SAMPLE PAPER-01
CHEMISTRY (Theory)
Class – XI

Time allowed: 3 hours Maximum Marks: 70

General Instructions:

a) All the questions are compulsory.
b) There are **26** questions in total.
c) Questions **1** to **5** are very short answer type questions and carry **one** mark each.
d) Questions **6** to **10** carry **two** marks each.
e) Questions **11** to **22** carry **three** marks each.
f) Questions **23**is value based question carrying **four** marks.
g) Questions **24**to **26** carry **five** marks each.
h) There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all three questions in five marks each. You have to attempt only one of the choices in such questions.
i) Use of calculators is **not** permitted. However, you may use log tables if necessary.

1. If a metal is higher than a particular metal in electrochemical series, will it be stronger reducing agent or weaker reducing agent? Why?
2. If the critical temperature for carbon dioxide and methane are 31.1^0C and – 81.9^0C respectively, then which of these has strong intermolecular forces? Give reason.
3. Which of these contain the largest number of atoms – 1.0 g Li(s) and 1g Na(s)?
4. Predict the shape of the PH_3 molecule according to VSEPR theory.
5. Give reason: "Metallichydrides are used forstoringhydrogen".
6. Convert:
   a) Carbon to benzene.
   b) Calcium carbide to oxalic acid.
7. How would you calculate the pH of 0.001M NaOH?

Or

Ramesh forgot to add the reaction mixture to the round bottomed flask at 27^oC but instead he placed the flask on the flame. But after sometime, he realized his mistake and used pyrometer and found the temperature of the flask which was 477^oC. What fraction of air would have been expelled out?

8. State the difference between classical smog and photochemical smog.
9. Given the electrode reduction potentials of four metallic elements A, B, C and D = + 0.79, - 0.74, 1.08 and – 0.31 V. Arrange these in order of decreasing electropositive character and support you answer.
10. Give any three factors favourable for the formation of ionic bond.
11.
    i. Which of the two is more stable H_2^+ or H_2^- and why?
    ii. All bonds in PCl_5 are not equal. Explain.
    iii. Which of the two is more ionic - NaCl or NaI and why?
12. Explain the following terms with an example each:
    i) Open system
    ii) Isolated system
    iii) Closed system
13. Draw the structure of the following IUPAC compounds:
    a) 2,8-Dimethyl-3, 6-decadiene
    b) 4-Ethyl-2,6-dimethyl-dec-4-ene
    c) 1,3,5,7 Octatetraene
    d) 4-Nitroso-N-dimethylbenzenamine
    e) Benzene 1,4-dicarboxylic acid
    f) 1-Phenylpropanone
14.
    i) Calculate the percentage of C and H in 0.2475 g of an organic compound gave on combustion 0.4950 g of carbon dioxide and 0.2025 g of water.
    ii) What will happen during Lassaigne's test for nitrogen if the compound also contains sulphur?
15. If water vapour is assumed to be a perfect gas, molar enthalpy change for vapourisation of 1 mol of water at 1bar and 100°C is 41kJmol^{-1}. Calculate the internal energy change, when
    i) 1 mol of water is vaporised at 1 bar pressure and 100°C
    ii) 1 mol of water is converted into ice.
16. Explain:

i. Boron is unable to form BF_6^{3-} ion.

ii. $[SiF_6]^{2-}$ is known whereas $[SiCl_6]^{2-}$ not known.

iii. Conc. HNO_3 can be stored in aluminium container.

17. Identify the species undergoing oxidation and reduction in the reactions given below.

i) $H_2S\ (g) + Cl_2\ (g) \rightarrow 2\ HCl\ (g) + S\ (s)$

ii) $3Fe_3O_4\ (s) + 8\ Al\ (s) \rightarrow 9\ Fe\ (s) + 4Al_2O_3\ (s)$

iii) $2\ Na\ (s) + H_2\ (g) \rightarrow 2\ NaH\ (s)$

18. What are the conclusions made by Rutherford w.r.t the structure of atom?

19. Define the following terms:

i. Functional groups

ii. Homologous series

Or

Predict about the formation of M^{3+} ion in solution and compare the electropositive character of the two metals given. The standard electrode potential values, E^{θ} for Al^{3+}/Al are –1.66 V and that of Tl^{3+}/Tl is +1.26 V.

20. Give reasons:

a) HCl is predominantly covalent in gaseous state.

b) KHF_2 exists while $KHCl_2$ does not.

c) Sigma bond is stronger than the pi bond.

d) NaCl gives white precipitate with silver nitrate solution.

21. Define:

i. Lattice enthalpy

ii. Bond length

iii. Bond angle.

22.

i. Name the class of hydrides to which H_2O and NaH belong.

ii. What do you understand by the term hydride gap?

iii. What do you mean by 15 volume H_2O_2 solution?

23. Ram uses urea and DAP for his crops whereas Shyam uses compost. Ammonia is prepared by Haber's process. It is used for making fertilizers. If it is used in excess, it is harmful for crops.

a) What is DAP?

b) What can be done with waste products?

c) What is the use of avoiding excess of fertilizers?

d) Natural manure is preferred than synthetic fertilizers. Why?

24. Differentiate valency and oxidation number. [Any five points]

Or

Calculate equilibrium concentrations of CO_2, H_2, CO and H_2O in $CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$ at 800 K, if only CO and H_2O are present initially at concentrations of 0.1 M each. [K*c* = 4.24] for the reaction:

25. Explain the rules for calculating oxidation number.

Or

i) Write the chemical reactions when borax solution is acidified.

ii) Explain why BF_3 exists whereas BH_3 does not?

iii) SiO_2 is solid but CO_2 is a gas at room temperature.

26.

a) In which C-C bond of $CH_3CH_2CH_2Br$, the inductive effect is expected to be least?

b) Which of the following compound shows geometrical isomerism?

i. Pent-1-ene

ii. Pent-2-ene

iii. 2-Methylbut-2-ene

c) What type of isomerism is present in the following pairs?

i) $CH_3 - CH_2 - CH_2 - OH$ and $CH_3 - CH(OH) - CH_3$

ii) $CH_3 - CH_2 - CO - CH_2 - CH_3$ and $CH_3 - CO - CH_2 - CH_2 - CH_3$

iii) $CH_3 - CH_2 - OH$ and $CH_3 - O - CH_3$

Or

a) How will you convert ethanoic acid into benzene?

b) "Branched chain hydrocarbons have lower boiling point than straight chain hydrocarbon". Why?

SAMPLE PAPER-01
CHEMISTRY (Theory)
Class – XI

Time allowed: 3 hours **Answers** 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) $2C + H_2 \xrightarrow{\text{Electric arc}} C_2H_2 \xrightarrow{\text{red hot Fe}} C_6H_6$

   (b) $CaC_2 + H_2O \rightarrow C_2H_2 \xrightarrow{\text{Hot } KMnO_4} C_2H_2O_2$
7. $[NaOH] = [OH^-] = 0.001M$

   $[H_3O^+]\,[OH^-] = 1.0 \times 10^{-14}$

   $[H_3O^+] = 10^{-11}$

   $pH = -\log [H_3O^+] = -\log 10^{-11} = 11$

   Or

   $\frac{n_1}{n_2} = \frac{T_2}{T_1}$

   $\frac{750}{300} = \frac{5}{2}$

   $\frac{n_2}{n_1} = \frac{2}{5}$ Thus, the amount of air escaped = $1 - \frac{2}{5} = 0.6$
8.

Classical smog	chemical smog
Occurs in cool humid climate.	s in warm, dry and sunny climate.
It is a mixture of smoke, fog and sulphur dioxide.	onents of photochemical smog result from the action of sunlight on

	unsaturated hydrocarbons & oxides of nitrogen produced by automobiles & factories.

9. Higher the electrode potential lower is its tendency to lose electrons and therefore, lower is the electropositive character of the metal. So the metals are arranged as: B, D, A, C.

10. (a) Low ionization enthalpy of the metal atom.
(b) High electron gain enthalpy of the non-metal atom.
(c) High lattice enthalpy of the compound formed.

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.

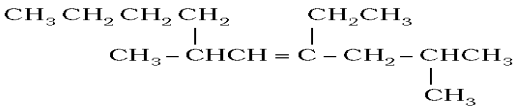
a)

$$(CH_3)_2CH - CH = CH - CH_2 - CH$$

b)

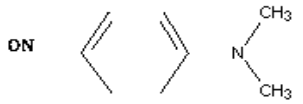
$$CH_3 - CH - C(=CH)$$
$$|$$
$$C_2H_5$$

c)

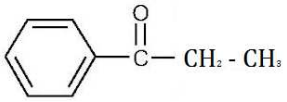


d)

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.

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.

No	Valency	Oxidation Number
1.	It is always a whole number.	It can be even fractional.
2.	It defined as the number of hydrogen atoms which combine with one atom of the element.	It is defined as the charge assigned to an atom of a molecule or ion.
3.	Usually an element has fixed valency in all its compounds.	An element has different valency in different compounds.
4.	It does not have any sign.	It has either positive or negative sign.
5.	Valency of no other element is zero except noble gases.	It can be zero.

Or

$CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$

Initialconcentration

0.1 M 0.1 M 0 0

Let x mole of each of the product be formed.

At equilibrium:

(0.1 – x) M (0.1 – x) M x M x M

Where x is the amount of carbon dioxide and hydrogen at equilibrium.

Hence equlibrium constant can be,

$K_c = K_c = \frac{x^2}{(0.1-x)^2} = 4.24$

$x^2 = 4.24\ (0.01 + x^2 - 0.2x)$

$= 0.0424 + 4.24x^2 - 0.848x$

$3.24x^2 - 0.848x + 0.0424 = 0$

a = 3.24, b = - 0.848, c = 0.0424

for quadratic equation $ax^2 + bx + c = 0$,

$$x = \frac{(-b \pm \sqrt{b^2 - 4ac})}{2a}$$

Substituting the values, we get

$$x = \frac{(0.848 \pm 0.4118)}{6.48}$$

$$x_1 = \frac{(0.848 - 0.4118)}{6.48} = 0.067$$

$$x_2 = \frac{(0.848 + 0.4118)}{6.48} = 0.194$$

The value 0.194 should be neglected because it will give concentration of the reactant which is more than initial concentration.

Hence the equilibrium concentrations are,

$[CO_2] = [H_2] = x = 0.067$ M

$[CO] = [H_2O] = 0.1 - 0.067 = 0.033$ M

25.

1. In elements, in the free or the uncombined state, each atom bears an oxidation number of zero. Evidently each atom in H_2, O_2, Cl_2, O_3, P_4, S_8, Na, Mg, Al has the oxidation number zero.
2. For ions composed of only one atom, the oxidation number is equal to the charge on the ion. Thus Na^+ ion has an oxidation number of +1, Mg^{2+} ion, +2, Fe^{3+} ion, +3, Cl^- ion, –1, O^{2-} ion, –2; and so on. In their compounds all alkali metals have oxidation number of +1, and all alkaline earth metals have an oxidation number of +2. Aluminium is regarded to have an oxidation number of +3 in all its compounds.

3. The oxidation number of oxygen in most compounds is –2. However, we come across two kinds of exceptions here. One arises in the case of peroxides and superoxides, the compounds of oxygen in which oxygen atoms are directly linked to each other. While in peroxides (e.g., H_2O_2, Na_2O_2), each oxygen atom is assigned an oxidation number of –1, in superoxides (e.g., KO_2,RbO_2) each oxygen atom is assigned an oxidation number of –(½). The second exception appears rarely, i.e. when oxygen is bonded to fluorine. In such compounds e.g., oxygen difluoride (OF_2) and dioxygen difluoride (O_2F_2), the oxygen is assigned an oxidation number of +2 and +1, respectively. The number assigned to oxygen will depend upon the bonding state of oxygen but this number would now be a positive figure only.
4. The oxidation number of hydrogen is +1, except when it is bonded to metals in binary compounds (that is compounds containing two elements). For example, in LiH, NaH,and CaH_2, its oxidation number is –1.
5. In all its compounds, fluorine has an oxidation number of –1. Other halogens (Cl,Br, and I) also have an oxidation number of –1, when they occur as halide ions in their compounds. Chlorine, bromine and iodine when combined with oxygen, for example in oxoacids and oxoanions, have positive oxidation numbers.
6. The algebraic sum of the oxidation number of all the atoms in a compound must be zero. In polyatomic ion, the algebraic sum of all the oxidation numbers of atoms of the ion must equal the charge on the ion. Thus, the sum of oxidation number of three oxygen atoms and one carbon atom in the carbonate ion, $(CO_3)^{2-}$ must equal –2.

Or

i) Borax solution on acidification forms boric acid.

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

ii) BF_3 is trigonal planar molecule. Due to pπ - pπ back bonding lone pair of electrons of F is back donated to B atom. This delocalization reduces the deficiency of electrons of boron thereby increasing the stability of BF_3 molecule. Thus, due to absence of lone pair of electrons on H atom this compensation does not occur in BH_3. In other words electron deficiency of B stays & hence it reduces its electron deficiency as BH_3 dimerises to form B_2H_6.

iii) Carbon is able to form pπ – pπ bond with O atom and constitute a stable non - polar molecule O = C = O. Due to weak inter particle force its boiling point is low and it is gas at room temperature. Si on the other hand is not able to from pπ – pπ bond with O atoms because of its relatively large size. In order to complete its octet Si is linked to four O atoms around it by sigma bond & these constitutes network structure, which is responsible for its solidity.

26.

a) The inductive effect is least in C2-C3 bond because the magnitude of inductive effect decreases as the number of intervening bonds increases.

b) Pent-2- ene will show geometrical isomerism.

c) Position isomerism, Metamerism, Functional isomerism.

Or

a) $CH_3COOH \xrightarrow{Aq.NaOH} CH_3COONa \xrightarrow{soda\ lime} CH_4$

$\xrightarrow{Cl_2/hv} CH_3Cl \xrightarrow{Na/dry\ ether} C_2H_6 \xrightarrow{Cl_2} C_2H_5Cl$

$\xrightarrow{alc.\ KOH} CH_2 = CH_2 \xrightarrow{Br_2} 2(C_2H_4Br) \xrightarrow{alc.KOH} CH_2 = CHBr$

$CH_2 = CHBr \xrightarrow{NaNH_2} CH \equiv CH \xrightarrow{Red\ hot\ iron\ tube/873K} C_6H_6$

b) Branched chain hydrocarbons try to acquire spherical shape which has minimum surface area, therefore minimum van der Waals' forces of attraction and hence they have lower boiling point.