Previous IPE

SOLVED PAPERS

MAY -2026(AP)

PREVIOUS PAPERS

IPE: MAY-2026 (AP)

JR. CHEMISTRY

Time : 3 Hours Max.Marks : 85

SECTION-A

I. Answer ALL the following questions. $9 \times 1 = 9$

4. Which of the following molecules has a triple bond?
   1) CH_4 2) C_2H_4 ✓3)C_2H_2 4) CO_2

4. Which of the following molecules has a triple bond?
   1) CH_4 2) C_2H_4 ✓3)C_2H_2 4) CO_2

2. The Oxidation number of oxygen in O_2F_2 and OF_2 are respectively
   1) +2 and +1 2) +1 and +1 ✓3)+1 and +2 4) +2 and +2

10. The electronic configuration of chromium is _____

10. For chemical reactions, _____ is used to measure the value of heat change at constant volume.

12. Propanone and propanal are_____ isomers.

15. For which group, valency and group number has no relation.

15. Write the relation between Gibbs energy and equilibrium constant.?

II. Answer ALL the following questions. $14 \times 2 = 28$

10. What volume of CO_2 is obtained at STP by heating 4 g of $CaCO_3$?

11. How many molecules of glucose are present in 5.23 g of glucose
    (Molecular weight of glucose 180 g)

12. What is the frequency of radiation of wavelength 600nm?

13. What is Aufbau principle? .

14. An element 'X' has atomic number 34. Give its position in the periodic table.

15. State Octet rule.

16. Give two examples of odd electron molecules.

17. What are intensive and extensive properties ?

18. Give two chemical equilibrium reactions for which $K_p < K_c$

19. What is disproportionation reaction? Give an example.

20. What is metamerism? Give example.

21. What are electrophiles and nucleophiles? Give examples.

22. What is Friedel -Crafts alkylation?

23. What is Wurtz'reaction? Give one example.

SECTION-C

III. Answer ANY EIGHT of the following questions. **8 × 4 = 32**

24. Calculate the empirical formula of a compound having percentage composition :
potassium (K) = 26.57, Chromium (Cr) = 35.36, Oxygen (O) = 38.07.
(Given the atomic weights of K, Cr and O as 39 ; 52 and 16 respectively)

25. Explain photoelectric effect .

26. Give any four characteristic properties of transition elements.

27. State Fajan's rules with suitable examples.

28. Explain the hybridisation involved in PCl_5 molecule.

29. State and explain"Hess law of constant heat summation" with example.

30. Define heat capacity. What are C_p and C_v ? Show that $C_p - C_v = R$.

31. State Le-Chatelier's principle. Discuss the application of Le-Chatelier's principle for the industrial synthesis of Ammonia by Haber's process.

32. The species : H_2O, HCO_3^-, HSO_4^- and NH_3 can act both as Bronsted acids and bases. For each case give the corresponding conjugate acid and conjugate base.

33. Balance the following redox equation in acidic medium by ion-electron method:
$$Cr_2O_{7(aq)}^{2-} + Fe_{(aq)}^{2+} \rightarrow Cr_{(aq)}^{3+} + Fe_{(aq)}^{3+}$$

34. What is position isomerism and functional isomerism? Give one example for each.

35. Complete the following reaction and name the products A, B and C.
$$CaC_2 \xrightarrow{H_2O} A \xrightarrow{\text{hot metal tube}} B \xrightarrow{AlCl_3+CH_3Cl} C$$

SECTION-D

IV. Answer ANY TWO of the following questions. **2 × 8 = 16**

36. Write the postulates and limitations of Bohr's model of an atom.

37. How do we get benzene from acetylene? Give the corresponding equation.
Explain the halogenation, alkylation, acylation, nitration and sulphonation of benzene.

38. Define IE_1 and IE_2. Why is $IE_2$is always greater than IE_1 for a given atom?
Discuss the factors that effect IE of an element.

IPE AP MAY - 2026
SOLUTIONS

SECTION-A

1. At present "amu" has been replaced by [3]

1) Molar mass 2) Atomic mass ✓**3) Unified mass** 4) Formula mass

2. Which of the following molecules has a triple bond? [3]

1) CH_4 2) C_2H_4 ✓**3)** $\mathbf{C_2H_2}$ 4) CO_2

3. The Oxidation number of oxygen in O_2F_2 and OF_2 are respectively [3]

1) +2 and +1 2) +1 and +1 ✓**3)+1 and +2** 4) +2 and +2

4. The electronic configuration of chromium is $\mathbf{[Ar]4s^1 3d^5}$.

5. For chemical reactions, **bomb calorimeter** is used to measure the value of heat change at constant volume.

6. Propanone and propanal are **Functional group isomerism** isomers.

---

7. For which group, valency and group number has no relation. **[BMP2]**

A: Noble gases or Group 18.

---

8. Write the relation between Gibbs energy and equilibrium constant.

A: $\Delta G^0 = -RT\ln K_c$ (or) $\Delta G^0 = -2.303\ RT\log K_c$

---

9. What is pyrolysis or cracking?

A: **Pyrolysis** is **decomposition** of higher alkanes on heating at high temperature into lower alkanes, alkenes.

Ex: Dodecane a constituent of kerosene oil on heating to 973K in the presence of platinum, palldium gives a mixture of heptane and pentene.

SECTION-B

10. What volume of CO_2 is obtained at STP by heating 4 g of $CaCO_3$?

A: GMW of $CaCO_3$ = 100g

$$CaCO_3 \xrightarrow{\Delta} CaO + CO_2$$

1mole 1mole

100 g of $CaCO_3$ liberates 22.4 L of CO_2

4 g of $CaCO_3$ liberates x L of CO_2

$$\therefore x = \frac{4\times 22.4}{100} = 4\times 0.224 = 0.896\,L$$

---

11. How many molecules of glucose are present in 5.23 g of glucose (Molecular weight of glucose 180 g)

A: Given weight of glucose (W) = 5. 23 g, GMW of glucose = 180 g; $N_A = 6.022 \times 10^{23}$

Number of moles $n = \frac{W}{GMW} = \frac{5.23}{180}$

No. of molecules $= n \times N_A = \frac{5.23}{180} \times 6.022 \times 10^{23} = 1.75 \times 10^{22}$ molecules.

---

12. What is the frequency of radiation of wavelength 600nm?

A: Given that $\lambda = 600\ nm = 600 \times 10^{-9} m$ We know $c = 3.0 \times 10^8\ ms^{-1}$

Formula: $c = \nu\lambda \Rightarrow \nu = \frac{c}{\lambda} = \frac{3.0\times 10^8\ ms^{-1}}{600\times 10^{-9} m} = 5 \times 10^{14} s^{-1}$.

---

13. What is Aufbau principle?

A: **Auf bau principle:** 'In the ground state of the atoms, the orbitals are filled with electrons, in their increasing order of energies'.

---

14. An element 'X' has atomic number 34. Give its position in the periodic table.

A: Electronic configuration of X: $[Ar]\ 3d^{10}4s^24p^4$.

Valency shell configuration is $4s^24p^4$.

Period number = Valence Shell number=4

Group number = No.of valence electrons=6

$\therefore$ X belongs to 4^{th} period and VIA group.

---

15. State Octet rule.

A: **Octet rule:** Atoms show a tendency, to have eight electrons in their outermost shell by losing, gaining or sharing electrons.

---

16. Give two examples of odd electron molecules.

A: NO, NO_2, ClO_2.

17. What are intensive and extensive properties ?

A: **Intensive properties** are the properties which do not depend on the total amount of substance.
Ex: Density, specific heat, temperature, pressure, mp, bp etc.

Extensive properties are the properties which depend on the total amount of substance.

Ex: Mass, Volume, Internal energy, enthalpy, entropy, heat capacity etc.

---

18. Give two chemical equilibrium reactions for which $K_p < K_c$

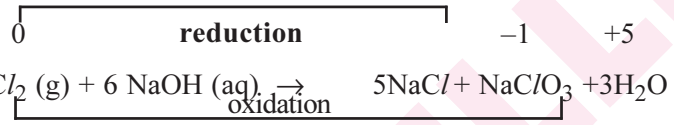
A: 1) $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$ $\Delta n = (2-4) = -2$

2) $2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$ $\Delta n = (2-3) = -1$ $\quad K_p = K_c(RT)^{-ve} \therefore K_p < K_c$

---

19. What is disproportionation reaction? Give an example.

A: **Disproportionation reactions:** The redox reactions, in which the same element undergoes both oxidation & reduction are called disproportionation reactions.



Here, Cl_2 undergoes both oxidation and reduction reactions.

---

20. What is metamerism? Give example.

A: Isomerism arises due to **difference** in the number of alkyl groups attached on either side of functional group.

Ex: $C_2H_5OC_2H_5$ (Diethyl ether) & $CH_3OC_3H_7$ (Methyl propryl ether)

---

21. What are electrophiles and nucleophiles? Give examples.

A: **Electrophiles** are electron seeking reagents that take away an electron pair from reactive site.

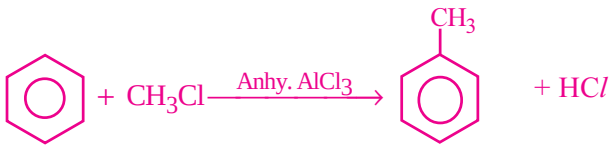
Ex: BF_3, $AlCl_3$

Nucleophiles are nucleus seeking reagents that bring an electron pair to the reactive site.

Ex: NH_3, H_2O

22. What is Friedel -Crafts alkylation?

A: Friedel - Craft's alkylation : Benzene reacts with methyl chloride in the presence of anhy. $AlCl_3$ and forms methyl benzene.



Methyl Benzene (Toluene)

---

23. What is Wurtz'reaction? Give one example.

A: Wurtz reaction: Ethane is prepared by **heating methyl iodide** with **sodium** metal in the presence of dry ether.

$$2CH_3I + 2Na \xrightarrow{\text{dry ether}} C_2H_6 + 2NaI$$

SECTION-C

24. Calculate the empirical formula of a compound having percentage composition : potassium (K) = 26.57, Chromium (Cr) = 35.36, Oxygen (O) = 38.07.
(Given the atomic weights of K, Cr and O as 39 ; 52 and 16 respectively)

A:

S.No	Element	% by weight	$\frac{\%\text{ by weight}}{\text{At.wt}}$	Simple ratio
1)	Potassium(K)	26.57	$\frac{26.57}{39}=0.67$	$\frac{0.67}{0.67}=1$
2)	Chromium(Cr)	35.36	$\frac{35.36}{52}=0.67$	$\frac{0.67}{0.67}=1$
3)	Oxygen(O)	38.07	$\frac{38.07}{16}=2.38$	$\frac{2.38}{0.67}=3.55$

On multiplying with 2 we get whole number ratio: $1\times2=2$; $1\times2=2$; $3.55\times2=7$;
Ratio of K:Cr:O= 2:2:7 .
Hence Empirical formula = $K_2Cr_2O_7$

---

25. Explain photoelectric effect .

A: Photo electric effect :

1) Energy absorbed (or) emitted by a body, takes place in the form of 'particles of light' called 'photons'.
2) A particle in the form of photons, emits energy when it falls from an excited state (E_2) to a ground state (E_1).
   This energy difference $\Delta E = E_2 - E_1$ is equal to energy of quantum.
   Thus, $\Delta E = E_2 - E_1 = h\nu$
3) When a photon strikes the surface of the metal, the energy ($h\nu$) of the photon is absorbed by the electron in the metal. A part of this energy is used to 'set free' the electron from the 'attractive forces in the metal'. The remaining part of energy of photons transform in the form of KE of the released electron.
4) Thus $h\nu = w + KE = h\nu_0 + \frac{1}{2} m_e V^2$. Here,'w' is called the work function.
   'w' denotes the energy required to over come the attractive force on the electron in the metal.

26. Give any four characteristic properties of transition elements.

A: Properties of transition elements :

1) They are all hard metals with high B.P and M.P.
2) They are good conductors of heat and electricity.
3) They form coloured ions.
4) They exhibit variable valency oxidation states.
5) They possess paramagnetic nature.
6) They form complex compounds.
7) They act as catalysts.

---

27. State Fajan's rules with suitable examples.

A: Fajan's rules:

1) 'Covalent character' **increases** with **increase in the size of Anion**.

   Ex: Bigger I^- has more covalent character than Br^-

2) 'Covalent character' **increases** with **decrease in the size of Cation**.

   Ex: Smaller Li^+ has more covalent character than Na^+

3) Covalent character increases with increasing charge of either Cations or Anions.
4) Cations with 'Pseudo inert gas configuration' favour 'covalent bonds'.

   Ex: $ZnCl_2$ is Covalent.

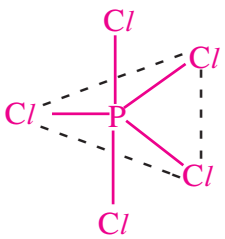
5) Cations with 'inert gas configuration' form Ionic bonds. **Ex:** $CaCl_2$ is ionic.

---

28. Explain the hybridisation involved in PCl_5 molecule

A: I) sp^3d hybridisation : One s-orbital, three p-orbitals and one d-orbital mix together to form five sp^3d hybrid orbitals .

II) Structure of PCl_5 molecule:



1) In PCl_5, the central atom is P(15).
2) It's ground state E.C = $[Ne]3s^23p^3$

   It's excited state E.C = $[Ne]\,3s^1 3p_x^1 3p_y^1 3p_z^1 3d^1$

3) In its excited state, the central P atom undergoes sp^3d hybridisation.
4) Central P forms 'five sp^3d hybrid orbitals', and each sp^3d orbital contains one electron.
5) 'Five sp^3d hybrid orbitals' of P, overlap axially with $3p_z$ orbital of five Cl atoms to form five σ bonds.

29. State and explain "Hess law of constant heat summation" with example.

A: **1) Hess Law:**'The total heat change in a chemical reaction is the same, whether the chemical reaction takes place in one step or several steps'.

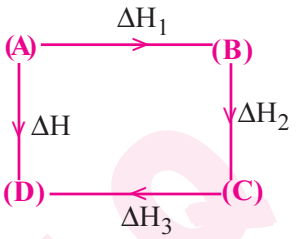
2) Suppose that D is formed from A in two different paths.

Path - I: $A \rightarrow D, \Delta H$

Path - II: $A \rightarrow B, \Delta H_1$

$B \rightarrow C, \Delta H_2$

$C \rightarrow D, \Delta H_3$



Total heat change in path - II= $\Delta H_1+\Delta H_2+\Delta H_3$

Total heat change in path - I = ΔH

From Hess law, $\Delta H = \Delta H_1+\Delta H_2+\Delta H_3$

3) Example: CO_2 can be obtained from $C_{(graphite)}$ and $O_{2(g)}$ in two different ways.

Path - I : $C_{(graphite)}+ O_{2(g)} \rightarrow CO_{2(g)}$; $\Delta H = -393.5$ KJ

Path - II : $C_{(graphite)} + 1/2\ O_{2(g)} \rightarrow CO_{(g)}$; $\Delta H_1 = -110.5$ KJ

$CO_{(g)} + 1/2O_{2(g)} \rightarrow CO_{2(g)}$; $\Delta H_2 = -283.02$ KJ

4) Total heat change in path-II = $\Delta H_1+\Delta H_2 = (-110.5)+ (-283.02) = -393.52$ KJ.

Total heat change in path-I = $\Delta H = -393.5$ KJ.

Thus $\Delta H \simeq \Delta H_1+\Delta H_2$. Hence the Hess law is proved.

---

30. Define heat capacity? What are C_P and C_V ? Show that $C_P - C_V = R$.

A: **1) Heat Capacity(C) :**It is the amount of heat required to raise the temperature of a substance by 1°C. Thus $C = \frac{q}{\Delta T}$. Where q = amount of heat absorbed; ΔT= raise in temperature

2) Heat capacity at constant volume (C_V) : It is the amount of heat required to raise the temperature of the substance by 1°C, at **constant volume**. $\therefore C_V = \left(\frac{dU}{dT}\right)_V$

3) Heat capacity at constant pressure (C_P): It is the amount of heat required to raise the temperature of the substance by 1°C, at **constant pressure**. $\therefore C_P = \left(\frac{dH}{dT}\right)_P$

4) Relation between C_P and C_V:

For 1 mole of an ideal gas H= U+PV= U+RT, [since PV= RT]

Differentiating w.r.t temperature (T), $\frac{dH}{dT} = \frac{dU}{dT} + R \Rightarrow C_P = C_V + R \Rightarrow C_P - C_V = R$

31. State Le-Chatelier's principle. Discuss the application of Le-Chatelier's principle for the industrial synthesis of Ammonia by Haber's process.

A: **I) Le-Chatelier's principle :** If a **chemical reaction at equilibrium,** is subjected to **'a change'** in temperature, pressure or concentration, then the equilibrium shifts in the direction, which nullifies the change .

II) Synthesis of Ammonia - Haber's process :

1) Formation of Ammonia: N_2 and H_2 are synthesized directly in the ratio 1:3 to produce NH_3.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g);\ \Delta H = -92kJ$$

2) This reaction is reversible and exothermic. Also it leads to a **decrease in volume**.

3) So, **Le-Chatelier principle** is applicable.

4) Effect of Temperature: As the reaction is exothermic, low temperature is favoured.

5) Effect of Pressure: As the reaction leads to decrease in volume, high pressure is favoured.

6) Optimum Conditions:

(a) Low Temperature : **725-775 K**

(b) High Pressure : **200-300 atm**

(c) High concentrations: **Pure N_2 and H_2** .

7) Catalyst : **Finely divided iron**

8) Promoter : **Mo**

---

32. The species : H_2O, HCO_3^-, HSO_4^- and NH_3 can act both as Bronsted acids and bases. For each case give the corresponding conjugate acid and conjugate base.

Sol:

Species	Conjugate acid	Conjugate base
H_2O	H_3O^+	OH^-
HCO_3^-	H_2CO_3	CO_3^{2-}
HSO_4^-	H_2SO_4	SO_4^{2-}
NH_3	NH_4^+	NH_2^-

33. Balance the following redox equation in acidic medium by ion-electron method:

$$Cr_2O_{7(aq)}^{2-} + Fe_{(aq)}^{2+} \rightarrow Cr_{(aq)}^{3+} + Fe_{(aq)}^{3+}$$

A: 1) Skeleton ionic equation:

RHR (+6) OHR

$$Cr_2O_7^{-2} + Fe^{+2} + \rightarrow Cr^{+3} + Fe^{+3}$$

	Oxidation half reaction	Reduction half reaction
	$Fe^{+2} \rightarrow Fe^{+3}$	$Cr_2O_7^{-2} \rightarrow Cr^{+3}$
3)	Balancing other than 'O' & 'H' atoms	Balancing other than 'O' & 'H' atoms
	$Fe^{+2} \rightarrow Fe^{+3}$	$Cr_2O_7^{-2} \rightarrow 2Cr^{+3}$
4)	Balancing oxygen atoms	Balancing oxygen atoms
	$Fe^{+2} \rightarrow Fe^{+3}$	$Cr_2O_7^{-2} \rightarrow 2Cr^{+3} + 7H_2O$
5)	Balancing hydrogen atoms	Balancing hydrogen atoms
	$Fe^{+2} \rightarrow Fe^{+3}$	$Cr_2O_7^{-2} + 14H^+ \rightarrow 2Cr^{+3} + 7H_2O$
6)	Balancing charges	Balancing charges
	$Fe^{+2} \rightarrow Fe^{+3} + 1e^-$	$Cr_2O_7^{-2} + 14H^+ + 6e^- \rightarrow 2Cr^{+3} + 7H_2O$
7)	Equalizing of electrons	Equalizing of electrons
	$6(Fe^{+2} \rightarrow Fe^{+3} + 1e^-)$	$1(Cr_2O_7^{-2} + 14H^+ + 6e^- \rightarrow 2Cr^{+3} + 7H_2O)$
	$6Fe^{+2} \rightarrow 6Fe^{+3} + 6e^-$ .....(1)	$Cr_2O_7^{-2} + 14H^+ + 6e^- \rightarrow 2Cr^{+3} + 7H_2O$ .....(2)

8) Adding the two half reactions

$$6Fe^{+2} \rightarrow 6Fe^{+3} + 6e^-$$
$$Cr_2O_7^{-2} + 14H^+ + 6e^- \rightarrow 2Cr^{+3} + 7H_2O$$

$$6Fe^{+2} + Cr_2O_7^{-2} + 14H^+ \rightarrow 6Fe^{+3} + 2Cr^{+3} + 7H_2O$$

---

34. What is position isomerism and functional isomerism? Give one example for each.

A: **Position Isomerism** is due to difference in the position of a substituent or functional group.

Ex: $CH_3CH_2CH_2OH$ — 1- propanol

$CH_3\underset{\displaystyle OH}{\underset{|}{C}}HCH_3$ — 2- propanol

Functional isomerism is due to difference in the functional group in the molecules.

Ex: CH_3CH_2OH — Ethyl alcohol

CH_3OCH_3 — Dimethyl ether

35. Complete the following reaction and name the products A, B and C.

$$CaC_2 \xrightarrow{H_2O} A \xrightarrow{\text{hot metal tube}} B \xrightarrow{AlCl_3+CH_3Cl} C$$

A: $CaC_2 + 2H_2O \rightarrow Ca(OH)_2 + C_2H_2$ $\therefore A = C_2H_2$ (Acetylene)

$3C_2H_2 \xrightarrow{\text{red hot Cu tube}} C_6H_6$ $\therefore B = C_6H_6$ (Benzene)

$C_6H_6 \xrightarrow[\text{Anhyd. } AlCl_3]{CH_3Cl} C_6H_5CH_3 + HCl$ $\therefore C = C_6H_5CH_3$ (Methyl benzene)

SECTION-D

36. What are postulates of Bohr's model of hydrogen atom? Discuss the importance of this model to explain various series of line spectra in Hydrogen atom.

A: I) Postulates of Bohr's model :

1) Electron in an atom revolve around the nucleus in certain fixed **circular paths** called **orbits.**
2) Each orbit has **fixed amount of energy**. So these orbits are also called **energy levels**. These orbits are denoted by 1,2,3,4,..... (or) K, L, M, N.....
3) As long as an electron revolves around the nucleus in a fixed orbit it **does not emit** (or) **absorb energy**. So these orbits are also called as **Stationary orbits**.
4) **Angular momentum** of revolving electron is **quantised** and is an integral multiple of $\frac{h}{2\pi}$.

$\therefore mvr = \frac{nh}{2\pi}$. Here, m = mass of electron, v = velocity of electron, r = radius of the orbit and h = Planck's constant

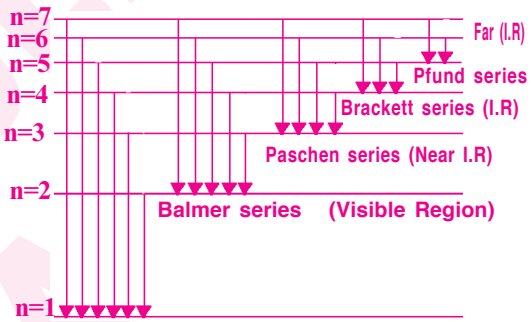
5) Energy is emitted (or) absorbed when electron jumps from one orbit to another orbit. The energy difference between two orbits is $\boxed{\Delta E = E_2 - E_1 = h\nu}$

Here, E_2= Energy of the higher orbit, E_1= Energy of the lower orbit

II) Hydrogen spectrum- Bohr's Explanation:

4 Marks

1) When electric discharge is passed through gaseous hydrogen, the electrons in atoms **absorb** energy.
2) Then they **jump** into **higher energy orbits**.
3) In higher orbits, they have **more energy and less stability.**
4) Then the excited electrons **come back** to **lower orbits** in **one** or **multiple steps**.



Hydrogen Spectrum

5) **Energy** is **released** during this process and it appears in the form of **spectral lines.**
6) When an electron jumps from any higher orbit to

i) **n = 1** produces spectral lines in the **UV** region.This is named as **Lyman series.**

ii) **n = 2** produces spectral lines in the **visible** region.This is named as **Balmer series.**

iii) **n = 3, 4, 5** produces spectral lines in near IR, IR, far IR regions.

These are named as **Paschen** ,**Brackett** and **Pfund** series respectively.

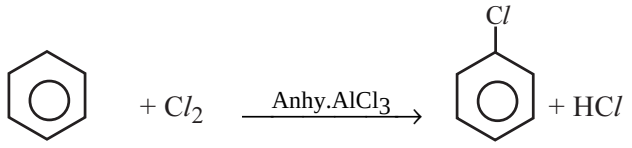
7) From the Rydberg equation, wavenumber $\bar{\nu} = \frac{1}{\lambda} = R_H\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

37. How do we get benzene from acetylene? Give the corresponding equation. Explain the halogenation, alkylation, acylation, nitration and sulphonation of benzene.

A : Benzene from acetylene: Acetylene is passed through red hot Cu to form benzene.

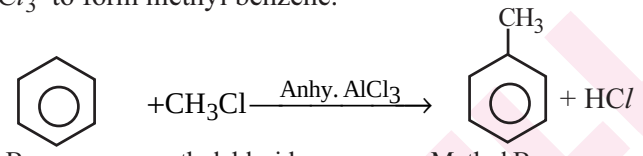
$$3C_2H_2 \xrightarrow[600^oC]{\text{Red hot Cu}} C_6H_6$$

1) Halogenation: Benzene reacts with chlorine in the presence of Anhy.AlCl_3 to form chloro benzene.



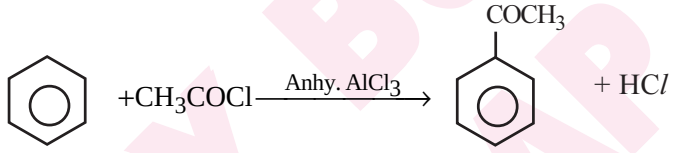
Benzene — Chloro Benzene

2) Friedel - Craft's alkylation: Benzene reacts with alkyl chloride in the presence of anhy. AlCl_3 to form methyl benzene.



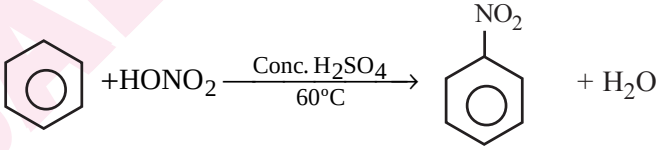
Benzene — methylchloride — Methyl Benzene

3) Friedel - Craft's acylation: Benzene reacts with acetyl chloride in the presence of anhy. AlCl_3 to form acetophenone.



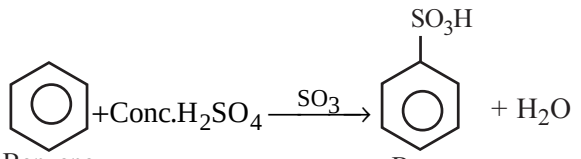
Benzene — acetylchloride — Acetophenone

4) Nitration: Benzene reacts with conc. Nitric acid in the presence of conc. H_2SO_4 at 60°C to form nitro benzene.



Benzene — Nitro benzene

5) Sulphonation: Benzene reacts with fuming sulphuric acid to form benzene sulphonic acid.



Benzene — Benzene sulphonic acid

38. Define IE_1 and IE_2. Why is $IE_2 > IE_1$ for a given atom? Discuss the factors that effect IE of an element.

A: **1) First Ionisation Enthalpy (IE_1):** It is the **minimum** amount of energy required to remove a valence electron from an **isolated, neutral**, **gaseous atom(X)**.

$$X(g) \xrightarrow{IE_1} X^+(g) + e^-$$

2) Second Ionisation Enthalpy (IE_2): It is the minimum amount of energy required to remove the valence electron from the **unipositive gaseous ion(X^+).**

$$X^+(g) \xrightarrow{IE_2} X^{2+}(g) + e^-$$

3) $IE_2 > IE_1$:

Reason: When compared to the parent atom X, the unipositive ion X^+ contains more protons than electrons. So its positive nuclear charge increase. Hence, the force of attraction on the valence electrons increases. So more energy is required to remove the electron in the second case. Hence, IE_2 is greater than IE_1.

4) Factors that effect IE :

i) Atomic Radius(AR) : As atomic radius decreases, the nuclear force of attraction on the valence electrons increases.
So, IE value also increases.

ii) Nuclear Charge(NC): When the 'effective nuclear charge' increases, the force of attraction on the valence electrons increases. So, IE value also increases.

iii) Electronic Configuration(EC): Atoms with completely filled (or) half-filled sub-shells are more **stable** than the others. So, IE values are more for stable atoms.

iv) Screening Effect(SE): The electrons present in the 'inner orbits', act as a 'screen' between nucleus and valance electrons. When the number of electrons in the inner orbits increases, the screening effect also increases. This screening effect reduces the effective nuclear charge. So, IE value decreases.

v) Penetrating Effect (PE): In a given shell ,the penetrating power of the 'valence electrons' decreases in the order of s > p > d > f. So, IE value decreases in the same order.