19. (d)
Given,
Density (d) = 1.964 g/L
Pressure (P) = 76 cm Hg= 760 mm Hg or 1 atm
Temperature (T) = 273 K
R = 0.0821 atm/k mol
According to ideal gas equation:
PV = nRT

$PV = \frac{m \times R}{Mwt \times T}$ $\quad \therefore\ n = \frac{mass(m)}{Moleculer\,weight\,(Mwt)}$

Molecular weight = $\frac{m \times R}{P \times V \times T}$ $\quad \therefore density = \frac{mass(m)}{Volume(v)}$

$Mwt = \frac{d \times R}{P \times T}$

$= \frac{1.964 \times 0.0821}{1 \times 273}$

= 44g
44g is the molecular weight of CO_2 gas.

20. (a)
According to Raoult's law partial vapor pressure of each volatile component in the solution is directly proportional to its mole fraction.

$P_{H_2} \propto x_{H_2}$

Suppose x_g of both are mixed.

Moles of H_2 = $\frac{weight}{molecular\ weight} = \frac{x}{2}$

Moles of C_2H_5 = $\frac{x}{30}$

Mole fraction of H_2 = $\frac{\frac{x}{2}}{\frac{x}{2} + \frac{x}{30}} = \frac{\frac{x}{2}}{\frac{16x}{30}} = \frac{15}{16}$

So, fraction of total pressure exerted by hydrogen is $\frac{15}{16}$.

21. (c)
For an ideal gas expanding adiabatically,
$\Delta U = w$
$\therefore q = 0$
So, $W = -P_{ext}\Delta V = 0$
Expansion against $P_{ext} = 0$
For Adiabatic Process:
$\Delta U = q + W$
$\Delta U = 0$

22. (c)

As we know

$$\Delta T_f = \frac{K_f \times W_B \times 1000}{M_B \times W_A}$$

Given that

$K_f = 1.86k\ kg / mol$

10 mass% $\Rightarrow$ 10g ethylene glycol mixed with 90g ice $\Rightarrow$ 100 g solution

w_A = ice_{CH_2O} = 90g

w_B = ethylene glycol = 10g

Molecular weight of ethylene glycol (m_B) = 62

So, $\Delta T_f = \frac{1.86 \times 10 \times 1000}{62 \times 90}$

$\Delta T_f = 3.33°C$

$\Delta T_f = T_f{}^\circ - T_f$

$T_f = \Delta T_f - T_f^\circ$

$T_f = -3.3°C$

23. (a)

Velocity of electron in first Bohr orbit of hydrogen atom

$$mvr = \frac{nh}{2\pi}$$

r = 0.53 × 10^{-8} m

n = 1

h = 6.626 × 10^{-26} m

m = 9.1 × 10^{-31} kg

$$v = \frac{nh}{2\pi mr}$$

On substituting the values velocity (v) = $\frac{1 \times 6.626 \times 10^{-26}}{2 \times 3.14 \times 9.1 \times 10^{-31} \times 0.53 \times 10^{-8}}$

= 2.18 × 10^6 m/s

= 2.18 × 10^8 cm/s

24. (d)

Oxygen is less electronegative element than the fluorine having electro negativity values 3.44 and 3.98 respectively.

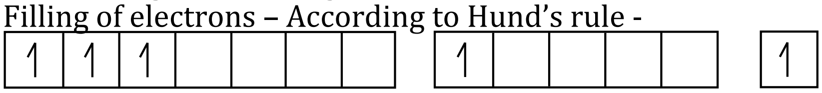
Hence, the option D is incorrect.

25. (a)

General electronic configuration of Uranium ($_{92}U$) = [Rn]$5f^3\ 6d^1\ 7s^2$

Orbital diagram of filling electrons:

Filling of electrons – According to Hund's rule -



5f 6d 7s

So, the number of total unpaired electrons in uranium atom = 3 + 1 = 4

26. (a)

Expression for the orbital angular momentum

$$(\mu_\ell) = \sqrt{\ell(\ell+1)}\frac{h}{2\pi}$$

For 4f electron, ℓ = 3 and

For 4s electron, ℓ = 0

So, $\mu_{\ell_{(4f)}} - \mu_{\ell_{(4s)}} = \sqrt{3+(3+1)}\frac{h}{2\pi} - \sqrt{0(0+1)}\frac{h}{2\pi}$

$= \sqrt{12}$

$= 2\sqrt{3}$

27. (d)

(A) 1g of Ag = $\frac{1}{\text{atomic weight}}$ mole atom of Au

$= \frac{1}{107} \times N_A$ atoms of Au

$= \frac{1}{107} \times 6.022 \times 10^{23}$ atoms of Au

Similarly,

(B) 1g of Fe = $\frac{1}{56}$ mole atom of Fe

1g of Fe = $\frac{1}{56}$ × 6.022 × 10^{23} atoms of Fe

(C) 1g of Cl_2 = $\frac{1}{71}$ mole molecules of Cl_2

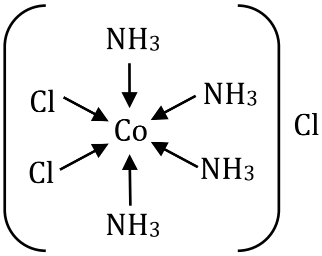
$= \frac{1}{71}$ × 6.022 × 10^{23} atoms of Cl_2

(D) 1g of Mg = $\frac{1}{24}$ mole atom of Mg

$= \frac{1}{24}$ × 6.022 × 10^{23} atoms of Mg

So, 1g magnesium has the largest number of atoms.

28. (d)



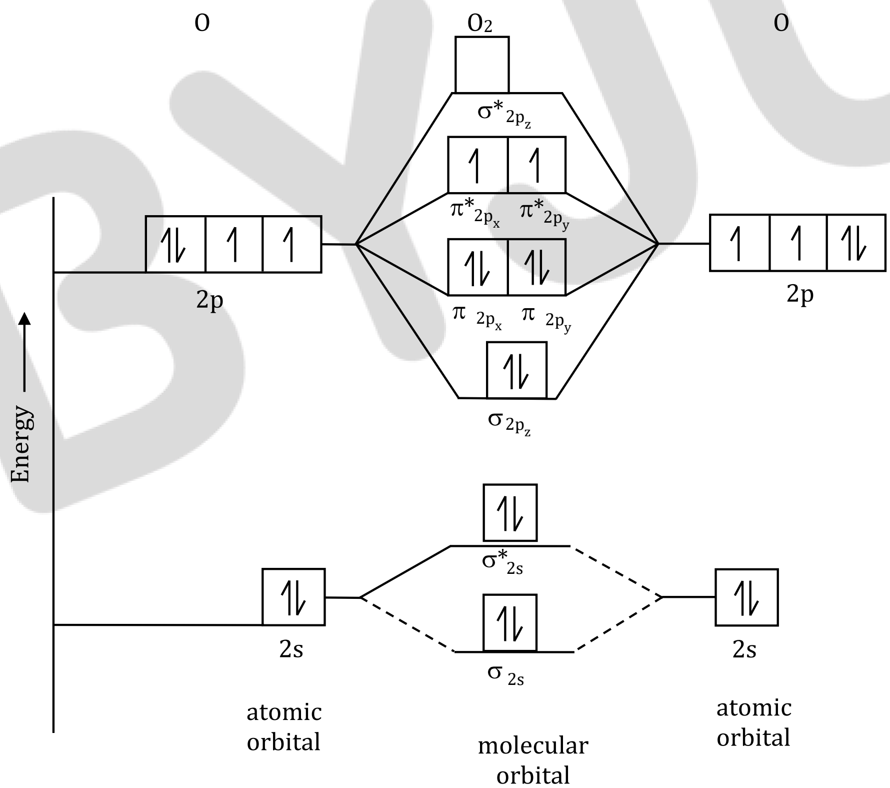
IUPAC name of Co-ordination compound is:Cis-tetraminedichlorochromium (III) chloride.

To write the correct IUPAC name of the compound first we write cationic part and then anionic part. The prefix 'tetra' indicates presence of four NH_3 ligands prefix 'di' indicates two chlorine ligand.

The name of ligands is written in alphabetical order because both the ammonia and the chlorine atoms are on same sides hence we use cis before the name of the compound.

29. (c)
The gas molecule must be O_2 because having two unpaired electrons in its outer most electronic configuration i.e.

$(\sigma_{1s})^2 (\sigma*_{1s})^2 (\sigma_{2s})^2 (\sigma_{2s}*)^2 \left(\pi_{2p_x}\right)^2 \left(\pi_{2p_y}\right)^2 \left(\pi*_{2p_x}\right)^1 \left(\pi*_{2p_y}\right)^1$



After removal of one electron (oxidized), bond length decreases as compared to neutral molecule.
O_2 behaves as oxidizing as well as reducing agent by either losingor gaining of an electron.

30. (b)

$CH_3{-}O{-}CH_2{-}Cl \xrightarrow[\Delta]{aq.\ \bar{O}H} CH_2{-}O{-}CH_2{-}OH$

Mechanism:

$CH_3{-}O{-}\overset{+\delta}{C}H_2 - Cl + {}^{-}OH \longrightarrow CH_3{-}O{-}\overset{\oplus}{C}H_2 \longleftrightarrow CH_3{-}\overset{\oplus}{O}{=}CH_2$

1° carbocation

stabilized by +M effect of OCH_3 group

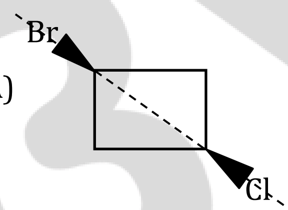
$\downarrow \bar{O}H$

$CH_3{-}O{-}CH_2{-}OH$

It is the Nucleophilic substitution reaction and follows S_N1 mechanism due to 1° stable carbocation.

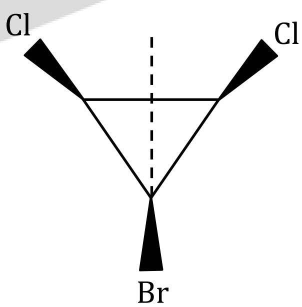
31. (d)

(A)

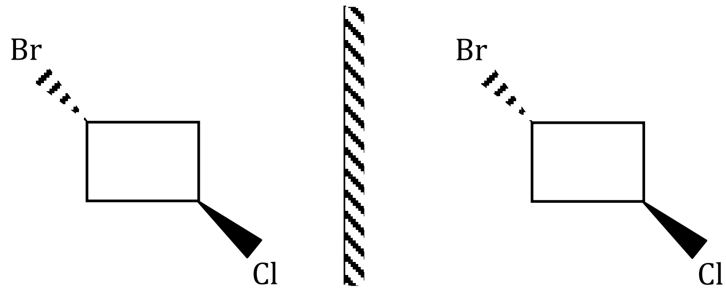


Plane of symmetry is present; hence it is a symmetric molecule.

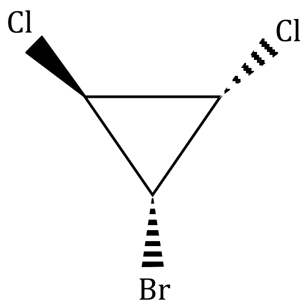
(B)



Plane of symmetry is present; hence it is a symmetric molecule.

(C) 

superimposable mirror images

(D) 

Plane of symmetry absent, has non superimposable mirror image (Diastereomer). Hence it is an Asymmetric compound.

32. (b)
For the reaction:
$$2A + B \longrightarrow P$$
Rate of reaction (r) = $k[A]^2[B]$

According to first order reaction, half-life $t_{1/2} = \frac{0.693}{K}$ is not affected by change in concentration.
So, order of the reaction with respect to b is one, similarly for A is also one.
Overall order of the reaction = 1 + 1 = 2
Hence, unit of rate constant is L/mol.

33. (d)
Given that solubility product of $SrCO_3 = 7.0 \times 10^{-10}$
Solubility product of $SrF_2 = 7.9 \times 10^{-9}$
Concentration of $\left[CO_3^{2-}\right] = 1.2 \times 10^{-3}$ M
Solution is saturated with $SrCO_3$ and SrF_2.

SrF^2 -> $Sr^{2+} + 2F^-$
$K_{sp}SrF_2 = [Sr^{2+}][F^-]^2$
$SrCO_3$ -> $Sr^{+2} + Co_3^{2-}$
$K_{sp}(SrCO_3)$ -> $(Sr^{+2})[CO_3]^{2-}$

so,

$$\frac{K_{sp}(SrF_2)}{K_{sp}(SrCO_3)} = \frac{[Sr^{+2}][F^-]^2}{[Sr^{+2}][CO_3^{2-}]} = \frac{[F^-]^2}{[CO_3^{2-}]}$$

$$[F^-]^2 = \frac{[CO_3^{2-}] \times 7.9 \times 10^{-10}}{7 \times 10^{-10}}$$

$$[F^-]^2 = \frac{1.2 \times 10^{-3} \times 7.9}{7}$$

$$[F^-]^2 = 13.5 \times 10^{-4}$$

$$[F^-] = \sqrt{13.5 \times 10^{-4}}$$

$$[F^-] = 3.7 \times 10^{-2}\ M$$

So, concentration of F^- in the solution would be 3.7×10^{-2} M

34. (a,c)

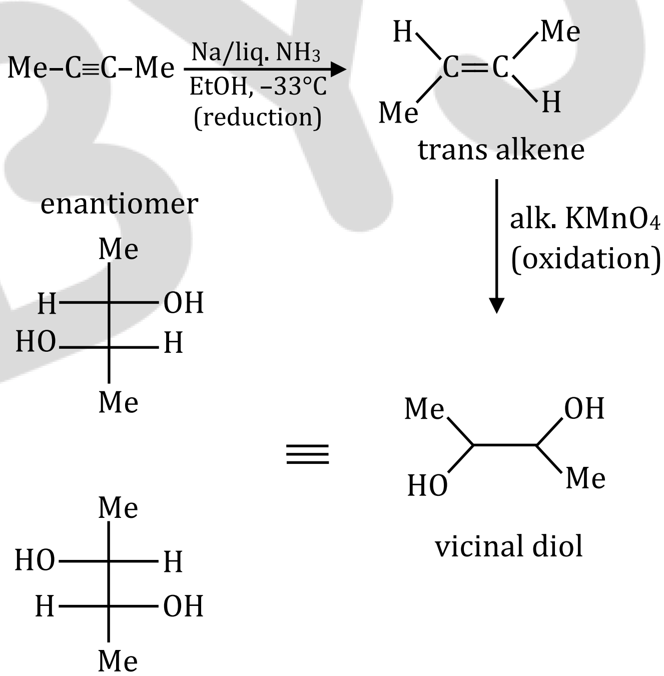
Reactions of SiO_2:

$SiO_2 + HF \longrightarrow H_2[SiF_6] + H_2O$

$SiO_2 + NaOH \longrightarrow Na_2SiO_3 + H_2O$

SiO_2 is an acid oxide. Therefore, it dissolves in alkaline solutions.

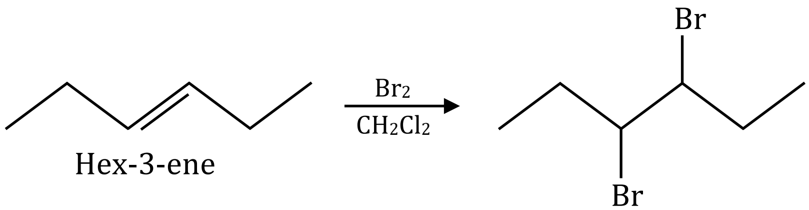
35. (a,c)



In the above reaction, presences of Na in liquid NH3 alkynes reduce to give trans alkene. Alkaline $KMnO_4$ gives vicinal diol as oxidation product. These diols are enantiomers of each other.

36. (a,b)

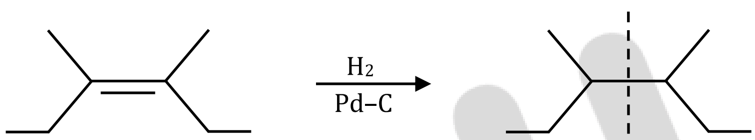
(A)



meso compounds

3,4-dibromohexane

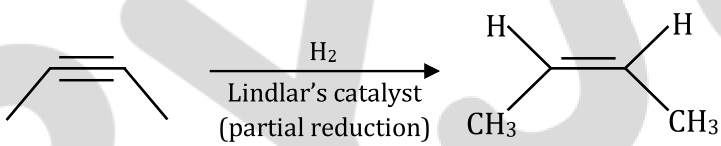
(B)



3,4-dimethyl hex-3-ene

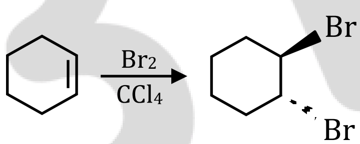
meso compound
3,4-dimethyl hexane

(C)



cis-Alkene

(D)



enantiomer

37. (a,b,d)

The free energy change for any polymerization will be,

$$\Delta G = G_{polymer} - G_{monomer}$$

So, $\Delta G = \Delta H - T\Delta S$

$$\Delta T = (H_{polymer} - H_{monomer}) - T(S_{polymer} - S_{monomer})$$

When the polymer has a lower free energy than the initial monomer, a polymerisation can occur spontaneously and the sign of ΔG is negative. ΔH is negative due to it's an exothermic process. Entropy change for polymerisation is also negative because, polymers are orderly arranged.

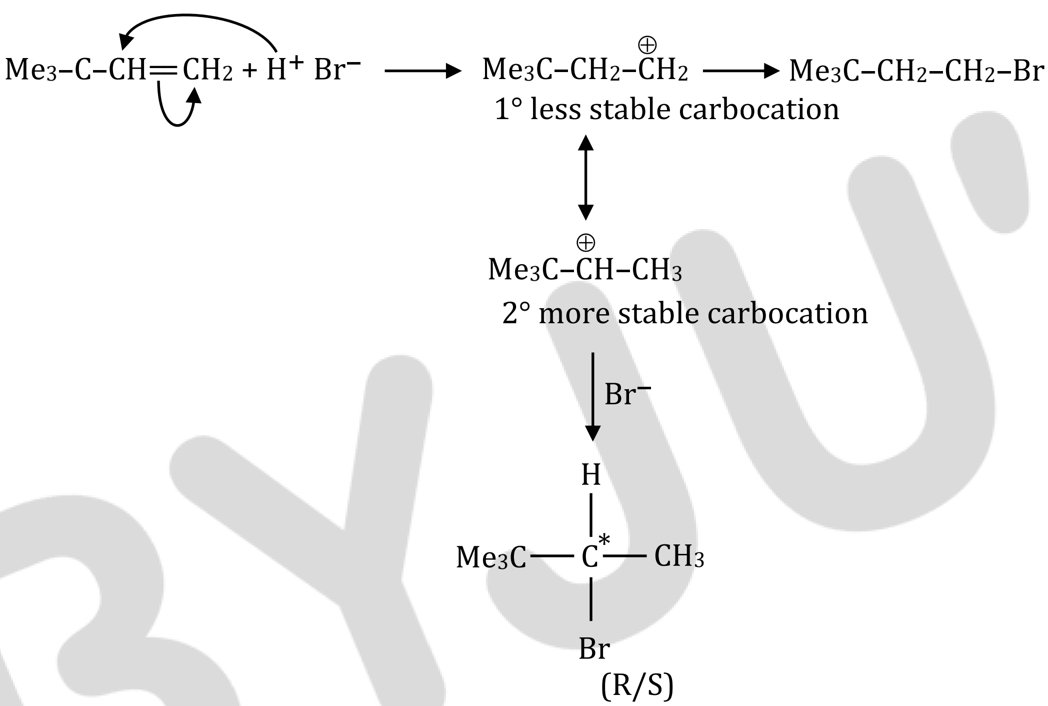
38. (b,c)

Fuel gas desulphurisation (FGD) process is used to remove sulphur from exhaust flue gases. In this system, the sulphur removed from the flue gas is converted into its elemental form or into sulphuric acid.

Alkaline scrubbing is used to remove SO_2 from combustion exhaust gas.

39. (c)

For chemical reaction:



Total number of stereo isomers possible for 4,4-dimethylpentene are three. As the molecule contain one chiral carbon atom.

Number of R and S isomers = $2^{n-1} = 2^{1-1} = 2$

So, total number of stereo isomers possible are = 2 + 1 = 3.

40. (a)

In electrolysis, water is decomposed in the presence of electricity, to produce hydrogen gas and oxygen gas.

The half reaction,

Reduction at cathode: $2H^+(aq.) + 2e^- \longrightarrow H_2(g)$

Oxidation at anode: $2H_2O(\ell) \longrightarrow O_2(g) + 4H^+(aq.) + 4e^-$

Over all reaction: $2H_2O(\ell) \longrightarrow 2H_2(g) + O_2(g)$

On electrolysis volume of gases produced increases.

Relation between density and volume

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

As the volume increases density decreases, so as the proportion of water molecules increases density decreases.