real crystal has more entropy than an ideal crystal.

25. What are the oxidation number of the underlined $H_2\underline{S}_4O_6$ element and how do you rationalise your results? **[3]**

26. An element with mass number 81 contains 31.7% more neutrons as compared to protons. Assign the atomic symbol. **[3]**

27. What is screening or shielding effect? How does it influence the ionization enthalpy? **[3]**

28. Vitamin C is essential for the prevention of scurvy. Combustion of 0.2000g of vitamin C gives 0.2998g of CO_2 and 0.819g of H_2O. What is the empirical formula of vitamin C? **[3]**

Section D

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

Once an organic compound is extracted from a natural source or synthesised in the laboratory, it is essential to purify it. Various methods used for the purification of organic compounds are based on the nature of the compound and the impurity present in it. Finally, the purity of a compound is ascertained by determining its melting or boiling point. This is one of the most commonly used techniques for the purification of solid organic compounds. In crystallisation Impurities, which impart colour to the solution are removed by adsorbing over activated charcoal. In distillation Liquids having different boiling points vaporise at different temperatures. The vapours are cooled and the liquids so formed are collected separately. Steam Distillation is applied to separate substances which are steam volatile and are immiscible with water. Distillation under reduced pressure: This method is used to purify liquids having very high boiling points.

i. Which method can be used to separate two compounds with different solubilities in a solvent?
ii. Distillation method is used to separate which type of substance?
iii. Which technique is used to separate aniline from aniline water mixture?

OR

Why chloroform and aniline are easily separated by the technique of distillation?

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

The molecular orbital theory is based on the principle of a linear combination of atomic orbitals. According to this approach when atomic orbitals of the atoms come closer, they undergo constructive interference as well as destructive interference giving molecular orbitals, i.e., two atomic orbitals overlap to form two molecular orbitals, one of which lies at a lower energy level (bonding molecular orbital). Each molecular orbital can hold one or two electrons in accordance with Pauli's exclusion principle and Hund's rule of maximum multiplicity.

For molecules up to N_2, the order of filling of orbitals is:

$$\sigma(1s)^*_\sigma(1s), \sigma(2s)^*_\sigma(2s), \pi\left(2p_x\right) = \pi\left(2p_y\right), \sigma\left(2p_z\right), ^*_\pi\left(2p_x\right) = \overset{*}{\pi}\left(2p_y\right), \overset{*}{\sigma}\left(2p_z\right)$$

and for molecules after N_2, the order of filling is:

$$\sigma(1s)^*_\sigma(1s), \sigma(2s)^*_\sigma(2s), \sigma\left(2p_z\right), \pi\left(2p_x\right) = \pi\left(2p_y\right), ^*_\pi\left(2p_x\right) = \overset{*}{\pi}\left(2p_y\right), \overset{*}{\sigma}\left(2p_z\right)$$

Bond order = $\frac{1}{2}$[bonding electrons - antibonding electrons]

Bond order gives the following information:

I. If bond order is greater than zero, the molecule/ion exists otherwise not.
II. Higher the bond order, higher is the bond dissociation energy.
III. Higher the bond order, greater is the bond stability.
IV. Higher the bond order, shorter is the bond length.

i. Arrange the following negative stabilities of CN, CN^+ and CN^- in increasing order of bond. (1)
ii. The molecular orbital theory is preferred over valence bond theory. Why? (1)
iii. Ethyne is acidic in nature in comparison to ethene and ethane. Why is it so? (2)

OR

Bonding molecular orbital is lowered by a greater amount of energy than the amount by which antibonding molecular orbital is raised. Is this statement correct? (2)

Section E

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

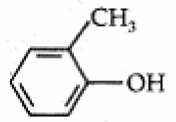
(a) What happens to equilibrium constant when temperature increases for a reaction? **[1]**

(b) Suggest a route for the preparation of nitrobenzene starting from acetylene? **[1]**

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

(d) Which type of isomerism is exhibited by but-1-yne and but-2-yne? **[1]**

(e) Write the IUPAC name given below: **[1]**



(f) What is a Lindlars' catalyst? **[1]**

(g) Why are Alkenes called olefins? **[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

One of the reactions that take place in producing steel from iron ore is the reduction of iron (II) oxide by carbon monoxide to give iron metal and CO_2.

$FeO(s) + CO(g) \rightleftharpoons Fe(s) + CO_2(g)$; $K_p = 0.265$ atm at 1050 K

What is the equilibrium partial pressures of CO and CO_2 at 1050 K if the initial pressures are: $P_{co} = 1.4$ atm and $P_{CO_2} = 0.80$ atm?

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

(a)

i. Draw the possible resonance structures for $CH_3 - \ddot{\underset{\cdot\cdot}{O}} - \overset{+}{C}H_2$ and predict which of the structures is more stable. Give reason for your answer. **[2.5]**

ii. Name the common techniques used for purification of organic compounds. **[2.5]**

OR

i. Differentiate between the principle of estimation of nitrogen in an organic compound **[2.5]**

   i. Dumas method
   ii. Kjeldahl's method.

ii. Write the structural formula of **[2.5]**

   i. o-ethylanisole,
   ii. p-nitroaniline,
   iii. 2, 3-dibromo-1-phenylpentane,
   iv. 4-ethyl-1-fluoro-2-nitrobenzene

Solution

Section A

1. **(a)** 93.3 °C

   Explanation: 93.3, as
   F= 9/5(degree C) + 32
   200 = 9/5 (c) +32
   (200 -32) × 5 / 9 = C
   C = 93.3

2. **(d)** non-metals

   Explanation: non-metals

3. **(b)** $C_p > C_v$

   Explanation: We know, $C_p - C_v = R$

   Hence, $C_p > C_v$

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. **(b)** 2000 K

   Explanation: Gibbs free energy, $\Delta G = \Delta H - T\Delta S$
   At equilibrium $\Delta G = 0$; then T= $\frac{\Delta H}{\Delta S}$ = 2000K
   Therefore, above 2000K, the reaction will be spontaneous.

6. **(b)** 2s, 4d and 3p respectively

   Explanation: 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.

7. **(b)** F

   Explanation: F (Fluorine) is most electronegative element so it always show -1 oxidation state.

8. **(a)** $(CH_3)_3\overset{\oplus}{C}$

   Explanation: $(CH_3)_3\overset{\oplus}{C}$ i.e. the tertiary carbocation is most stable. Alkyl groups directly attached to the positively charged carbon stabilise the carbocations due to inductive and hyperconjugation effects.

9. **(d)** 3

Explanation: The three isomers will be ortho(i.e.1,2- or 1,4-disubstituted), meta(i.e.1,3- or 1,5-disubstituted) and para (1,4-disubstituted).

10.

(d) ns^{1-2}

Explanation: The elements of Group 1 (alkali metals) and Group 2 (alkaline earth metals) which have ns^1 and ns^2 outermost electronic configuration belong to the s-Block Elements. The general electronic configuration of the valence shell for s-block elements is ns^{1-2}.

11.

(b) law of conservation of energy.

Explanation: It is a restatement of the law of conservation of energy.

It states that Thermodynamics is the branch of physical science that deals with the relations between heat and other forms of energy (such as mechanical, electrical, or chemical energy) and by extension, of the relationships between all forms of energy.

12.

(d) CH_4

Explanation: Terminal alkynes act as a nucleophile. The organometallic compound 'Grignard's reagent (R -Mg-X), therefore, reacts to form alkane. Thus when CH_3-Mg-Br is treated with $CH_3C \equiv CH$ we get CH_4 as per the following equation:

$CH_3C \equiv CH - Mg - Br \rightarrow CH_3C \equiv C\text{-}Mg\text{-}Br + CH_4$

13.

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

Explanation: The carbanion has two extra electrons which are not bonded.

14.

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

Explanation: Phenanthrene is aromatic because it has 14π electrons and follows $(4n+2)\pi$ electron rule.

or $4n + 2 = 14$

or $4n = 12$ or, $n = 3$.

15. **(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.

16.

(c) A is true but R is false.

Explanation: The molecular formula of glucose is $C_6H_{12}O_6$

This is $(HCHO)_6$

Therefore its empirical formula is HCHO.

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. The atomic size are generally expressed in terms of the following radii covalent radius, metallic radius and Van der waal's radius.

Van der waal's radius > Metallic radius > covalent radius.

Vander waal's radius is greater than metallic radius and covalent radius because van der waal forces of attraction are weak and therefore, the inter-nuclear distance in case of atoms held by van der waal forces are much larger than those between covalently bonded atoms and metallic bond. On the other hand metallic bond is larger than covalent bond as metallic bond results from partial attraction between the metal atoms and the mobile electrons constituting the metal while in Covalent bond there is overlapping of two electron clouds which makes it samller than other two bonds.

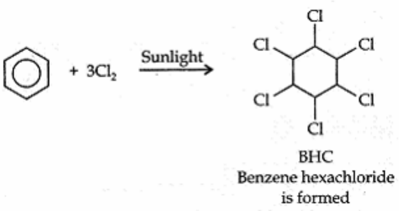
19. **Conversion of 35^0C to ^{o}F :**

We know that, $F = \frac{9}{5}(^\circ C) + 32$

$F = \frac{9}{5}(35) + 32$ = 63 + 32 = 95^oF

Conversion of 35^0C to K:

We know that, K = ^oC + 273.15 = 35 + 273.15= 308.15K

20. 

OR

Electrophilic substitution reaction: The reactions in which the functional group attached to a compound is replaced by an electrophile.

The common electrophilic substitution reactions are nitration, halogenation, sulphonation, Friedel Craft's alkylation and acylation reactions in which attacking reagent is an electrophile.

21. By Rydberg Formula, Wave number $\bar{v} = RZ^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$ and $\bar{v} = \frac{1}{\lambda}$

Where, R =Rydberg constant, Z = Atomic number.

For He^+ spectrum (for Balmer transition)

$\bar{v} = R \times (2)^2\left(\frac{1}{2^2} - \frac{1}{4^2}\right)$

$\bar{v} = R \times 4 \times \frac{3}{16} = \frac{3}{4}R$ ....(i)

For H-spectrum,$\bar{v} = R \times 1^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$ .....(ii)

Now, From (i) and (ii), we get.

$\frac{3}{4}R = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) \Rightarrow \frac{3}{4} = \frac{1}{n_1^2} - \frac{1}{n_2^2}$

Hence, n_1 =1 and n_2 = 2. In H-spectrum, the transition from n=2 to n=1 have same wavelength as the Balmer transition from n = 3 to n = 2 of He^+ spectrum.

Section C

22. Dipole moment, μ = q × r

μ = 0.54 ⇒ D = 0.54 × 10^{-18} state C cm

δ = 1.14 × 10^{-8} cm

$\therefore\ q = \frac{0.54 \times 10^{-18} \text{ stat Ccm}}{1.41 \times 10^{-8} \text{ cm}}$ = 0.38 × 10^{-10} stat

Now, fraction of charge = $\frac{\text{Change present}}{\text{Electronic charge}}$

= $\frac{0.38 \times 10^{-10}}{4.8 \times 10^{-10}}$ = 0.08

$\therefore\ \delta_A$ = 0.08, δ_B = -0.08

23. Answer:

(i) According to the question, the combustion of 1 g of graphite produces 20.7 kJ of heat.

The molar enthalpy change for the combustion of graphite, ΔH = enthalpy of combustion of 1 g graphite × molar mass

ΔH = - 20.7 kJ g^{-1} × 12 g mol^{-1}

= - 2.48 × 10^2 kJ mol^{-1}

Here, a negative sign indicates that the reaction is exothermic.

(ii) **Heat capacity:** The quantity of heat needed to raise the temperature of one mole of substance by one degree Celsius is known as heat capacity of that substance.

(iii) It is a spontaneous process because although $\Delta H = 0$, i.e., energy factor has no role to play but randomness increases, i.e., randomness factor favours the process.

24. i. q + w = Δu

As Δu is a state function hence q + w is a stable function.

ii. A real crystal has some disorder due to the presence of defects in their structural arrangements whereas ideal crystal does not have any disorder. Hence a real crystal has more entropy than ideal crystal.

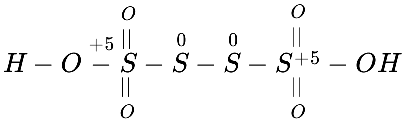
25. In $H_2S_4O_6$, let the oxidation number of S be x.

$\overset{+1}{H_2}\overset{x}{S_4}\overset{-2}{O_6}$

$2(+1) + 4x + 6(-2) = 0$

$4x = +10$ or $= +\frac{10}{4} = +2.5$

Let us consider the structure of $H_2S_4O_6$



$$H-O-\overset{+5}{\underset{\underset{O}{||}}{\overset{\overset{O}{||}}{S}}}-\overset{0}{S}-\overset{0}{S}-\underset{\underset{O}{||}}{\overset{\overset{O}{||}}{S}}^{+5}-OH$$

In $H_2S_4O_6$ the oxidation number of each of two S-atoms which are linked with each of the other by a single bond (in the centre) is zero and each of the remaining two S-atoms both side is +5. Hence, the oxidation number of 4 S-atoms in $H_2S_4O_6$ is +5, 0, 0, and +5 respectively.

26. We know that mass number of the element, A = p + n.

Given, A= 81

Therefore, p +n = 81 .....(1)

Let the number of protons, p =x

Then, the number of neutrons, n = x+ $\frac{31.7}{100}x = 1.317x$ (As number of neutrons are 31.7% more than the protons.)

Hence, from or Eq. (i)

x+1.317 x = 81

or 2.317 x = 81

or $x = \frac{81}{2.317} = 34.958 = 35$.

Since atomic number = Number of protons.

Therefore, Atomic number of element = 35 (Bromine).

The symbol of an element = ${}^{81}_{35}Br$.

27. In a multielectron atom, the electrons present in the inner shells shield the electrons in the valence shell from the attraction of the nucleus or they act as a screen between the nucleus and these electrons. This is known as shielding effect or screening effect. As the screening effect increases, the effective nuclear charge decreases. Consequently, the force of attraction by the nucleus for the valence shell electrons decreases and hence the ionization enthalpy decreases.

28. Since, Combustion of 0.2000g of vitamin C gives 0.2998g of CO_2 and 0.819g of H_2O.

Therefore, Percentage of carbon = $\frac{12}{44} \times 0.02998 \times \frac{100}{0.2}$= 47.69

Percentage of Hydrogen= $\frac{2}{18} \times 0.0819 \times \frac{100}{0.2}$= 4.55

Percentage of oxygen = 100 - (47.69) + 4.55 = 47.76

Element	%	Atomic Mass	Relative no. of atoms	Simplest molar Ratio	Simple whole number molar ratio
C	47.69	12	$\frac{47.69}{12}$ = 3.97	$\frac{3.97}{2.98}$ = 1.33	4/3 = 8/6
H	4.55	1	$\frac{4.55}{1}$ = 4.55	$\frac{4.55}{2.98}$ = 1.5	3/2 = 9/6
O	47.76	16	$\frac{47.76}{15}$ = 2.98	$\frac{2.98}{298}$ = 1	1

Therefore, Empirical formula = $C_{1.33}H_{1.5}O$ = $C_{\frac{8}{6}}H_{\frac{9}{6}}O_1$ = $C_8H_9O_6$

Section D

29. i. Fractional crystallizationis used to separate two compounds with different solubilities in a solvent.

ii.
- volatile liquids from nonvolatile impurities.
- the liquids having sufficient difference in their boiling points.

iii. Aniline is separated from aniline water mixture by steam distillation as one of the substances in the mixture is water and the other, a water insoluble substance.

OR

Chloroform and aniline are easily separated by the technique of distillation because chloroform and aniline have sufficient difference in their boiling points.

30. i. The increasing order of negative stabilities of CN, CN^+ and CN^- is $CN^+ > CN > CN^-$.

ii. The molecular orbital theory is preferred over valence bond theory because molecular orbital theory explains the magnetic nature of the molecule.

iii. In ethyne, hydrogen atoms are connected to sp hybridized carbon atoms, but in ethene, they are attached to sp^2 hybridized carbon atoms and in ethane, they are attached to sp^3 hybridized carbons.

OR

The given statement is not correct because the bonding molecular orbital is lowered by a lesser amount of energy than the amount by which antibonding molecular orbital is raised.

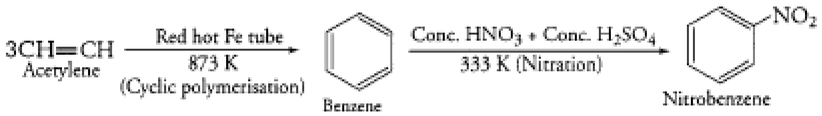
Section E

31. Attempt any five of the following:

(i) Equilibrium constants gets changed if we change the temperature of the system.

- For Exothermic reactions, if the temperature is increased, the equilibrium will shift to favour the reaction which will decrease the temperature and the exothermic reaction is favoured.
- For Endothermic reactions, if the temperature is increased, the equilibrium will shift to favour the reaction which will reduce the temperature and the endothermic reaction is favoured.

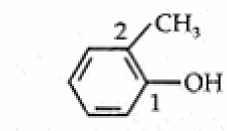
(ii) Preparation of nitrobenzene from acetylene:



(iii) **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.

(iv) Position isomerism.

(v)



2 – Methylphenol

(vi) **Lindlar’s catalyst:** Partially deactivated palladised charcoal is known as Lindlar’s catalyst.

Uses: Alkynes on partial reduction with calculated amount of dihydrogen in the presence of palladised charcoal partially deactivated with poisons like sulphur compounds or quinoline give alkenes.

(vii) Alkenes are commonly known as olefins because the lower members form oily products on treatment with chlorine or bromine.

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

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

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

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

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

OR

$$\begin{array}{lcccc} & \mathrm{FeO}(s) + & \mathrm{CO}(g) & \rightleftharpoons \mathrm{Fe}(s) + & \mathrm{CO_2}(g) \\ \text{Initial pressure:} & & 1.4\ \text{atm} & & 0.8\ \text{atm} \end{array}$$

$Q_p = \frac{pco_2}{pco} = \frac{(0.8\ atm)}{(1.4\ atm)} = 0.571$

Since $Q_p > k_p$ (0.265), this means that the reaction will move in the backward direction to attain the equilibrium. Therefore, the partial pressure of CO_2 will decrease while that of CO will increase so that the equilibrium may be attained again. Let p atm be the decrease in the partial pressure of CO_2. Therefore, the partial pressure of CO will increase by the same magnitude i.e. p atm.

P_{CO_2} = (0.8 - p) atm; P_{CO} (g) = (1.4 + p) atm

At equilibrium $K_p = \frac{p_{co_2}}{p_{co}} = \frac{(0.8-p)\ atm}{(1.4+p)\ atm} = \frac{(0.8-p)}{(1.4+p)}$

or $0.265 = \frac{(0.8-p)}{(1.4+p)}$

0.371 + 0.265 p = 0.8 - p or 1.265 p = 0.8 - 0.371 = 0.429

p = 0.429 / 1.265 = 0.339 atm

The equilibrium partial pressure of CO is $(P_{CO})_{eq}$ = (1.4 + 0.339) = 1.739 atm

The equilibrium partial pressure of CO_2 is (P_{CO_2})eq = (0.8 - 0.339) = 0.461 atm

33. Answer:

(i)

i. Two resonating structures can be of a given carbocation:

   In structure $CH_3 - \underset{\cdot\cdot}{\ddot{O}} - \overset{+}{C}H_2, CH_2$ has +ve charge means octet is not completed, but in structure II, $CH_3 - \overset{+}{O} = CH_2$ both the carbon atoms and oxygen atom have an octet of electrons hence, it is more stable structure.

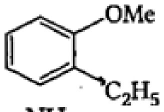
ii. The common techniques used for purification are as follows :
   - i. Sublimation
   - ii. Crystallization
   - iii. Distillation
   - iv. Differential extraction and
   - v. Chromatography.

OR

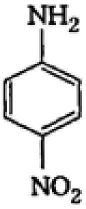
i. (i) **Dumas method:** The organic compound is heated strongly with excess of CuO (Cupric oxide) in an atmosphere of CO_2 when free nitrogen, CO_2 and H_2O are obtained.

   (ii) **Kjeldahl's method:** A known mass of the organic compound is heated strongly with conc. H_2SO_4 and a little potassium sulphate and a little mercury (a catalyst). As a result of reaction the nitrogen present in the organic compound is converted to ammonium sulphate.

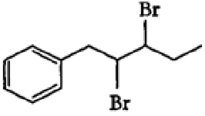
ii. i.



ii.



iii.



iv.