NEW SYLLABUS

Board of Intermediate Education

NEW SYLLABUS

Jr. INTER CHEMISTRY

Model Paper (English Medium)

Time: 3 Hours **Max. Marks: 60**

SECTION-A

I. **(i) Very short answer type questions.**
(ii) Answer ALL questions.
(iii) Each question carries TWO marks. **(10 × 2 = 20)**

1. What volume of CO_2 is obtained at STP by heating 4 grams of $CaCO_3$?

2. What are Lewis Acids and Bases?

3. Calculate Kinetic Energy of 5 moles of Nitrogen at 27° C.

4. Give the reactions that take place at anode and cathode in Castner - Kellner process.

5. What is Plaster of Paris? Give one use of it.

6. Give the formula and structure of Borazine. What is its common name?

7. Give the reason for higher stability of Tl^{+1} than Tl^{+3}.

8. What are the adverse effects caused by the acid rain?

9. Define 'Sink' and 'TLV'.

10. What is Wurtz reaction?

SECTION - B

II. **(i) Short answer type questions.**

(ii) Answer any SIX questions.

(iii) Each question carries FOUR marks. **(6 × 4 = 24)**

11. Balance the following redox reaction in acidic medium by ion - electron method.

$$MnO_4^- + SO_3^{-2} \rightarrow Mn^{+2} + SO_4^{-2}$$

12. State Dalton's law of partial pressures. 360 cm^3 of CH_4 gas diffused through a porous membrane in 15 minutes. Under similar conditions, 120 cm^3 of another gas diffused in 10 minutes. Find the molar mass of the gas.

13. State Hess's Law of Constant heat summation. Explain with one example.

14. Write the chemical reactions to justify that Hydrogen Peroxide can function as an oxidising as well as reducing agent.

15. Derive the relation between K_c and K_p for the equilibrium reaction.

$N_2\,(g) + 3\,H_2\,(g) \rightleftharpoons 2\,NH_3\,(g)$

16. Explain sp^3d^2 hybridization with one example.

17. Explain molecular oribital theory of Nitrogen molecule. Calculate its bond order and explain its magnetic property.

18. Explain the difference in properties of Diamond and Graphite on the basis of their structure.

SECTION - C

III. (i) Long answer type questions.

(ii) Answer any TWO questions.

(iii) Each question carries EIGHT marks. **(2 × 8 = 16)**

19. What are quantum numbers? Explain the significance of the four quantum numbers associated with an electron.

20. What is a periodic property? How do the following properties change in a

(i) Group and (ii) Period?

Explain: a) Atomic Radius b) Ionization Enthalpy

c) Electron gain Enthalpy

21. Describe two methods of preparation of Ethylene. Give equation for the reactions of Ethylene with the following.

a) Ozone b) Bromine c) Cold and dilute alk. $KMnO_4$

in presence of at high pressure and high temperature.

ANSWERS

SECTION - A

1. What volume of CO_2 is obtained at STP by heating 4 grams of $CaCO_3$?

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

100 g ..... 22.4 L

4 g ..... ?

$\therefore$ Volume of $CO_2 = \frac{4 \times 22.4}{100} = 0.896$ L

2. What are Lewis acids and bases?

Ans: **Lewsis Acid:** The species that accepts electron pair and forms a dative bond is called Lewis acid. **e.g:** BF_3, H^+

Lewis base:

The species that donates electron pair and forms a dative bond is called Lewis base.

e.g: NH_3, H_2O.

3. Calculate Kinetic Energy of 5 moles of Nitrogen at 27 °C

Ans:

$$\text{Kinetic Energy} = \frac{3}{2} nTR$$

$$= \frac{3}{2} \times 5 \times 300 \times 8.314$$

$$= 18706.5 \text{ J}$$

n = 5 moles

T = 27 + 273

= 300 K

R = 8.314 J/K Mole

4. Give the reactions that take place at anode and cathode Castner- Kellner process.

Ans: **At Mercury Cathode:** $2\,Na^+ + 2e^- + Hg \rightarrow Na_2Hg$

(Sodium Amalgam)

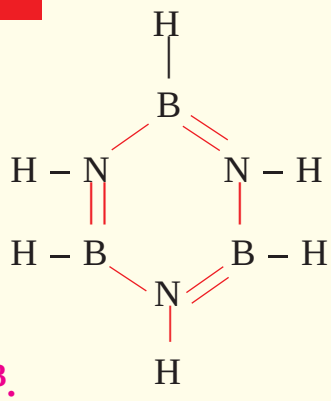
At Carbon (Graphite) Anode: $2\,Cl^- \rightarrow Cl_2 + 2e^-$.

5. What is Plaster of Paris? Give one use of it.

Ans: Hemi hydrate of Calcium Sulphate is called Plaster of Paris ($CaSO_4 . \frac{1}{2} H_2O$). It is used in surgical bandages for bone fracture.

6. Give the formula and structure of Borazine.

What is its common name?



Ans: Formula: $B_3N_3H_6$

Common Name: Inorganic Benzene

7. Give the reason for higher stability of Tl^{+1} than Tl^{+3}.

Ans: Tl has $4f^{14}\ 5d^{10}\ 6s^2\ 6p^1$ configuration in its valence shell. Due to poor shielding of 4f and 5d electrons, 6s pair is inert. So Tl^{+1} is more stable than that of Tl^{+3}.

8. What are the adverse effects caused by the acid rain?

Ans: ★ Acid rain damages buildings and historical monuments.

★ Acid rain affects plants, aquatic animals.

9. Define 'Sink' and 'TLV'.

Ans: Sink: The medium that retains and interacts with pollutants.

Eg: Oceans, Trees are sinks for CO_2.

TLV: The permissible level of a toxic pollutant in atmosphere where a healthy person works in that atmosphere for 8 hours per day without any adverse effect.

Eg: TLV for Zn = 1 mg/m^3

10. What is Wurtz reaction?

Ans: The reaction in which higher alkanes are formed when alkyl halides (smaller) are treated with Sodium metal in dry Ether.

$$CH_3\boxed{Br + 2\ Na + Br}CH_3 \xrightarrow{\text{Dry Ether}} C_2H_6 + 2\ NaBr$$

SECTION - B

11. Balance the following redox reaction in acidic medium by ion - electron method.

OXIDATION	REDUCTION
1. $SO_3^{-2} \rightarrow SO_4^{-2}$	$MnO_4^{-2} \rightarrow Mn^{+2}$
2. Balance other than O and H. S is balanced	Mn balanced
3. Balance 'O' atoms by adding H_2O $SO_3^{-2} + H_2O \rightarrow SO_4^{-2}$	$MnO_4^{-} \rightarrow Mn^{+2} + 4\ H_2O$

4. Balance H atoms by adding H^+

$SO_3^{-2} + H_2O \rightarrow SO_4^{-2} + 2\ H^+$

5. Balance charges by adding e^-

$SO_3^{-2} + H_2O \rightarrow SO_4^{-2} + 2\ H^+ + 2e^-$

6. Multiplying above equation with 5 to balance e^-

$5\ SO_3^{-2} + 5\ H_2O \rightarrow 5\ SO_4^{-2} + 10\ H^+ + 10\ e^-$

$MnO_4^- + 8\ H^+ \rightarrow Mn^{+2} + 4\ H_2O$

$MnO_4^- + 8\ H^+ + 5\ e^- \rightarrow Mn^{+2} + 4\ H_2O$

Multiplying above equation with 2 to balance e^-

$2\ MnO_4^- + 16\ H^+ + 10\ e^- \rightarrow 2\ Mn^{+2} + 8\ H_2O$

Adding L.H.S of Oxidation and reduction halves, R.H.S of Oxidiation and reduction halves and bringing similar terms together

$2\ MnO_4^- + 5\ SO_3^{-2} + 6\ H^+ \rightarrow 2\ Mn^{+2} + 5\ SO_4^{-2} + 3\ H_2O$

12. State Dalton's law of partial pressures. 360 cm^3 of CH_4 gas diffused through a porous membrame in 15 minutes. Under similar conditions, 120 cm^3 of another gas diffused in 10 minutes. Find the molar mass of the gas.

Dalton's Law: The total pressure (P_{total}) exerted by the mixture of non - reactive gases is equal to the sum of the partial pressures of component gases.

Ans. $P_{total} = P_1 + P_2 + P_3 + ...$

Rate of diffusion of CH_4 $(r_1) = \frac{V_{CH_4}}{t_{CH_4}} = \frac{360}{15} = 24\ cm^3/min$

Molar mass of CH_4 $(M_1) = 16$

rate of diffusion of unknown gas $(r_2) = \frac{V_{unknow}}{t_{unknow}}$

$= \frac{120}{10}$

$= 12\ cm^3/min$

Molar mass of unknown gas $(M_2) = ?$

$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$

$\frac{24}{12} = \sqrt{\frac{M_2}{16}}$ or $\frac{24 \times 24}{12 \times 12} = \frac{M_2}{16}$

$\therefore M_2 = \frac{24 \times 24 \times 16}{12 \times 12} = 64$

13. State Hess's law of constant heat summation Explain with one example.

Ans. The total Change in enthalpy of a reaction is same whether the reaction takes place in a single step or in many steps.

e.g. $C\ (graphite) + \frac{1}{2} O_2\ (g) \rightarrow CO\ (g)\ \Delta H = -110.5\ KJ/\ mol$

$CO\ (g) + \frac{1}{2} O_2\ (g) \rightarrow CO_2\ (g)\ \Delta H = -283\ KJ/\ mol$

$C\ (graphite) + O_2\ (g) \longrightarrow CO_2\ (g)\ \Delta H = -393.5\ KJ/\ mol$

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14. Write the Chemical reactions to justify that hydrogen peroxide can function as an oxidising as well as reducing agent.

Ans. As a Oxidising agent:

H_2O_2 Oxidises PbS to $PbSO_4$

$PbS + 4\ H_2O_2 \rightarrow PbSO_4 + 4\ H_2O$

H_2O_2 Oxidises Ferrous to Ferric in acidic medium

$2\ Fe^{+2} + 2\ H^+ + H_2O_2 \rightarrow 2\ Fe^{+3} + 2\ H_2O$

As a reducing agent:

H_2O_2 reduces MnO_4^- to Mn^{+2} in acidic medium.

$2\ MnO_4^- + 6\ H^+ + 5\ H_2O_2 \rightarrow 2\ Mn^{+2} + 8\ H_2O + 5\ O_2$

H_2O_2 reduces $HOCl$ to Cl^-

$HOCl + H_2O_2 \rightarrow H_3O^+ + Cl^- + O_2$

15. Derive the relation between K_c and K_p for the equilibrium reaction.

$N_2\ (g) + 3\ H_2\ (g) \rightleftharpoons 2\ NH_3\ (g)$

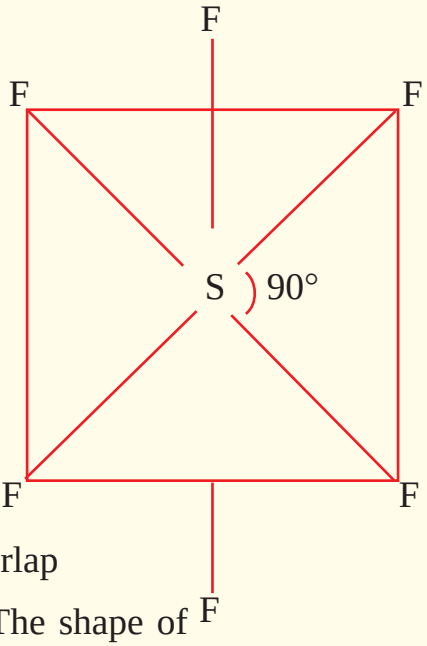
Ans: $K_c = \dfrac{[NH_3]^2}{[N_2][H_2]^3}$ $\quad K_p = \dfrac{P^2NH_3}{P_{N_2}.\ P^3H_2}$

$PV = nTR \quad \therefore P = \frac{n}{v} TR = C.TR$

$$K_p = \frac{[NH_3]^2\,[RT]^2}{[N_2][RT][H_2]^3[RT]^3} = \frac{K_c}{[RT]^2}$$

$\therefore K_p = K_c\,[RT]^{-2}$

16. Explain sp^3d^2 hybridization with one example.

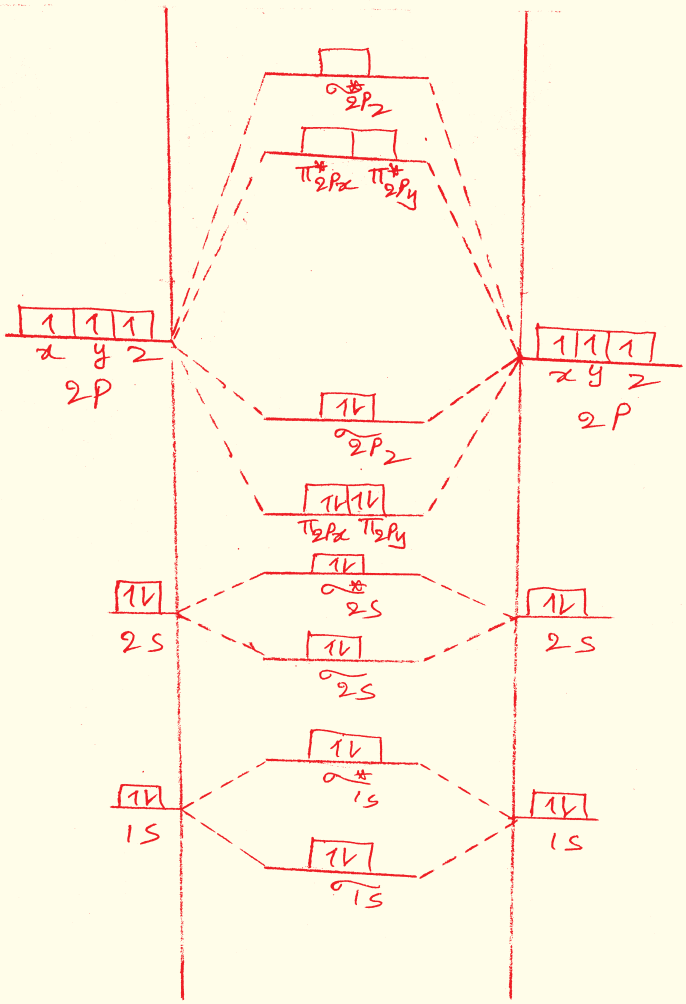


Ans: The phenomenon of intermixing of one s, three p and two d orbitals of an atom to form six identical sp^3d^2 hybrid orbitals is called sp^3d^2 hybridization.

eg.: SF_6

Sulphur in SF_6 has $1s^2\ 2s^2\ 2p^6\ 3s^1\ 3p_x^1\ 3p_y^1\ 3p_z^1\ 3d^1\ 3d^1$ configuration in its second excited state. Six sp^3d^2 Hybrid orbitals Sulpher overlap with 6p orbitals of F atoms to form six bonds. The shape of SF_6 molecule is octahedral and the bond angle is 90°

17. Expalin molecular orbital theory of nitrogen molecule. Calculate its bond order and explain its magnetic property.



N — **Atomic Orbital** | N_2 — **Molecular Orbital** | N — **Atomic Orbital**

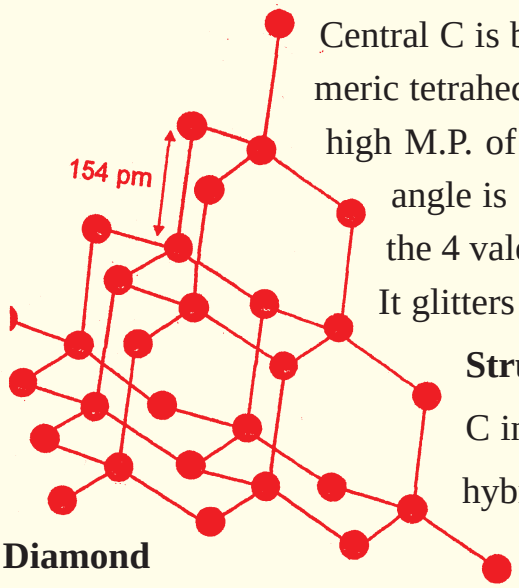
M.O. configuration $N_2 = \sigma_{1s^2}\ \sigma^*_{1s^2}\ \sigma_{2s^2}\ \sigma^*_{2s^2}\ \Pi_{2p_x^2} = \Pi_{2p_y^2}\ \sigma_{2p_z^2}$

N_2 Bond order $= \frac{1}{2}(N_b - N_a) = \frac{1}{2}(10 - 4) = 3$

As all the orbitals are paired with electrons, it is diamagnetic.

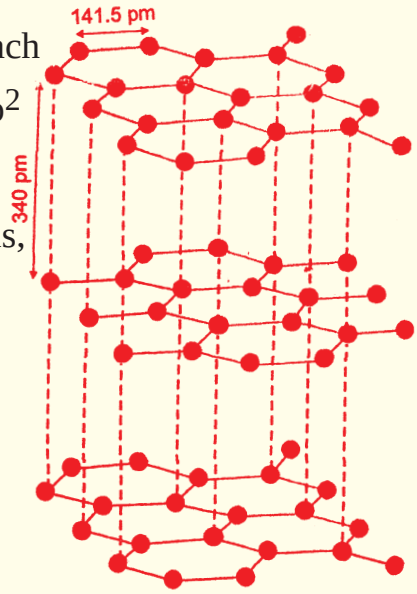
18. Explain the difference in properties of Diamond and Graphite on the basis of the structure.

Ans: **Structure of Diamond:** Each C in Diamond undergoes sp^3 hybridization. Central C is bonded to 4C atoms to form tetrahedron. 3-D polymeric tetrahedron network makes Diamond very hard, possesses high M.P. of 4200°K. C - C bond length is 154 Pm. The bond angle is 109° 28'. C. It is bad conductor of electricity as all the 4 valence e^- of C involves in covalent bonds formation. It glitters due to high refractive index.



Diamond

Structure of Graphite: Each C in Graphite undergoes sp^2 hybridization. By using 3 sp^2 hybridizing orbitals, each C is going to form 3 covalent bonds with 3 other C atoms in the same plane to form 2-D hexagonal layers. Weak vander waal's forces between such layers make Graphite soft and can be used as lubricant. 4th valence e^- of C remains free and makes it a good conductor of electricity. C - C bond length is 141.5 Pm. The bond angle is 120°.



Graphite

SECTION - C

19. What are quantum numbers? Explain the significance of the four quantum numbers associated with an electron.

Ans: In order to explain complete address, arrangement of electrons in various sub shells, shells in an atom, four quantum numbers are introduced. They are

1. Principal quantum number (n)

- It was proposed by Niels - Bohr.
- It is denoted by 'n'.
- 'n' values can be denoted by K, L, M, N, ... or 1, 2, 3, 4, ...

- As 'n' value increases the size, energy of the orbit increases.
- It also represents the distance between the electron and nucleus.
- In any orbit, if the number of shells = n

  No. of orbitals = n^2; No. of electrons = $2n^2$
- With the increase of 'n', the energy of electron also increases.

$$E_n = \frac{-13.6}{n^2} \text{ e.v./atom}$$

- This quantum number describes the size and energy of the orbit.

2. Azimuthal quantum number (*l*)

- It was proposed by somerfeld.
- It is denoted by '*l*'.
- '*l*' values are ranging from 0 to n – 1.
- It represents sub-shells in a shell.
- The no. of sub-shells in an orbit are equal to 'n'.
- The no. of electrons present in a sub-shell is equal to $2(2l + 1)$ i.e., 2 electrons in s, 6 in p, 10 in d, 14 in f sub-shells.
- This quantum number describes the shape of the orbital i.e., if $l = 0$ (s, Spherical), $l = 1$ (p, Dumb-bell), $l = 2$ (d, Double Dumb-bell), $l = 3$ (f, four fold Dumb-bell)

n	*l*	sub shell notation
1	0	1s
2	0	2s
2	1	2p
3	0	3s
3	1	3p
3	2	3d
4	0	4s
4	1	4p
4	2	4d
4	3	4f

3. Magnetic quantum number (m)

- It was proposed by Lande to explain Zeeman and Stark effects.
- m values are ranging from $-l$ to 0 to $+l$.
- m has $(2l + 1)$ values.
- m values are 1, 3, 5, 7 if the *l* values are 0, 1, 2, 3 respectively.
- The energy of all the orbitals present in a sub-shell is same.
- This quantum number describes orientation of the orbitals in space.

4. Spin quantum number (s)

- It was proposed by Uhlenbeck and Goudsmit.
- It is denoted by 's'.

- The value of s = $+\frac{1}{2}$ (If the spin is clockwise)
- The value of s = $-\frac{1}{2}$ (If the spin is anti clockwise)
- This quantum number describes the direction of spin of the electron (orientation of spin)

20. What is a periodic property? How do the following properties change in a (i) group and (ii) period?

Explain: a) Atomic radius b) Ionization enthalpy c) Electron gain Enthalpy.

Ans: The repetition of similar property of elements at regular intervals (2, 8, 8, 18, 18, 32) when they are arranged in increasing order of their atomic numbers (or electronic configuration)

a) Atomic radius:

In a group: Due to decrease in effective nuclear charge over the valence electrons, and the addition of new shells, atomic radius increases from top to bottom in a group.

In a period: Atomic radius decreases from left to right in a period due to increase in effective nuclear charge over the valence electrons

b) Ionization Enthalpy:

In a group: Ionization Enthalpy decreases from top to bottom in a group due to increase in atomic radius, decrease in attraction between the nucleus and valence electrons, lowest required energy to remove valence electrons.

In a period: Ionization Enthalphy increases from left to right in a period, due to decrease in atomic radius, increase in attraction between nucleus and valence electrons, highest required energy to remove valence electrons

c) Electron gain Enthalpy:

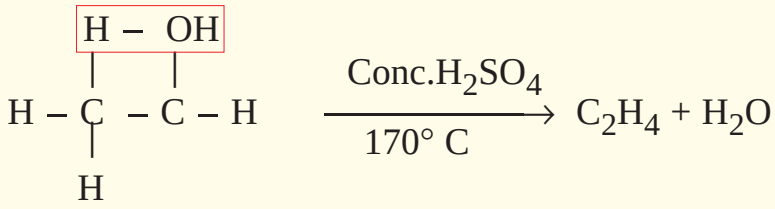
In a group: Electron gain Enthalpy decreases from top to bottom in a group due to decrease in attraction between the nucleus and added electron.

In a period: Electron gain Enthalpy gradually increases from left to right in a period due to increase in attraction between the nucleus and added electron.

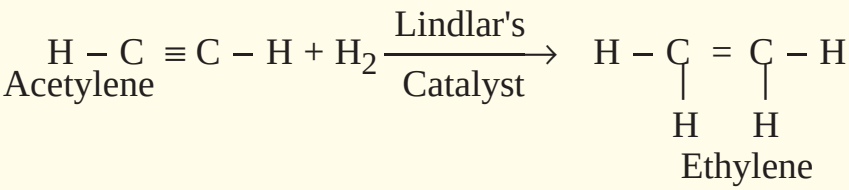
21. Describe two methods of preparation of Ethylene. Give equation for the reactions of Ethylene with the following a) Ozone b) Bromine c) Cold and dilute alkaline $KMnO_4$ (d) in presence of catalyst at high pressure and high temperature.

Ans: Preparation:

★ **From Alcohol:** Ethyl Alcohol on heating upto 170° C with Conc. H_2SO_4 gives Ethylene.

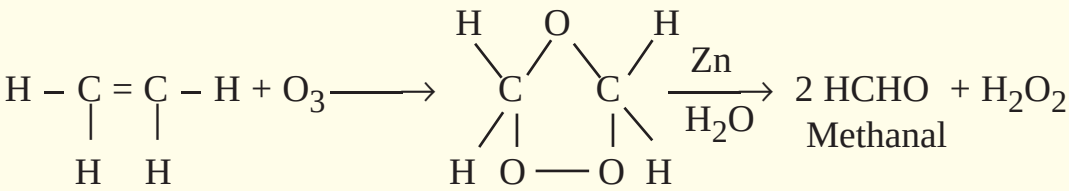


★ **From Acetylene:** Acetylene on partial reduction with Lindlar's catalyst (Palladised Charcoal in $BaSO_4$) gives Ethylene.

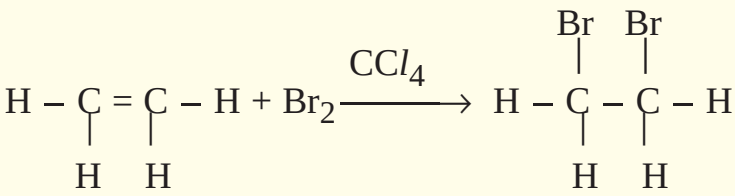


Reactions:

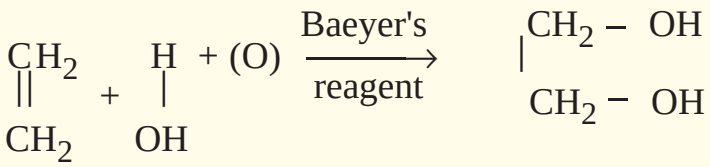
a) With Ozone: Ethylene on reaction with O_3 gives Ethylene Ozonide, which on hydrolysis gives Methanal.



b) With Bromine: Ethylene on reaction with Br_2 gives 1, 2, Di Bromo Ethane



c) With cold and dilute alkaline $KMnO_4$: It gives Ethane 1, 2, diol with Baeyer's reagent (cold & dil. alk. $KMnO_4$)



d) Ethylene on polymerization gives polythene.

$$n(CH_2 = CH_2) \xrightarrow[\text{Catalyst}]{\text{high P / high T}} \underset{\text{Polythene}}{-(CH_2 - CH_2)_n-}$$