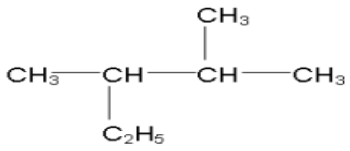
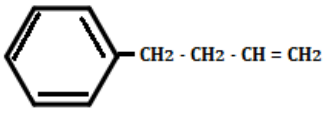
Sample Paper-03
Chemistry (Theory)
Class – XI

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

1. (a)



(b)



2. It will remain the same because the rate of inflow is equal to the rate of outflow. This state is called state of equilibrium.
3. 32.93.
4. (i) $^{138}_{56}Ba$

   (ii) $^{55}_{26}Fe$
5. Due to poor screening effect of 10 d electrons, effective nuclear charge in Ga increases leading to decrease in size.
6. Since NaOH is deliquescent in nature and absorbs both moisture and carbon dioxide from air. The accurate weighing is not possible and not feasible to prepare standard solution of NaOH by weighing.
7. In case of ammonia, only one lone pair of electron is present and due to repulsion between lp – bp, the bond angle between bond pairs is 107^0. In case of water, two lone pairs of electrons are present. Thus lp – lp repulsion is more than lp – bp. So the bond angle is reduced to 104.5^0.

   Or

   The extra-ordinary stability of benzene is due to resonance. Due to this, the π electron cloud gets delocalized resulting in the stability of the molecule.
8. Mass of organic compound = 0.468 g

   Mass of $BaSO_4$ formed = 0.668 g

233 g of $BaSO_4$ contains S = 32 g

0.668 of $BaSO_4$ contains S = 32 x 0.668/233 = 0.917 g

% of S = 0.917/0.468 x 100 = 19.59%

9. No. Here, the rate of evaporation is still constant but since the molecules get dispersed into a large open volume, the rate of condensation from gas to liquid state can never be equal to the rate of evaporates eventually completely.

10. (a) Electronegativity goes on decreasing down in the group due to increase in atomic size.

(b) It goes on increasing along the period due to decrease in atomic size.

11. (i) H_2^+ is more stable than H_2^- as it contains no electron in antibonding MO while latter contains an electron in antibonding MO making it less stable.

(ii) PCl_5 contains axial and equatorial bonds. Axial bonds are longer than equatorial bonds as they face more repulsion from equatorial bonds. Hence axial bonds are weaker than equatorial bonds.

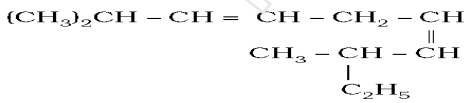
(iii) NaI is more covalent due to high polarizability of iodide than chloride ion.

12. (i) In an open system, there is exchange of energy and matter between system and surroundings. The presence of reactants in an open beaker is an example of an open system. Here the boundary is an imaginary surface enclosing the beaker and reactants.

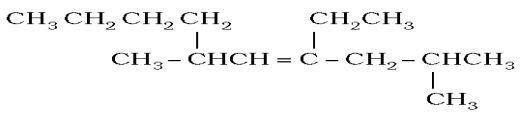
(ii) In a closed system, there is no exchange of matter, but exchange of energy is possible between system and the surroundings. The presence of reactants in a closed vessel made of conducting material e.g. copper or steel is an example of a closed system.

(iii) In an isolated system, there is no exchange of energy or matter between the system and the surroundings. The presence of reactants in a thermos flask or any other closed insulated vessel is an example of an isolated system.

13. (a)

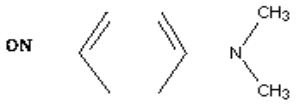


(b)



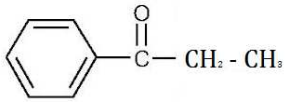
(c)

(d)



(e)

(f)



14. (i) Mass of organic compound = 0.2475 g

Mass of carbon dioxide produced = 0.4950 g

Mass of water produced = 0.2025 g

$$\text{Percentage of Carbon} = \frac{12}{44} \times \frac{\text{Mass of carbon dioxide}}{\text{Mass of compound taken}} \times 100 = 54.54\%$$

$$\text{Percentage of Hydrogen} = \frac{2}{18} \times \frac{\text{Mass of water}}{\text{Mass of compound taken}} \times 100 = 9.09\%$$

(ii) Blood red colouration due to Fe(CNS) will be produced.

15. (i) The change $H_2O(l) \rightarrow H_2O(g)$

$\Delta H = \Delta U + \Delta n_g RT$

$\Delta U = 41.00\ kJ/mol - 1 \times 8.3\ J/mol/K \times 373\ K$

$= 41.00 - 3.096\ kJ/mol = 37.904\ kJ/mol$

(ii) The change $H_2O(l) \rightarrow H_2O(s)$

There is negligible change in volume, so $\rho = \Delta n_g RT = 0$

In this case, $\Delta H \cong \Delta U$

Therefore, $\Delta U = 41.00\ kJ/mol$

16. (i) Due to non-availability of d orbitals, boron is unable to expand its octet. Therefore, the maximum covalence of boron cannot exceed 4 and it cannot form BF_6^{3-} ion.

(ii) $[SiF_6]^{2-}$ is known whereas $[SiCl_6]^{2-}$ is not known since six large size atoms i.e. six chlorine atoms cannot be accommodated around Si but six small size atoms (F atoms) can be comfortably accommodated.

(iii) Conc. HNO_3 can be stored in aluminium container because of the formation of protective layer of oxide which prevents subsequent layers from undergoing reaction with nitric acid.

17. (i) H_2S is oxidised because a more electronegative element, chlorine is added to hydrogen and so get reduced.

(ii) Aluminium is oxidised because oxygen is added to it. Ferrous ferric oxide (Fe_3O_4) is reduced because oxygen has been removed from it.

(iii) With the careful application of the concept of electronegativity only we may infer that sodium is oxidised and hydrogen is reduced.

18. (i) Most of the space in the atom is empty as most of the a–particles passed through the foil undeflected.

(ii) A few positively charged alpha– particles were deflected. The deflection must be due to enormous repulsive force showing that the positive charge of the atom is not spread throughout the atom as Thomson had presumed. The positive charge has to be concentrated in a very small volume that repelled and deflected the positively charged alpha– particles.

(iii) Calculations by Rutherford showed that the volume occupied by the nucleus is negligibly small as compared to the total volume of the atom. The radius of the atom is about 10^{-10} m, while that of nucleus is 10^{-15} m.

19. (i) The functional group may be defined as an atom or group of atoms joined in a specific manner which is responsible for the characteristic chemical properties of the organic compounds. The examples are hydroxyl group (–OH), aldehyde group (–CHO).

(ii) A group or a series of organic compounds each containing a characteristic functional group forms a homologous series and the members of the series are called homologues. The members of a homologous series can be represented by general molecular formula and the successive members differ from each other in molecular formula by a $–CH_2$ unit.

Or

Standard electrode potential values for two half-cell reactions suggest that aluminium has high tendency to make $Al^{3+}(aq)$ ions, whereas Tl^{3+} is not only unstable in solution but is a powerful oxidising agent also. Thus Tl^{+} is more stable in solution than Tl^{3+}. Aluminium being able to form +3 ions easily is more electropositive than thallium.

20. (a) In HCl, the electronegativity difference in Cl and H atoms is 0.9. so it is predominantly covalent in gaseous state.

(b) HF molecules are hydrogen bonded. Therefore, they can associate to form HF_2^- anion which can exist in combination with potassium ion.

(c) The strength of a covalent bond depends on the extent of the overlap. Greater the overlap, stronger is the bond. A sigma bond is formed by the axial overlap of the orbitals which is more effective than the sidewise overlap of pi bond as greater energy will be released in axial overlap.

(d) Both NaCl and $AgNO_3$ are ionic solids. They readily dissociate to form ions in the solution. Silver ions combine with chlorine ions to give white precipitate of AgCl.

21. (i)

	Orbit	Orbital
1	Orbit is a well-defined 2D circular path around the nucleus in which the electrons revolve.	Orbital is a 3D space around the nucleus within which the probability of finding the electrons is maximum.
2	Concept of Orbit is not in accordance with the wave nature of electrons	It is in accordance with the wave nature of electrons
3	Orbits do not have directional characteristics	All orbitals except s-orbitals have directional characteristics

(ii) Uncertainty in speed $\Delta V = \frac{0.005}{100} x 600\,m/s = 0.03\ m\ s^{-1}$

Heisenberg Uncertainty Principle

$$\Delta x \times m\Delta V = \frac{h}{4\pi}$$

$$\Delta x = \frac{6.626 \times 10^{-34}\ Js}{4 \times \frac{22}{7} \times 9.11 \times 10^{-31}\ kg \times 0.03 ms^{-1}} = 1.93 \times 10^{-3} m$$

22. (i) Anions are formed when a neutral atom gains one or more electrons. Since the number of electrons increases and the number of protons remains same, the effective nuclear charge decreases which results in decreases in ionic radii.

(ii) Due to the half-filled orbital nitrogen $1s^2\ 2s^2\ 2p^3$, the stability of this configuration is more and ionization energy is higher than oxygen.

(iii) Due to the smaller size and seven electrons in its outermost shell, incoming electrons experience less attraction in F. hence less energy will be released in case of F than Cl.

23. (a) 0.1 nm

(b) It is done to screen any undesirable or dangerous items carried by passengers.

(c) Life imprisonment for such crimes can be useful to prevent smuggling

24. If S and N both are present, it result in the formation of NaSCN

$Na + S + C + N \rightarrow NaSCN$

It also reacts with Fe^{3+} and gives red colour due to the formation of ferric thiocyanate.$Fe^{3+} + SCN^- \rightarrow [Fe(SCN)]^{2+}$

This takes place when fusion is not carried out in excess of sodium. If excess of sodium is used, then thiocyanate ion will change to NaCN and sodium cyanide.

$NaSCN + 2Na \rightarrow NaCN + Na_2S$

The Prussian blue colour is formed due to the formation of ferric ferro cyanide.

$Fe^{2+} + 6CN^- \rightarrow [Fe(CN)_6]^{4-}$

$3[Fe(CN)_6]^{4-} + 4\ Fe^{3+} + x.\ H_2O \rightarrow Fe_4[Fe(CN)_6]_3.\ x.\ H_2O$

Or

(a) It is based on the principle of differential adsorption.

(b) Different inks have different adsorbing power, therefore it can be detected by chromatography.

(c) Yes.

(d) Liquid on paper is stationary phase and the solution of substance to be separated is mobile phase.

(e) Alumina.

25. (a) Because it is thermally stable.

(b) Because they are biocompatible.

(c) Since they are surrounded by non-polar alkyl groups which is water repelling.

(d) Because they are highly polar and have strong forces of attraction.

(e) Yes.

Or

(i) (a) 'A' is borax ($Na_2B_4O_7.10H_2O$)

(b) The aqueous solution of borax is alkaline to litmus.

$Na_2B_4O_7 + 2H_2O \rightarrow 2NaOH + H_2B_4O_7$

(c) Borax swells to a glassy material on strong heating to give sodium metaborate, 'B'

$Na_2B_4O_7 \xrightarrow{1000K} 2NaBO_2 + B_2O_3$

(d) On adding hot solution of 'A' to conc. HCl, it gives boric acid, 'C'.

$Na_2B_4O_7 + 2HCl + 5H_2O \rightarrow 2NaCl + 4H_3BO_3$

(ii) (a) $2Al + 6HCl \rightarrow 2AlCl_3 + 3H_2$

(b) $8BF_3 + 6LiH \rightarrow B_2H_6 + 6LiBF_4$

26. (i) Heat absorbed by the system (q)= + 701 J

Work done by the system (w) = - 394 J

Change in the internal energy (ΔU) = q + w = + 701 + (- 394) = + 307 J

(ii) $\Delta G^\theta = -2.303\ RT \log K$

Substituting, the values, we get = - 5527.2 J/mol

Or

$$\Delta_f H^\theta = \Delta_{sub} H^\theta + \Delta_{le} H^\theta + \frac{1}{2} \Delta_{diss} H^\theta + \Delta_{eg} H^\theta + \Delta_{lattice} H^\theta$$

$\Delta_{lattice} H^\theta$ = - 839.31 kJ/mol, ΔU^θ = - 10.5 kJ,

Δn (g) = - 1 mol, T = 298 K, R = 8.314 x 10^{-3} kJ/K/mol

$\Delta H^\theta = \Delta U^\theta + \Delta nRT$

Substituting, we get

ΔH^θ = - 12.978 kJ

Substituting the values for $\Delta G^\theta = \Delta H^\theta - T\Delta S^\theta$, we get

ΔG^θ = - 2816.2 J

Since the value of ΔG^θ is negative, the reaction is spontaneous.