Sample Paper-05
Chemistry (Theory)
Class – XI

Time allowed: 3 hours **Answer** **Maximum Marks: 70**

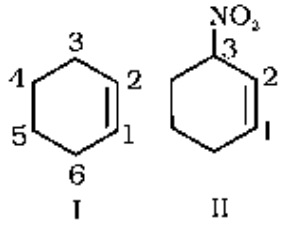
1. It will be a weaker reducing agent if electrochemical series has elements in decreasing order of their reduction potential.
2. The intermolecular forces in carbon dioxide are more than in methane molecules because of greater polarity
3. g Li.
4. Trigonal pyramidal.
5. Metallic hydrides trap hydrogen in their voids forming interstitial hydrides, thus they can be used for storing hydrogen.
6. (a) Kinetic energy.
   (b) It increases with increase in temperature.

   Or

   Work done in isothermal reversible expansion of an ideal gas
   $W = -2.303\ nRT \log V_2/V_1 = -2.303\ nRT \log P_1/P_2$
   In the free expansion of an ideal gas, w = 0 because ideal gases have negligible force of attraction, therefore work done is zero in free expansion because no external force is acting.
   $W = -P_{ext}\Delta V$
   $P_{ext} = 0$; w = 0
7. (a) LuF_3
   (b) AlI_3
   (c) SiO_2
   (d) PF_5
8. Hydrogen peroxide is unstable and so decomposes in water and oxygen on long standing or heating. Hence to lower the vapour pressure inside the bottle, it is cooled before opening.
9. Due to small size, the ionization energy of Be and Mg are much higher than alkaline earth metals. So they need large amount of energy for excitation of electrons to higher energy levels. This energy is not available in Bunsen flame and so do not impart any colour to the flame.
10. Molarity = 3M
    Density = 1.25g/mL
    Mass of NaCl in 1L solution
    = Molarity x molar mass = 3 x 58.5 = 175.5g
    $\text{Density} = \frac{\text{Mass}}{\text{Volume}}$
    Mass of 1L NaCl solution = 1.25 x 1000 = 1250g
    Mass of water in solution = 1250-175.5 = 1074.5g = 1.0745 kg
    $\text{Molality} = \frac{\text{No. of moles of solute}}{\text{Mass of water}} = \frac{3}{1.0745} = 2.79\ \text{m}$
11. (a) Sodium hydroxide and hydrogen gas will be formed which will catch fire
    $2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$
    (b) Sodium peroxide is formed
    $2Na + O_2 \rightarrow Na_2O_2$
    (c) Sodium hydroxide and hydrogen peroxide are formed
    $Na_2O_2 + 2H_2O \rightarrow 2NaOH + H_2O_2$

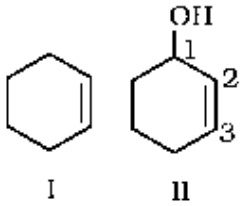
12. F_2 is best oxidizing agent because it has highest standard reduction potential. It has low bond dissociation energy, high electron affinity and highest hydration energy of F^- ions.
    H-I is best reductnt due to low bond dissociation energy.
13. (i) $2BF_3 + 6LiH \rightarrow B_2H_6 + 6LiF$
    (ii) $2BF_3 + 6LiH \rightarrow B_2H_6 + 6LiF$
    (iii) $B_2H_6 + 6H_2O \rightarrow 2B(OH)_3 + 6H_2$
    (iv) $2NaH + B_2H_6 \rightarrow 2NaBH_4$
    (v) $H_3BO_3 \xrightarrow{\Delta} HBO_3 + H_2O$
    (vi) $Al + 3NaOH \rightarrow Al(OH)_3 + 3Na$
    (vii) $3B_2H_6 + 6NH_3 \xrightarrow{Heat} 2B_3N_3H_6 + 12H_2$
14. Paper chromatography – it is a type of partition chromatography. A special quality of paper known as chromatographic paper is used which traps water and act as a stationary phase. The mixture of components is dissolved in suitable solvent. This solvent act as a mobile phase. It is based on continuous differential partitioning of components of mixture between stationary and mobile phase.
15. (i) Acid rain – It is a rain which contains water along with sulphuric acid, nitric acid and hydrochloric acid which are formed from the oxides of sulphur, nitrogen and CO_2 present in the air as pollutants and has a pH of 4-5.
    (ii) Eutrophication – It refers to the ageing of the confined water bodies, for example lakes. Normally it is a slow geological phenomenon but the process is accelerated due to the flow of excessive nutrients into the lake. Excessive flow of fertilizers, pesticides etc., into the lake lead to the algae bloom that ultimately leads to the death of aquatic life. The dead matter sinks to the bottom of the lake making lake shallow and marshy.
    (iii) Green Chemistry – The term green chemistry is used to refer the procedures of synthesis of chemical of our needs through a process that neither use nor emit toxic chemicals. For example earlier chlorine gas was used for bleaching paper which is a highly toxic gas but it has now been replaced by hydrogen peroxide with a suitable catalyst.
16. (a) Initially the vapour pressure will decrease.
    (b) The rate of evaporation remains constant at constant temperature in a closed vessel. But the rate of condensation will be low initially because there are fewer molecules per unit volume in the vapour phase and hence the no. of collisions per unit time with the liquid surface decreases.
17. (a) Barium and Beryllium sulphate can be distinguished by solubility test. Beryllium sulphate is soluble in water and barium sulphate is insoluble in water.
    (b) Barium carbonate is thermally most stable alkaline earth metal carbonate because; its ion being larger in size is more stabilized by larger carbonate ion through the formation of stable lattice.
18. (a) The word 'hexane' indicates the presence of 6 carbon atoms in the chain. The functional group chloro is present at carbon 2. Hence, the structure of the compound is CH_3-CH_2-CH_2-CH_2-CH (Cl)-CH_3.
    (b) The word 'pent' indicates that parent hydrocarbon contains 5 carbon atoms in the chain. 'en' and 'ol' correspond to the functional groups C=C and -OH at carbon atoms 4 and 2 respectively. Thus, the structure is CH_2=$CHCH_2$CH (OH) CH_3.
    (c) Six membered rings containing a carbon-carbon double bond is implied by cyclohexene, which is numbered as shown in (I). The prefix 3-nitro means that a nitro group is present on

C-3. Thus, complete structural formula of the compound is (II). Double bond is suffixed functional group whereas NO_2 is prefixed functional group therefore double bond gets preference over $-NO_2$ group:



I II

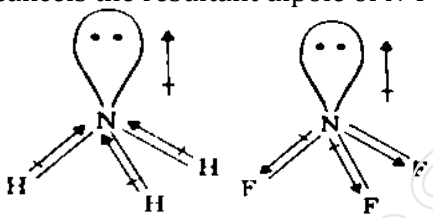
(d) '1-ol' means that a -OH group is present at C-1. OH is suffixed functional group and gets preference over C=C bond. Thus the structure is as shown in (II):



I II

Or

NH_3 has a higher dipole moment than NF_3. In case of NH_3 orbital dipole due to lone pair is in same direction as resultant dipole due to three N-H bonds. Therefore lone pair moment adds on the resultant dipole of N-H bonds. In case of NF_3 orbital dipole due to lone pair is in opposite direction as resultant dipole due to three N-F bonds. Therefore lone pair moment cancels the resultant dipole of N-F bonds.



19. The entropy of all substances at absolute zero (0 K) is taken as zero because of complete order in the system. That is the atoms or molecule do not move at all in the perfectly crystalline state.

$\Delta G^0 = -2.303RT \log K$

= -2.303 x 8.314 J K^{-1} mol^{-1} x 298 K log 6.6 x 10^5

= - 19.147 J x 298 log 6.6 x 10^5

= - 5705.8 [log 6.6 + log 10^5]

= - 5705.8 [0.8195 + 5.0000]

= - 5705.8 x 5.8195 J

= - 33204.903 J

$\Delta G^0 = -33.205 kJmol^{-1}$

20. (a) Critical temperature – It is the temperature above which a gas cannot be liquefied.
    (b) Avogadro law – Equal volumes of all gases contain equal number of molecules at same conditions of temperature and pressure.
    (c) Charles Law – Pressure remaining constant, the volume of a fixed mass of a gas is directly proportional to its absolute temperature.
21. (a) The Lattice Enthalpy of an ionic solid is defined as the energy required to completely separating one mole of a solid ionic compound into gaseous constituent ions.

(b) Bond length is defined as the equilibrium distance between the nuclei of two bonded atoms in a molecule.

(c) Bond angle is defined as the angle between the orbitals containing bonding electron pairs around the central atom in a molecule/complex ion.

22. (a) H_2O is covalent hydride whereas NaH is ionic or saline hydride.

(b) Group 7 to group 9 elements do not form hydrides. This region of periodic table from group 7 to 9 is called as hydride gap.

(c) 1 L of H_2O_2 gives 15 L of O_2 at NTP.

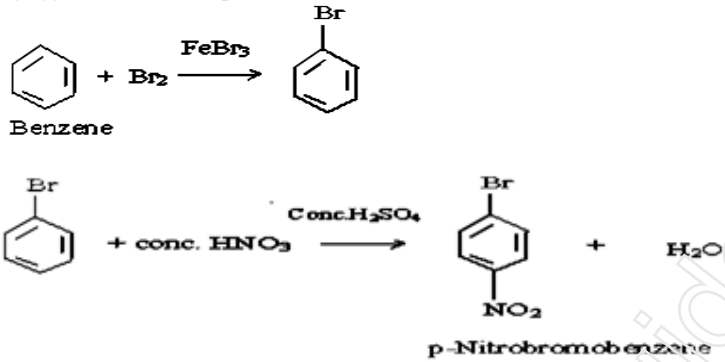
23. (a) Diammonium phosphate.

(b) It is used to produce bio gas.

(c) It will make the soil basic which is not suitable for crops.

(d) Manure does not harm the soil whereas fertilizers harm the soil.

24. (a) (i) Benzene to p-Nitrobromobenzene



(ii) Ethyl chloride to ethane

$CH_3CH_2Cl + Alc.\ KOH \rightarrow CH_2 = CH_2 + KCl + H_2O$

(a) Mechanism of addition of HBr to propene

Step – 1

$CH_3 - CH = CH_2 + H^+ \rightarrow CH_3 - CH_2 - \overset{+}{C}H_2$ (Primary carbocation, less stable)

Step – 2

$CH_3 - CH = CH_2 + H^+ \rightarrow CH_3 - \overset{+}{C}H - CH_3$ (Secondary carbocation, more stable)

Step – 3

$CH_3 - \overset{+}{C}H - CH_3 + Br^- \rightarrow CH_3 - CH(Br) - CH_3$ (Major product)

(b) Friedel- Crafts alkylation - It is the reaction of benzene with alkyl halide in presence of anhydrous aluminium chloride. The reaction results in the formation of alkyl benzene.

$C_6H_6 + CH_3Cl \xrightarrow{Anhy.AlCl_3} C_6H_5CH_3 + HCl$

Or

(a) Write the oxidation no. of each atom

$\underset{+6}{Cr_2}\ \underset{}{O_7^{2-}} + \underset{-1}{C_2}\ \underset{}{H_4O} \rightarrow \underset{0}{C_2}\ \underset{}{H_4O_2} + \underset{+3}{Cr^{3+}}$

(b) Write separately oxidation & reduction half reactions

Oxidation half reaction:

$\underset{-1}{C_2}\ \underset{}{H_4O} \rightarrow \underset{0}{C_2}\ \underset{}{H_4O_2}$

Reduction half reaction:

$\underset{+6}{Cr_2}\ \underset{}{O_7^{2-}} \rightarrow \underset{+3}{Cr^{3+}}$

(c) Balance Cr atoms in reduction half reaction

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

(d) Balance O atoms and H atoms

$C_2H_4O + H_2O \rightarrow C_2H_4O_2 + 2H^+ + 2e^-$

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

(e) Balance the charges

$C_2H_4O + H_2O \rightarrow C_2H_4O_2 + 2H^+ + 2e^-$

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

(e) Equalize the electrons lost and gained by multiplying the oxidation half reaction with 3

$3C_2H_4O + 3H_2O \rightarrow 3C_2H_4O_2 + 6H^+ + 6e^-$

Adding the oxidation half reaction and reduction half reaction we get,

$3C_2H_4O + 3H_2O \rightarrow 3C_2H_4O_2 + 6H^+ + 6e^-$

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

$3C_2H_4O + Cr_2O_7^{2-} + 8H^+ \rightarrow 3C_2H_4O_2 + 2Cr^{3+} + 4H_2O$

25. (a) I and III

(b) I and III

(c) VI and VII

(d) V and VI

(e) Those isomers which differ in position of functional groups are called position isomers. Eg – But-1-ene and But-2-ene and those isomers which differ in functional groups are called functional isomers. Eg – Ethanol and Dimethyl ether.

Or

(a) $C_6H_6 \xrightarrow{CH_3Cl/an.AlCl_3} C_6H_5CH_3 \xrightarrow{(O)/KMnO_4} C_6H_5COOH$

(b) $CH_3CH_2Br \xrightarrow{\text{Wurtz Reaction}} CH_3CH_2CH_2CH_3 \xrightarrow{Cl_2/hv} CH_3CH_2CH_2CH_2Cl \xrightarrow{KOH} CH_3CH_2CH_2CH_2OH$

(c) $CH_2 = CH_2 \xrightarrow{HI} CH_3CH_2I \xrightarrow{KCN} CH_3CH_2CN \xrightarrow{4[H]} CH_3CH_2CH_2NH_2 \xrightarrow{HNO_2} CH_3CH_2CH_2OH \xrightarrow{alc.KOH} CH_3\text{-}CH = CH_2$

(d) $CH \equiv CH \xrightarrow{H_2O/HgSO_4 or H_2SO_4} CH_3CHO \xrightarrow{(O)/KMnO_4} CH_3COOH \xrightarrow{NaOH} CH_3COONa \xrightarrow{\text{decarboxylation/NaOH/CaO}} CH_4$

(e) $CH_3 - CH = CH_2 + HBr \rightarrow CH_3 - CH(Br) - CH_3 + aq.KOH \rightarrow CH_3 - CH(OH) - CH_3$

26. (a) Carbon monoxide:

Industrial preparation:

$2C(s) + O_2(g) \xrightarrow{\text{Limited air}} 2CO(g)$

Laboratory preparation:

$HCOOH \xrightarrow{\text{Conc. sulphuric acid}} CO(g) + H_2O$

Carbon dioxide:

Industrial preparation:

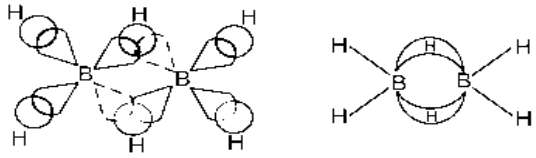
$C(s) + O_2(g) \xrightarrow{\text{Excess air}} CO_2(g)$

Laboratory preparation:

$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$

(b) (i) Forms the most acidic oxide = Carbon (i.e. CO_2).
(ii) Used as semiconductor = Silicon and Germanium.

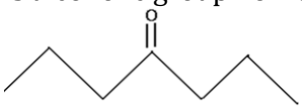
(c) Each boron atom in diborane is sp^3hybridised. Four sp^3 hybrid orbitals adopt tetrahedral arrangement. Two hybrid orbitals of each B atom overlaps with 1s orbital of two H atoms. Of the two hybrid orbitals left on each B atom one contains an unpaired electron while other is vacant. Hybrid orbital containing unpaired electron of one boron atom and vacant hybrid orbital of second boron atom overlaps simultaneously with 1s orbital of H atom to form B-H-B bond, a three centre electron pair bond. The four terminal B-H bonds are regular two centre-two electron bonds while the two bridge (B-H-B) bonds are can be described in terms of three centre–two electron bonds.



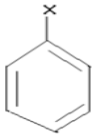
Or

(a) The principal functional group is aldehydic group –CHO and the secondary functional group is alcoholic group –OH and methoxy (- OMe) group.

(b)



(c) For mono-substituted benzene, there is only one isomer.



(d) For disubstituted benzene, there are three isomers.