SECOND YEAR HIGHER SECONDARY MODEL EXAMINATION MARCH 2021

CHEMISTRY

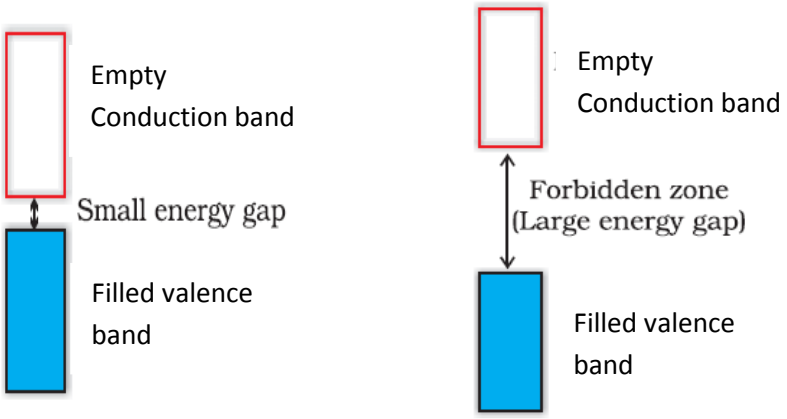
Qn. Code: ME-25 **Maximum Score: 60**

Answer the following questions from 1 to 40 upto a maximum score of 60.

Questions from 1 to 11 carry 2 scores each. **(11 x 2 = 22)**

1. The given lattice is a body centred cubic (bcc) lattice.
   Here the particles are present at the corners of the cube and also one atom at the body centre.
   The number of atoms at the corner = 8×1/8 = 1
   The atom present at the centre of the body is not shared by other atoms.
   So the number of atoms at the body-centre = 1
   Therefore, total number of atoms in the unit cell = 1+1=2 (2)

2.



Semi-conductors Insulators (2)

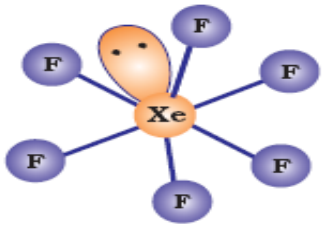
3. Ionic Solids: *Sodium chloride, Zinc sulphide* (1)
   Molecular Solids*: Ice, Solid* NH_3 (1)
4. Isotonic solutions are solutions having same osmotic pressure. (1)
   E.g: Fluid inside our blood cell and 0.9% (mass/volume) NaCl solution. (1)
5. The methods to prevent rusting are:
   a) By giving a non-metallic coating on the metal surface with paint, varnish etc.
   b) By coating the metal surface with electropositive metal like zinc, magnesium etc.
   c) By coating with anti-rust solution.
   d) By connecting the metal with a sacrificial electrode of another metal (like Mg, Zn, etc.) which corrodes itself but saves the iron object (sacrificial protection). ***[Any 2 methods required]*** (2)
6. (i) Overall order of the reaction = 2 (1)
   (ii) Unit of k is L mol^{-1} s^{-1} (1)
7. In chemisorption, the force of attraction between adsorbent and adsorbate is chemical bond. It is irreversible, highly specific, very high heat of adsorption, only unimolecular layer of adsorption occurs, increases with increase in temperature etc. (***Only 2 characteristics required***). (2)
8. When xe is heated with fluorine at 573 K and 60-70 bar pressure, we get XeF_6.

$Xe\ (g) + 3F_2\ (g) \xrightarrow{573K,\ 60\text{-}70bar} XeF_6(s)$
(1:20 ratio)

Or, By the interaction of XeF_4 and O_2F_2 at 143K.

$XeF_4 + O_2F_2 \rightarrow XeF_6 + O_2$ (1)

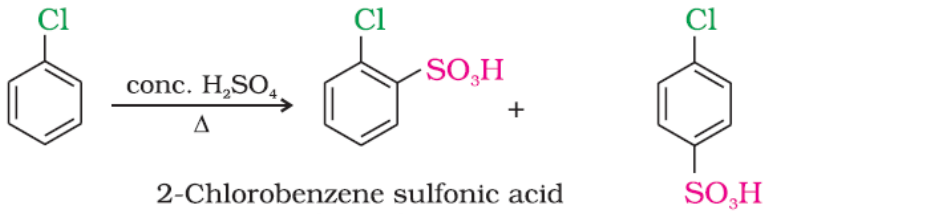
Structure of XeF_6 is distorted octahedral.



Distorted octahedral (1)

9. Inter halogen compounds are compounds of halogen with another halogen. (1)
   E.g. ClF_3, BrF_3, IF_7 etc.
   They are used as non aqueous solvents and as fluorinating agents. [***Only one use is required***] (1)
10. A is 2-chlorobenzenesulphonic acid (o-chlorobenzenesulphonic acid) and B is 4-chlorobenzenesulphonic acid (p-chlorobenzenesulphonic acid)

OR



2-Chlorobenzene sulfonic acid (Minor)

4-Chlorobenzene sulfonic acid (Major)

11. CH_2Cl-COOH is more acidic than CH_3-COOH. This is due to the electron withdrawing inductive effect (-I effect) of Cl atom.

Questions from 12-29 carry 3 scores each.

12. (i) Henry's Law (1)
    (ii) Applications: Preparation of soda water, a condition known as *Bends* in Scuba divers, a medical condition known as *Anoxia* in people living at high altitudes. (**Any 2 applications required**) (2)
13. (i) Ideal solutions are solutions which obey Raoult's law over the entire range of concentration. (1)
    (ii) A mixture of chloroform and acetone shows ***negative deviation from Raoult's law***. This is because here the solvent - solute interaction is greater than solvent – solvent interaction and solute – solute interaction. [Or, A-B interaction is greater than A-A and B-B interactions]. (2)
14. Primary cell is a cell that cannot be recharged or reused. (1)
    E.g.: Dry cell or mercury cell (button cell) (1)
    In dry cell the anode is zinc container and cathode is a graphite rod surrounded by powdered MnO_2 and carbon. [In mercury cell, the anode is zinc –mercury amalgam and cathode is a paste of HgO and carbon]. (1)
15. $Mg/Mg^{2+}//Ag^{+}/Ag$ (1)
    At 298 K, $E_{cell} = E^0_{cell} - \frac{0.0591}{n} \log \frac{[Mg^{2+}]}{[Ag^{+}]^2}$
    Here n = 2, $[Mg^{2+}] = 0.130$ M, $[Ag^{+}] = 0.0001 = 10^{-4}$M and $E^0_{cell} = 3.17$ V
    So, $E_{cell} = 3.17 - \frac{0.0591}{2} \log [0.13/(10^{-4})^2]$
    = **2.96 V** (2)

16. For a first order reaction, the integrated rate law equation is $k = \frac{2.303}{t} \log\frac{[R]_0}{[R]}$ (1)

When $t = t_{1/2}$, $[R] = [R]_0/2$

Substitute these values in the above equation, we get

$k = \frac{2.303}{t_{1/2}} \log\frac{[R]_0}{[R]_0/2}$

Or, $t_{1/2} = \frac{2.303}{k} \log 2 = \frac{2.303 \times 0.3010}{k}$

Or, $\boldsymbol{t_{1/2} = \frac{0.693}{k}}$

This is the expression for half life period for a first order reaction.

17. (i) The process of settling of colloidal particles is called coagulation or precipitation of the sol. (1)

(ii) Lyophilic sols can be coagulated by the following ways:

a) By adding an electrolyte and

b) By adding a suitable solvent. (2)

18. (i) (B) Haematite (1)

(ii) **Hydraulic washing:** This method is used when the gangue is lighter than the ore. The powdered ore is washed in a stream of water. The lighter gangue particles are washed away leaving behind the ore particles. (2)

19. (i) Cryolite (Na_3AlF_6) is added to purified alumina to lower the melting point of alumina and to increase the conductivity. (1)

(ii) Aluminium foils are used as wrappers for chocolates. The fine dust of Aluminium is used in paints and lacquers. Al is also used in the extraction of chromium and manganese from their oxides. Aluminium wires are used as electricity conductors. Al is also used for making alloys.

[***Any 2 uses required***] (2)

20. (i) ***Mond's process:*** In this process, nickel is heated in a stream of carbon monoxide forming a volatile complex, nickel tetracarbonyl ($Ni(CO)_4$).

$Ni + 4CO \xrightarrow{330 - 350K} Ni(CO)_4$

It is then decomposed to Ni and CO by heating at very high temperature.

$Ni(CO)_4 \xrightarrow{450 - 470\ K} Ni + 4CO$ (2)

(ii) (A) Mercury (1)

21. From left to right in lanthanide series, the atomic and ionic radii decrease regularly. This is known as Lanthanoid contraction. (1)

Its consequences are:

a) The 2nd and 3rd row transition series elements have similar radii. E.g. Zr (160 pm) and Hf (159 pm).

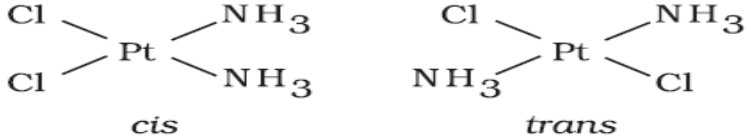
b) Lanthanides have similar physical properties and they occur together in nature. So their isolation is difficult. (2)

22. (i) Transition metals are used as catalysts due to their large surface area and their ability to show variable oxidation state. (2)

(ii) Vanadium pentoxide (V_2O_5) (1)

23. (i) Ionisation isomerism (1)

(ii) Geometrical isomers of $[Pt(NH_3)_2Cl_2]$ are:



(2)

24. (i) (A) $[Co(NH_3)_4(H_2O)_2]Cl_3$ (1)
(B) $K_2[Ni(CN)_4]$ (1)
(ii) $K_2[Ni(CN)_4]$ is homoleptic since it contains only one type of ligand. (1)

25. (i) Ethanol is manufactured by the fermentation of molasses. The sugar in molasses is converted to glucose and fructose, in the presence of an enzyme, *invertase*. Glucose and fructose undergo fermentation in the presence of another enzyme, *zymase* to give ethanol and carbondioxide. (Both the enzymes invertase and zymase are produced by yeast).

$C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{Invertase}} C_6H_{12}O_6 + C_6H_{12}O_6$
Sucrose Glucose Fructose

$C_6H_{12}O_6 \xrightarrow{\text{Zymase}} 2\ C_2H_5OH + 2\ CO_2$
Ethanol (2)

(ii) The commercial alcohol is made unfit for drinking by mixing it with some copper sulphate and pyridine. This process is known as ***denaturation of alcohol.*** (1)

26. (i) This is due to intermolecular hydrogen bonding in alcohols, which is absent in hydrocarbons. (1)
(ii) Ethanol < Propanol < Butan-2-ol < Butan-1-ol (2)

27. (i) Glycosidic linkage (1)
(ii) Difference between DNA and RNA are:

DNA	RNA
DNA is double stranded	RNA is single stranded
The pentose sugar is deoxy ribose	The pentose sugar is ribose
The nitrogen bases are Adenine, Guanine, Cytosine and Thymine.	The nitrogen bases are Adenine, Guanine, Cytosine and Uracil.

[***Only 2 differences required***] (2)

28. (i) (A) Monomer of Nylon 6 is Caprolactam (1)
(B) Monomer of Polystyrene is Styrene (C_6H_5-CH=CH_2) (1)
(ii) (C) Nylon-6,6 (1)

29.

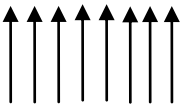
Column – I	Column – II
(i) Antacid	(C) Treatment for acidity
(ii) Tranquilizer	(A) Neurologically active drugs
(iii) Disinfectant	(B) Antimicrobial drugs

(3 x 1 = 3)

Questions from 30 - 40 carry 4 scores each.

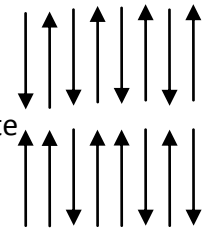
30. (i) **Crystal lattice:** It is the regular three dimensional arrangements of constituent particles of a crystal in space.
(ii) **Void:** It is the vacant space in close packed arrangement.
(iii) **Frenkel defect:** It is the stoichiometric defect arising due to the shifting of a cation from the lattice site to the interstitial site.
(iv) **f-centres:** These are the electrons occupied at the anion vacancies. (4 x 1 = 4)

31. Solids are divided into 5 based on their magnetic properties:
a) Diamagnetic Substances: These are weakly repelled by a magnetic field. They contain only paired electrons. E.g.: H_2O, NaCl, Benzene (C_6H_6)
b) Paramagnetic Substances: They are weakly attracted by a magnetic field. They contain one or more unpaired electrons. They are temporary magnets. Eg: O_2, Cu^{2+}, Fe^{3+}, Cr^{3+} etc.
c) Ferromagnetic Substances: They are very strongly attracted by a magnetic field and can be permanently magnetised. Here the magnetic



moments are aligned in the same direction.
Eg: Fe, Co, Ni, Gd (Gadolinium), CrO_2 etc.

d) <u>Anti-ferromagnetic Substances</u>: Here the magnetic moments are oppositively oriented and cancel each other. So they have no net magnetic moment. Eg: MnO



e) <u>Ferrimagnetic Substances</u>: Here the domains are arranged in opposite directions but in unequal numbers. They are weakly attracted by a magnetic field and have a net magnetic moment.
Eg: Fe_3O_4 (magnetite) and ferrites like $MgFe_2O_4$, $ZnFe_2O_4$ etc.
[***Any 4 required***] (4 x 1 = 4)

32. (i) These are properties which depend on the number of solute particles and not on their nature. (1)
(ii) The important colligative properties are: Relative lowering of Vapour pressure, Elevation of Boiling point, Depression of Freezing point and Osmotic Pressure. [Any 2 required] (1)
(iii) The osmotic pressure (π) = $\frac{w_2RT}{M_2V}$
Here w_2 = 1 g, M_2 = 18500g/mol, V = 450 mL = 0.45 L, T = 37^0C = 37+273 = 310 K, R = 0.0821 Latm $K^{-1}mol^{-1}$.
So, $\pi = \frac{1 \times 0.0821 \times 310}{18500 \times 0.45}$ = 0.003057 = **3.057×10^{-3} atm**

33. (i) Kohlrausch's law states that the limiting molar conductivity of an electrolyte is the sum of the individual contributions of the anion and the cation of the electrolyte. (2)
(ii) According to Kohlrausch's law: $\lambda^0CH_3COOH = \lambda^0m\ (CH_3COONa) + \lambda^0m\ (HCl) - \lambda^0m\ (NaCl)$
= 91.0 + 425.9 – 126.4 = **390.5 S cm^2mol^{-1}**. (2)

34. (i) A is the Arrhenius parameter or frequency factor or pre-exponential factor. (1)
(ii) We know that $\log \frac{k_2}{k_1} = \frac{Ea}{2.303R} \frac{[T_2 - T_1]}{T_1.T_2}$
Here T_1 = 300 K, T_2 = 310 K, R = 8.314 J/K/mol. Let $k_1 = x$, then $k_2 = 2x$
So, $\log (2x/x) = \frac{Ea}{2.303 \times 8.314} \frac{[310 - 300]}{300 \times 310}$
Therefore, Ea = $\frac{2.303 \times 8.314 \times 300 \times 310 \times \log 2}{10}$ = 53598.59 J/mol = **53.599 kJ/mol** (3)

35. (i) **Lyophilic colloid:** It is a colloidal dispersion in which the force of attraction between the dispersed phase and the dispersion medium is strong.
(ii) **Peptization:** It is the process of conversion of a freshly prepared precipitate into a colloid by shaking it with a suitable dispersion medium in presence of small amount of electrolyte.
(iii) **Tyndall effect:** It is the phenomenon of scattering of light beam by colloidal particles.
(iv) **Electrophoresis:** It is the movement of colloidal particles under the influence of an electric field.
(4 x 1 = 4)

36. (i) **Ostwald's process** for the manufacture of Nitric acid involves the following three steps:
1) The oxidation of NH_3 by atmospheric oxygen in presence of platinum/rhodium gauge catalyst.
$4\ NH_3(g) + 5\ O_2(g) \xrightarrow{\text{Pt/Rh gauge catalyst, 500K \& 9 bar}} 4NO(g) + 6\ H_2O(g)$
2) The nitric oxide is converted to NO_2
$2NO(g) + O_2(g) \rightleftharpoons 2\ NO_2\ (g)$
3) Absorption of nitrogen dioxide in water to get nitric acid.
$3\ NO_2(g) + H_2O(l) \longrightarrow 2\ HNO_3(aq) + NO(g)$ (3)

(ii) Nitric acid is used i) in the manufacture of ammonium nitrate for fertilizers and other nitrates for use in explosives and pyrotechnics. ii) for the preparation of nitroglycerin, trinitrotoluene and other organic nitro compounds. iii) in the pickling of stainless steel, etching of metals and as an oxidiser in rocket fuels. [**Any 2 required**] (1)

37. (i) Pent-1-ene and Pent-2-ene (2)
    (ii) Pent-2-ene (1)
    (iii) Saytzeff rule [Zaitsev rule] (1)

38. (i) **HVZ reaction:** In this reaction, a carboxylic acid having α-hydrogen atom is treated with halogen (chlorine or bromine) in the presence of red phosphorus to get α-halocarboxylic acids.

    E.g. CH_3-CH_2-COOH $\xrightarrow[ii)\ H_2O]{i)\ Cl_2/\ Red\ P}$ CH_3-CHCl-COOH + HCl

    Propanoic acid 2-chloropropanoic acid (2)

    (ii) **Cannizzaro Reaction:** Aldehydes having *no α-hydrogen atom,* when treated with conc. alkali (NaOH or KOH) undergo self oxidation and reduction (disproportionation) to form one molecule of the alcohol and one molecule of carboxylic acid salt. This reaction is called Cannizzaro reaction.

    2 HCHO $\xrightarrow{Conc.\ KOH}$ CH_3-OH + H-COOK

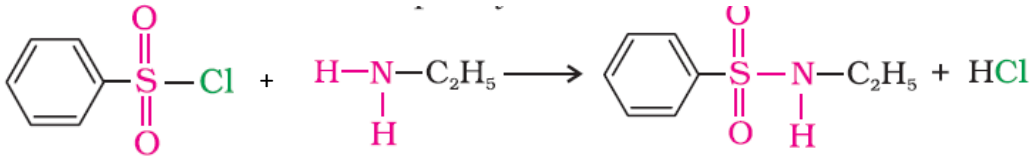
    Formaldehyde methanol potassium formate (2)

39. (i) Ethanal (1)
    (ii) (A) Cyanohydrins
    (B) Acetals (Hemiacetals)
    (C) Oximes (3 x 1 = 3)

40. (i) (A) $(CH_3)_2CHNH_2$ (1)

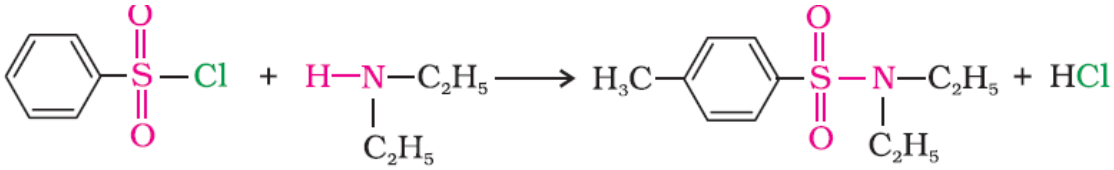
(ii) Benzenesulphonyl chloride ($C_6H_5SO_2Cl$) is known as Hinsberg's reagent. It is used to distinguish the 3 types of amines.

a) Primary amines react with benzenesulphonyl chloride to form a precipitate which is soluble in alkali.



Benzene sulphonylchloride ethanamine N-ethylbenzenesulphonamide

b) Secondary amines react with benzene sulphonyl chloride to give a precipitate, which is insoluble in alkali.



Benzene sulphonylchloride N-ethylethanamine N,N-diethylbenzenesulphonamide

c) Tertiary amines do not react with benzenesulphonyl chloride. (3)

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