Meghalaya Board
Class XI
Chemistry
Sample Paper 1 – Solution

PART-I

1.

(a)

(iii) According to Gay Lussac's law when gases combine or are produced in a chemical reaction they do so in a simple ratio by volume. Thus the volumes of hydrogen and oxygen which combine together (i.e. 100ml and 50ml) bear a simple ratio of 2:1.

(b)

(ii) For an electron in the 5d subshell the value of l = 2 and the magnetic quantum number ml can have values from –l,…0,…+l, meaning ml could not have a value = 3.

(c)

(i) Boyle's law states that - "The volume of a given mass of a dry gas is inversely proportional to its pressure."

(d)

(iii)Solvation of ions or hydration involves interaction among the ions produced in solution and the solvent molecules.

(e)

(i) The oxidation number of Hydrogen is +1 except in binary metal hydrides. For example NaH, here the oxidation state of H is -1 as metals are more electropositive than hydrogen.

(f)

(i)Both LiCl and $MgCl_2$ are deliquescent as they readily dissolve in water which they absorb.

(g)

(i)IUPAC name of the compound COOH-C=C-COOH is But-2-ene-1,4-dioic acid.

(h)

(iv)Cyclopentadienyl cation has only four electrons, therefore it is not aromatic or we can say it is antiaromatic.

PART- II

2. This is because o – nitro phenol has intramolecular hydrogen bonding where as p- nitro phenol has intermolecular hydrogen bonding.

3. CO_2 has a larger bond angle than BF_3. This is because CO_2 has a linear shape and the bond angle is 180°, BF_3 on the other hand has a trigonal planar geometry and hence the bond angle is 120°.

4. Energy change in climbing the hill is a state function. This is because it is independent of the path followed to reach the state.

5. $NaH \xrightarrow{\text{electrolysis}} Na^{+} + H^{-}$

At anode: $2H^{-} - 2e^{-} \longrightarrow H_2(g)$

6. Alkali metals have low ionization energies. They can lose electrons when light falls on them, and hence are used in photo electric cells.

7. The eclipsed conformation of propane is less stable and has more energy than the eclipsed conformation of ethane. This is because in propane there are additional interactions between C-H and C-C bond of methyl group.

8. $O_2NCH_2CH_2O^{-}$ will be more stable because $-NO_2$ group has electron withdrawing inductive effect or – I effect.

9. In Antarctica, ozone depletion is due to the formation of chlorine nitrate.

PART-III

10.

(a) C will have the highest first ionization enthalpy since it has the smallest size and highest effective nuclear charge.

(b) C will have the most negative electron gain enthalpy because of its small size.

11. Statement a is correct and b is incorrect.
Statement b is incorrect because d sub shell can have a maximum of 10 electrons. Therefore it has 10 columns and not 8.

Or

(a) Since the element is in the third period $\therefore n = 3$

The element is in the seventeenth group

$\therefore$ The outermost configuration is: $3s^2 3p^5$

Therefore, the atomic number of the atom is 17.

(b) Cr (Z=24) has 5 electrons in the d sub shell. Its electronic configuration is: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^1$

12.

$$2Al + 2NaOH + 2H_2O \longrightarrow 2NaAlO_2 + 3H_2$$

$2 \text{ x } 27 \qquad\qquad 3 \text{ x } 22.4\text{ L}$

$= 54\text{ g}$

$54\text{ g of Al give } H_2 \quad = 3 \times 22.4\ \text{ L}$

$0.15\text{ g of Al gives } H_2 = \dfrac{3 \times 22.4}{54} \times 0.15$

$= 0.186\ \text{ L}$

So, 0.186 L will be released at 1 bar pressure and 273 K. To calculate volume of H_2 at 20°C and 1 bar pressure,

$V_1 = 0.186\text{ L} \qquad V_2 = ?$

$T_1 = 273\text{ K} \qquad T_2 = (20°C + 273)\text{ K} = 293\text{ K}$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$V_2 = \frac{0.186 \times 293}{273} = 0.1996\text{ L} = 199.6\ \text{ mL}$$

13. Ammonia will liquefy first because its critical temperature will be reached first. Liquefaction of CO2 will require more cooling.

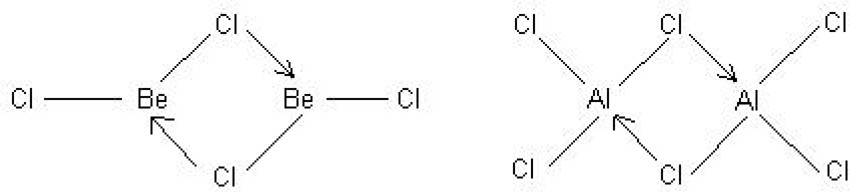
14. $2H_2O + 2F_2 \longrightarrow 4HF + O_2$

F_2 is the oxidizing agent and H_2O is reducing agent.

H_2O is getting oxidized to O_2 whereas F_2 is getting reduced to F^- ion.

15. A is Beryllium (Be)

B is Aluminum (Al)



16. Mg is present in chlorophyll.

N_2 reacts with Mg to form magnesium nitride.

$$3Mg + N_2 \longrightarrow \underset{\text{Magnesium nitride}}{Mg_3N_2}$$

17. Molar mass of Na_2SO_4= (2 x 23)+32+(4 x 16)=142 g mol^{-1}

Mass % of sodium $= \frac{2 \times 23}{142} \times 100 = 32.39\%$

Mass % of sulphur $= \frac{32}{142} \times 100 = 22.53\%$

Mass % of oxygen $= \frac{4 \times 16}{142} \times 100 = 45.07\%$

PART-IV

18. $x_{C_2H_5OH} = \dfrac{n_{C_2H_5OH}}{n_{C_2H_5OH} + n_{H_2O}}$

For dilute solution, 1 L of solution can be nearly equal to 1 L of water.

$n_{H_2O} = \dfrac{1000}{18} = 55.55 \text{ moles}$

$\dfrac{n_{C_2H_5OH}}{n_{C_2H_5OH} + 55.55} = 0.040$

$n_{C_2H_5OH} = 2.31 \text{ moles}$

19.

(a) Atom is empty space. Being able to see the atom and structure of the atom itself means looking at empty space. Hence all of us will be seen as empty space. The wall will be seen as empty space. You and I will be seen as empty space. Hence, Kavita will not be able to see anything. In any other words she will be blind

(b) Praise to the almighty who has limited our abilities such that we are able to enjoy this colourful world.

20.

(a) 7

(b)This means that 6 electrons are present in p sub shell of the 4th shell

(c) Z =29. Electronic configuration $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^1$

Or

(a) Number of electrons in 1 molecule of methane = 6 + 4 =10 electrons

Number of molecules in 1 mole of methane $= 6.022 \times 10^{23}$ molecules of methane

Number of electrons in 1 mole of methane $= 6.022 \times 10^{24}$ electrons

(b) n = 3

$l = 0 \; to (n - 1)$

$= 0, 1,$

For $l = 0$,

$m_l = 0$

For $l = 1$

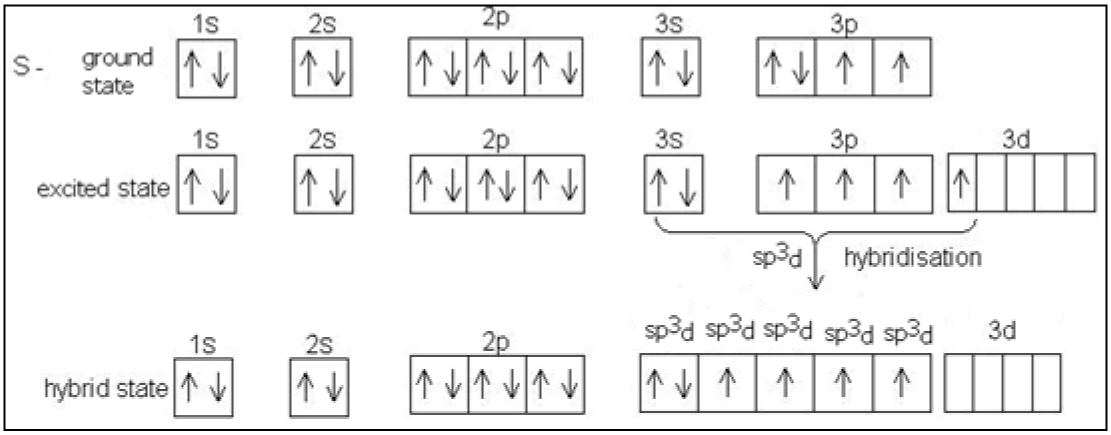
$m_l = -1, 0, +1$

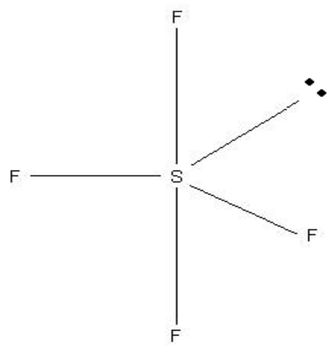
For $l = 2$

$m_l = -2, -1, 0, +1, +2$

21. The electronic configuration of $S = 1s^2 2s^2 2p^6 3s^2 3p^4$

Sulphur undergoes sp^3d hybridization





22.

(a) $K = \frac{[HI]^2}{[H_2]}$

(b) According to Henderson's equation,

$$pOH = pK_b + \log\frac{[salt]}{[base]}$$

Also, $pK_b = -\log K_b$

$$= -\log 1.85 \times 10^{-5} = 4.733$$

$$pOH = 4.733 + \log\frac{0.2}{0.1}$$

$$= 4.733 + 0.3010 = 5.034$$

$$pH = 14 - pOH = 14 - 5.034 = 8.966$$

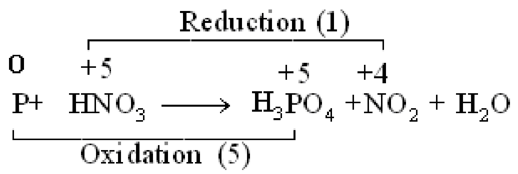
23.

(a) The equilibrium will shift the backward direction as the increase in temperature will be compensated by absorbing heat. It is an exothermic reaction.

(b) The equilibrium will shift in the forward direction since the reaction will shift to the direction of lesser number of moles.

(c) The equilibrium will shift in the forward direction so that additional SO_2 iused up.

24.



$$P + 5\,HNO_3 \longrightarrow H_3PO_4 + 5\,NO_2 + H_2O$$

O = 15 O =15

H = 5 H=5

Oxygen and Hydrogen atoms are balanced

25.

(a) 3 – Methylpentanenitril

(b) 3-Chloropropanal

(c) 4- Nitroaniline

26.

(a) Order of stability

$CH_3\ _3\overset{-}{C},\ CH_3\ _2\overset{-}{C}H, CH_3\overset{-}{C}H_2, \overset{-}{C}H_3$

This is because $-CH_3$ group has electron releasing inductive effect or +I effect. Due to this, electron density increases on the negatively charged carbon and hence makes it more unstable. As the number of methyl groups increases the instability increases.

(b) The negatively charged carbon atom in a carbanion is sp^3 hybridised

Or

PART-V

27. $NH_4Cl(s) \longrightarrow NH_3(g) + HCl(g)$

$\Delta H = 177\ kJ\ mol^{-1}$

$\Delta S = 285 J\ K^{-1} mol^{-1} = 0.285\ kJ\ K^{-1} mol^{-1}$

$T = 25^{o}C = 298\ K$

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

$= 177 - (298 \times 0.285)$

$= +92.07\ kJ\ mol^{-1}$

The reaction will be non-spontaneous. This is because the value of ΔG is positive.

Or

$6C(s) + 3H_2(g) \longrightarrow C_6H_6(l) \quad \Delta_f H^{\theta} = ?$

$C_6H_6(l) + \frac{15}{2} O_2(g) \longrightarrow 6CO_2(g) + 3H_2O(l) \quad \Delta_C H^{\theta} = -3266.0\ kJ$ eqn (1)

$C(s) + O_2(g) \longrightarrow CO_2(g) \quad \Delta_f H^{\theta} = -393.1\ kJ$ eqn (2)

$H_2(g) + \frac{1}{2} O_2(g) \longrightarrow H_2O(l) \quad \Delta_f H^{\theta} = -286.0\ kJ$ eqn (3)

Multiplying equation (2) by 6 and (3) by 3, and adding, (1 x 3)

$6C(s) + 6O_2(g) + 3H_2(g) + \frac{3}{2} O_2(g) \longrightarrow 6CO_2(g) + 3H_2O(l) \quad \Delta H^{\theta} = -3216.6\ kJ$ (1)

Subtracting eqn (4) – eqn (1)

$6C(s) + 3H_2(g) \longrightarrow C_6H_6(l) \quad \Delta_f H^{\theta} = -3216.6 + 3266.0 = +49.4\ kJ\ mol^{-1}$

28.

(b) Kolbe's electrolytic method –

$2CH_3COO^- Na^+ + 2H_2O \xrightarrow{electrolysis} CH_3CH_3 + 2CO_2 + H_2 + 2NaOH$

Mechanism:

$2CH_3-\overset{O}{\overset{\|}{C}}-O^-Na^+ \rightleftharpoons 2CH_3-\overset{O}{\overset{\|}{C}}-O^- + 2Na^+$

At anode:

$2CH_3-\overset{O}{\overset{\|}{C}}-O^- \xrightarrow{-2e^-} 2CH_3-\overset{O}{\overset{\|}{C}}-O \text{ ® } 2\dot{C}H_3 + 2CO_2$

$H_3\dot{C} + \dot{C}H_3 \rightarrow H_3C-CH_3$

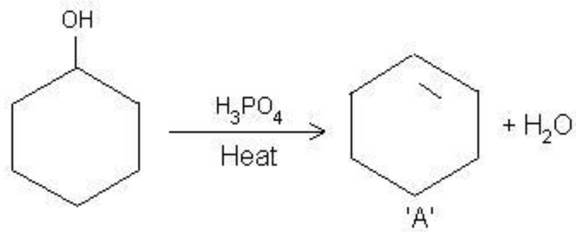
At cathode:

$H_2O + e^- \rightarrow {}^-OH + \dot{H}$

$2\dot{H} \rightarrow H_2 \uparrow$

At cathode hydrogen is liberated. At anode ethane is formed.

Or



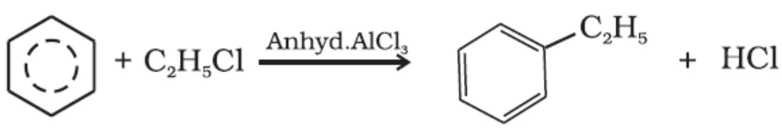
$$CH_3CH = CH_2 + HBr \longrightarrow CH_3\underset{\underset{\text{Br}}{|}}{C}HCH_3$$

'B'

$\downarrow$ (i) O_3 (ii) Zn/H_2O

$CH_3CHO + HCHO$

'C'



'D'

$$CaC_2 + 2\,H_2O \rightarrow Ca(OH)_2 + C_2H_2$$

'E'

29.

(a) Boron has a very small size and has a very high sum of three ionisation nthalpies (IE_1+ IE_2+ IE_3). Therefore, it cannot lose its three electrons to form B^{3+} ions.

(b) $AlBr_3$ is predominantly a covalent compound. Even in molten state it does not have ions which can conduct electricity.

(c) B exhibits +3 oxidation state and can form stable BCl_3. Thallium shows +3 oxidation state as well as +1 oxidation state but +1 oxidation state is more predominant than +3 oxidation state because of inert pair effect. Therefore, $TiCl_3$ is not stable. It can form stable TiCl.

(d) BCl_3 molecule has a symmetrical trigonal planar structure in which three B-Cl bonds are oriented at an angle of 120° to one another. The three bonds lie in one plane and the dipole moments of these bonds cancel one another giving net dipole moment zero.

(e) Electrical conductivity of Aluminium is twice as that of copper. On mass to mass basis, Al conducts electricity twice as Cu. Therefore, it is used in transmission cables.

Or

(a) $$2CH_3Cl + Si \xrightarrow[570K]{\text{Cu powder}} (CH_3)_2SiCl_2$$
Dichlorodimethyl silicon

(b) $$ZnO + CO \xrightarrow{\Delta} Zn + CO_2$$

(c) $$4BF_3 + LiAlH_4 \xrightarrow{\text{diethyl ether}} 2B_2H_6 + 3LiF + 3AlF_3$$

(d) $$2BF_3 + 6NaH \xrightarrow{450K} B_2H_6 + 6NaF$$

(e) $$B_2H_6 + 6H_2O \longrightarrow 2H_3BO_3 + 6H_2$$
Boric acid