

Sample Question Paper – B

1. Seven. 1
2. Bond length is found to be inversely proportional to the bond order. 1
3. $PV = nRT$ 1
4. Oxidation number of O = + 2 in OF_2 and -2 in Na_2O . $\frac{1}{2} + \frac{1}{2}$
5. $CaC_2 + 2D_2O \rightarrow Ca(OD)_2 + DC \equiv CD$ 1

Calcium carbide
Deuteroacetylene
6. The balanced chemical equation is 1

$$2C_4H_{10} + 9O_2 \rightarrow 4CO_2 + 10H_2O$$

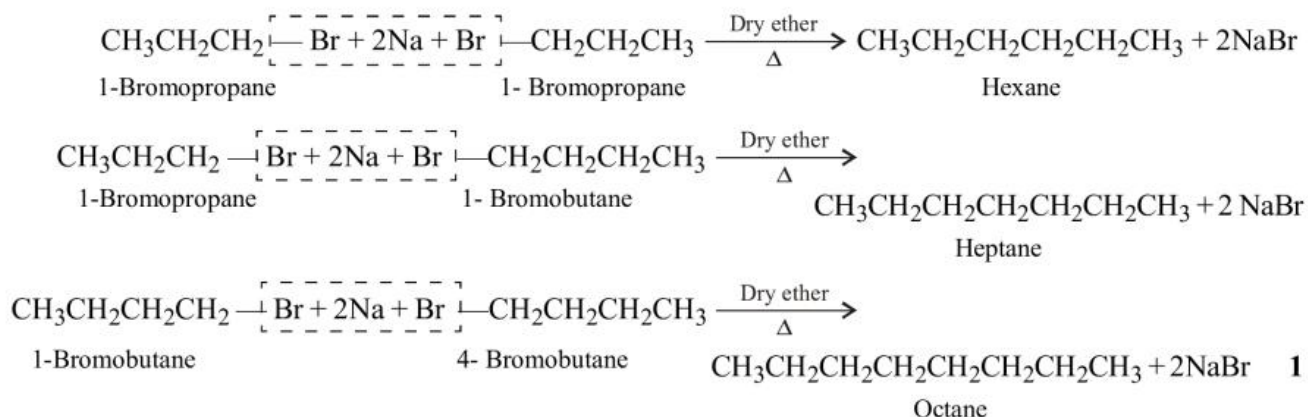
$$2(12 \times 4 + 10) \quad 9(32)$$

116 gm butane react with 288 gm oxygen

$\therefore$ 29 gm butane react with $\frac{288 \times 29}{116} = 72 \text{ g } O_2$ 1
7. Average atomic mass of Cl = $\frac{75.77 \times 34.9689 + 24.23 \times 36.9659}{100}$ 2
 $= 35.453$
8. At equilibrium, $[H_2O] = \frac{1 - 0.40}{10} \text{ mol L}^{-1} = 0.06 \text{ mol L}^{-1}$, $[CO] = 0.06 \text{ mol L}^{-1}$ $\frac{1}{2}$
 $[H_2] = \frac{0.4}{10} \text{ mol L}^{-1}$, $[CO_2] = 0.04 \text{ mol L}^{-1}$ $\frac{1}{2}$
 $K = \frac{[H_2][CO_2]}{[H_2O][CO]} = \frac{0.04 \times 0.04}{0.06 \times 0.06} = 0.444$ 1
9. Pesticides are the chemicals that are used to kill or stop the growth of unwanted organisms. For example DDT (dichlorodiphenyltrichlorethane) and BHC (benzene hexachloride). 1 + 1
10. (iii) and (iv) show geometrical isomerism. 1 + 1

OR

For preparation of alkanes containing odd number of carbon atoms, a mixture of two alkyl halides has to be used. Since, two alkyl halides can react in three different ways, therefore, a mixture of three alkanes instead of the desired alkane would be formed. For example, Wurtz reaction between 1-bromopropane and 1-bromobutane gives a mixture of three alkanes, *i.e.*, hexane, heptanes and octane as shown below : 1



11.

$$\text{Energy (E)} = hc/\lambda : h = 6.6 \times 10^{-34} \text{ Js};$$

$$c = 3 \times 10^8 \text{ ms}^{-1}$$

$\therefore$

$$E = \frac{6.6 \times 10^{-34} \text{ Js} \times 3 \times 10^8 \text{ ms}^{-1}}{4 \times 10^{-7} \text{ m}}$$

$$= 4.97 \times 10^{-19} \text{ J}$$

$$= \frac{4.97 \times 10^{-19}}{1.602 \times 10^{-19}} \quad [1 \text{ eV} = 1.602 \times 10^{-19} \text{ J}]$$

$$= 3.10 \text{ eV}$$

(i) $\therefore$ Energy of the photon in eV = 3.10 1

(ii) Kinetic energy of the emission of photoelectron (K.E.)
 $= h\nu - W_0$ [where W_0 = work function]
 $= 3.10 \text{ eV} - 2.13 \text{ eV} = 0.97 \text{ eV}$ 1

(iii) Velocity of the photoelectron

$$\text{Since K. E.} = mv^2 \text{ or } v^2 = \frac{2 \times \text{K.E.}}{m}$$

or

$$v = \sqrt{\frac{2 \times \text{K.E.}}{m}}$$

$$= \sqrt{\frac{2 \times 0.97 \times 1.602 \times 10^{-19}}{9.1 \times 10^{-31}}}$$

$$= 5.84 \times 10^5 \text{ ms}^{-1}$$
 1

12. Heavy atoms have a heavy nucleus carrying a large amount of charge. Hence, some α -particles are easily deflected back on hitting the nucleus. Also a number of α -particles are deflected through small angles because of large positive charge on the nucleus. If light atoms are used, their nuclei will be light and moreover, they will have small positive charge on the nucleus. Hence, the number of particles deflected back and those deflected through some angle will be negligible. 3

13. (i) $\text{BeCl}_2 = \text{Cl} : \text{Be} : \text{Cl}$. The central atom has only two bond pairs and no lone pair, *i.e.*, it is of the type AB_2 . Hence, shape is linear. $\frac{1}{2}$

(ii) $\text{BCl}_3 = \text{Cl} : \text{B} : \text{Cl}$. The central atom has only 3 bond pairs and no lone pair, *i.e.* it is of the type AB_3 . Hence, shape is **triangular planar**. $\frac{1}{2}$

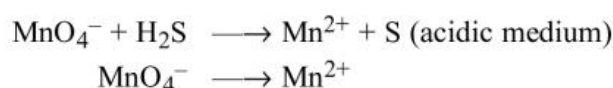
(iii) $\text{SiCl}_4 = \text{Cl} : \text{Si} : \text{Cl}$. Bond pairs = 4, lone pairs = 0, *i.e.*, it is of the type AB_4 . Shape = **Tetrahedral**. $\frac{1}{2}$

(iv) $\text{AsF}_5 = \text{F} : \text{As} : \text{F}$. Bond pairs = 5, lone pair = 0, *i.e.*, it is of the type AB_5 . Shape = **Trigonal bipyramidal**. $\frac{1}{2}$

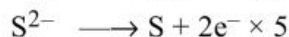
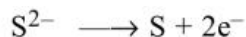
(v) $\text{H}_2\text{S} = \text{H} : \text{S} : \text{H}$. Bond pairs = 2, lone pairs = 2, *i.e.*, it is of the type AB_2L_2 . Shape = **Bent/V-shaped**. $\frac{1}{2}$

(vi) $\text{PH}_3 = \text{H} : \text{P} : \text{H}$. Bond pairs = 3, lone pair = 1, *i.e.*, it is of the type AB_3L . Shape = **Trigonal pyramidal**. $\frac{1}{2}$

14.

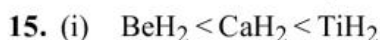


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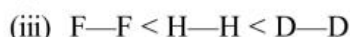
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1



1



1

16. If two cations have the same size and charge, then the one with pseudo noble gas configuration (with 18 electrons in the outermost shell *e.g.*, $Cu^{+} = 2, 8, 18$) has greater polarising power than the other with noble gas configuration (with 8 electrons in the outermost shell *e.g.*, $Na^{+} = 2, 8$). This is known as Fajan's rule. Thus $Cu^{+}Cl^{-}$ is more covalent than $Na^{+}Cl$. That is why $CuCl$ is insoluble in water but $NaCl$ is soluble in water.

3



If s is the solubility of $CaSO_4$ in mol L^{-1} , then $K_{sp} = [Ca^{2+}] \times [SO_4^{2-}] = s^2$

1

Or $s = \sqrt{K_{sp}} = \sqrt{9.1 \times 10^{-6}} = 3.02 \times 10^{-3} \text{ mol L}^{-1} = 3.02 \times 10^{-3} \times 136 \text{ g L}^{-1} = 0.411 \text{ g L}^{-1}$

(Molar mass of $CaSO_4 = 136 \text{ g mol}^{-1}$) 1

Thus, for dissolving 0.411 g, water required = 1 L

$\therefore$ For dissolving 1 g, water required = $\frac{1}{0.411} \text{ L} = 2.43 \text{ L}$

1

18. Radius of the balloon = 10 m

$\therefore$ Volume of the balloon = $\frac{4}{3} \pi r^3 = \frac{4}{3} \times \frac{22}{7} \times (10 \text{ m})^3$
 $= 4190.5 \text{ m}^3$

1

Volume of He filled at 1.66 bar and $27^{\circ} \text{C} = 4190.5 \text{ m}^3$

Calculation of mass of He :

$$PV = nRT = \frac{w}{M} RT \text{ or } w = \frac{MPV}{RT}$$

$$= \frac{(4 \times 10^{-3} \text{ kg mol}^{-1})(1.66 \text{ bar})(4190.5 \times 10^3 \text{ dm}^3)}{(0.083 \text{ bar dm}^3 \text{ K}^{-1} \text{ mol}^{-1})(300 \text{ K})} = 1117.5 \text{ kg}$$

1

Total mass of the balloon along with He = $100 + 1117.5 = 1217.5 \text{ kg}$

Maximum mass of the air that can be displaced by balloon to go up = Volume $\times$ Density

$$= 4190.5 \text{ m}^3 \times 1.2 \text{ kg m}^{-3} = 5028.6 \text{ kg}$$

$\therefore$ Pay load = $5028.6 - 1217.5 \text{ kg} = 3811.1 \text{ kg}$

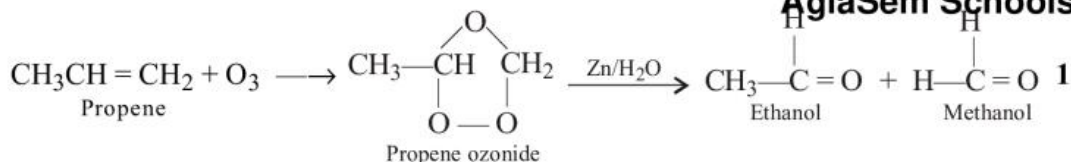
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19. Yes, polluted water is the water whose quality has been degraded by the addition of substances such as chemical effluents, industrial waste, sewage. Oil, fertilizers, detergents, etc. It can be controlled by the following methods :

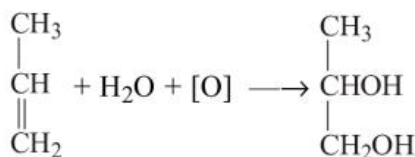
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1. Industrial waste discharge from paper, fertilizers, pesticides, detergents, drugs industries and refineries should not be allowed to get mixed in water bodies such as river, lakes etc. $\frac{1}{2}$
2. Non-biodegradable detergents should be used for cleansing of clothes. $\frac{1}{2}$
3. The pH of water should be checked. $\frac{1}{2}$
4. Excessive use of fertilizers should be prevented. $\frac{1}{2}$

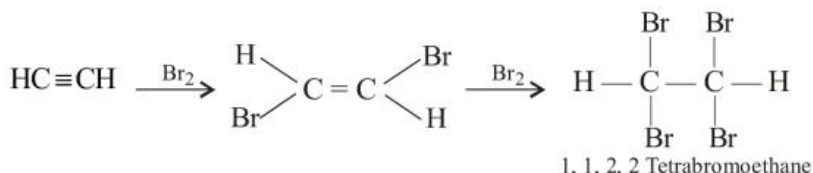
20. (1)



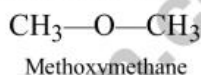
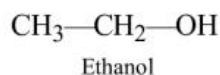
(2)



(3)



21. (1) Compounds having the same molecular formula but different functional groups are called functional isomers and the phenomenon is called functional isomerism. For example,

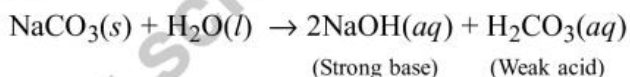


- (2) When a covalent bond joining two atoms A and B breaks in such a way that both the electrons of the covalent bond (*i.e.*, shared pair) are taken away by one of the bonded atoms, the mode of bond cleavage is called heterolytic cleavage.



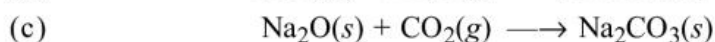
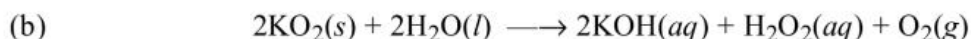
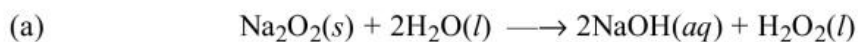
Displacement of σ -electrons along a saturated carbon chain whenever an electron withdrawing (or electron donating) group is present at the end of the chain called the **inductive effect** or the **I-effect**.

22. (a) Na_2CO_3 is a salt of a weak acid, carbonic acid (H_2CO_3) and a strong base, sodium hydroxide (NaOH) therefore, it undergoes hydrolysis to produce strong base NaOH and hence its aqueous solution is alkaline in nature.



- (b) Since the discharge potential of alkali metals is much higher than that of hydrogen, therefore, when the aqueous solution of any alkali metal chloride is subjected to electrolysis, H_2 instead of the alkali metal is produced at the cathode. Therefore, to prepare alkali metals, electrolysis of their fused chlorides is carried out.
- (c) Sodium ions are found primarily in the blood plasma and in the interstitial fluid which surrounds the cells while potassium ions are primarily present within the cell fluids. Sodium ions help in the transmission of nerve signals, in regulating the flow of water across cell membranes and in the transport of sugars and amino acids into the cells. Thus, sodium is found to be more useful than potassium.

OR



23. (i)

Electron gain enthalpy	Electronegativity
(a) It is the property of isolated atoms.	It is the property of a bonded atom.
(b) It can be experimentally measured.	It cannot be measured experimentally. It is only a relative number.

- (ii) The electronegativity of nitrogen will not be 3.0 on all its compounds. It depends upon the other atoms attached to it. Electronegativity also depends on the state of hybridization and the oxidation state of the element. 2

24. (i) Irreversible expansion takes place when external pressure (P_{ext}) remains constant

$$W_{\text{irrev}} = -P_{\text{ext}} (V_2 - V_1) = -P_{\text{ext}} \Delta V \quad 1$$

- (ii) Reversible expansion takes place when internal pressure is infinitesimally greater than external pressure ($P_{\text{int}} \approx P_{\text{ext}}$) at every stage. Thus, external pressure has to be adjusted throughout.

$$W_{\text{rev}} = -nRT \ln \frac{V_2}{V_1} \quad 1$$

- (iii) The expansion is irreversible, Further, as $P_{\text{ext}} = 0$, therefore,

$$w = -P_{\text{ext}} \Delta V = 0 \times (\Delta V) = 0 \quad 1$$

- (iv) When gas is compressed, work is done on the gas. For isothermal reversible compression,

$$w = +nRT \ln \frac{P_2}{P_1} \quad 1$$

- (v) For the adiabatic expansion, temperature falls, *i.e.*, $T_2 < T_1$

$$w = C_v(T_2 - T_1), \text{ i.e., } w \text{ is } -ve \quad 1$$

OR

- (a) $-\Delta G^\circ = RT \ln K$. Thus, if ΔG° is less than Zero *i.e.*, it is $-ve$, then $\ln K$ will be positive and hence K will be greater.. 1

- (b) Under ordinary conditions, the average energy of the reactants may be less than threshold energy. They require some activation energy to initiate the reaction. 2

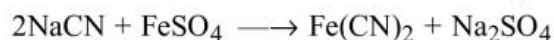
- (c) $\Delta G = \Delta H - T\Delta S$. At low temperature, $T\Delta S$ is small. Hence, ΔH dominates. At high temperatures, $T\Delta S$ is large, *i.e.*, ΔS dominates the value of ΔG . 2

25. **Preparation of Lassaigne's filtrate**—A pea-sized and dried fresh piece of sodium is put in a small ignition tube and heated till sodium melts. A pinch of the given organic compound (or a drop of it if it is a liquid) is now added to the fused sodium and heated again to red hot. The fusion tube contents are now transferred to a china dish containing 10–15 ml of distilled water. The tube breaks and contents are boiled in the China dish. The solution, after filtration, is called **Lassaigne's filtrate**.



From organic compound

Now to an part of L. F., freshly prepared FeSO_4 is added when the following reaction occur. A small amount of H_2SO_4 is added. A Prussian blue colour confirms the presence of nitrogen in organic compound.



Sodium hexacyanoferrate (II)



Iron (III) hexacyanoferrate(II)

(Prussian blue)

If S is present



When lead acetate $\text{Pb}(\text{CH}_3\text{COO})_2$ is added in a small quantity of L.F. and acidified with acetic acid, a black ppt. of PbS is obtained; S alone is present in the organic compound. 1

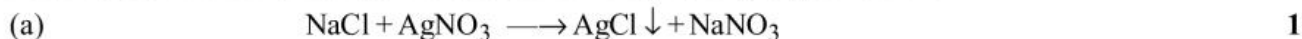


Black ppt.



From the organic compound

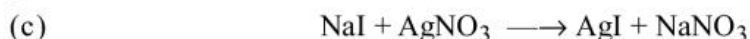
L.F. is boiled with dil. HNO_3 and cooled. A few drops of AgNO_3 are added.



If a **white ppt.** is **obtained** which is soluble in ammonia solution, but insoluble in HNO_3 , the organic compound contains chlorine. 1



Formation of a pale yellow precipitate partially soluble in excess of ammonia solution indicate the presence of bromine



Yellow ppt.

A yellow ppt. insoluble in ammonia solution indicates the presence of iodine in the organic compound. 1

OR

Estimation of phosphorus : A known mass of an organic compound is heated with fuming HNO_3 , phosphorus is oxidized to phosphoric acid. It is precipitated as ammonium phosphomolybdate $(\text{NH}_4)_2\text{P}_2\text{O}_7$ by adding HNO_3 and ammonium molybdate (molar mass of ammonium phosphomolybdate = 1877)

Let the mass of organic compound taken = m g

Mass of ammonium phosphomolybdate = m_1 g

$$\% \text{ of phosphorus} = \frac{31 \times m_1 \times 100}{1877 \times m} \quad 3$$

Estimation of oxygen : There is no direct method for the estimation of oxygen in a given organic compound. It is estimated by subtracting the sum of the percentages of all other elements in the compound from 100.

$$\text{Percentage of oxygen} = 100 - (\% \text{ of all other elements}) \quad 2$$

26. (a) Carbon monoxide is very toxic because it combines with haemoglobin in the blood preventing its function as an oxygen carrier. It is particularly dangerous because it is odourless and therefore, is not easily detected. 2

- (b) (i) **Inert pair effect :** It is defined as the tendency of s -electrons to remain together or the reluctance of s -electrons to participate in a reaction, because the energy required to unpair the ns^2 electrons is not compensated by energy released in forming the additional bonds. 1

(ii) **Allotropy :** The phenomenon of existence of a chemical element in two or more forms differing in physical properties but having same chemical nature is known as **allotropy**. This phenomenon is due to the difference either in the number of atoms in the molecules, *e.g.*, in O_2 and O_3 or arrangement of atoms in the molecules in graphite. 1

(iii) **Catenation :** The tendency of formation of long open or closed chains by the combination of same atoms is known as **catenation**. It is maximum in carbon and decreases down the group, *e.g.*, $\text{C} \gg \text{Si} > \text{Ge} = \text{Sn} \gg \text{Pb}$. 1

OR

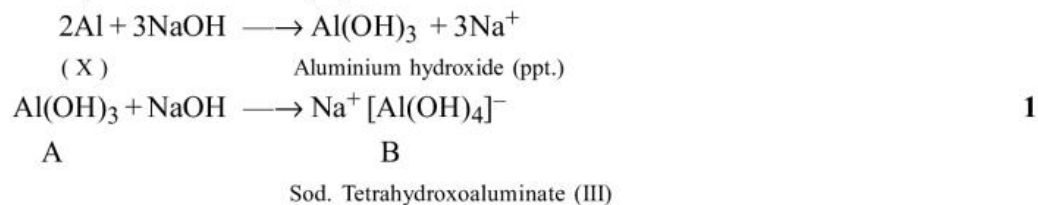
- (a) Aluminium shows a uniform oxidation of +3. Like aluminium, Tl also shows +3 oxidation state in some of its compounds like TlCl_3 , Tl_2O_3 , etc. Like Al, Tl also forms octahedral complexes : $[\text{AlF}_6]^{3-}$ and $[\text{TlF}_6]^{3-}$.

Group 1 metals shown an oxidation state of +1. Like group 1 metals. Tl due to inert pair effect also shows +1 oxidation state in some of its compounds such as Tl_2O , TlCl , TlClO_4 etc.

Like group 1 oxides, Tl_2O is strongly basic. 2

- (b) Since metal X reacts with NaOH to first give a white ppt. (A) which dissolves in excess of NaOH to

give a soluble complex (B), therefore, metal (X) must be Al; ppt (A) must be $\text{Al}(\text{OH})_3$ and complex (B) must be sodium tetrahydroxoaluminate (III).



Since (A), *i.e.*, $\text{Al}(\text{OH})_3$ reacts with dil. HCl to give compound (C), therefore, (C) must be AlCl_3 .



Since (A) on heating gives (D) which is used to extract metal (*i.e.*, electrolysis of Al_2O_3 gives Al metal), Therefore, (D) must be alumina (Al_2O_3).



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