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**SAMPLE PAPER-02**  
**CHEMISTRY (Theory)**  
**Class - XI**

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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.
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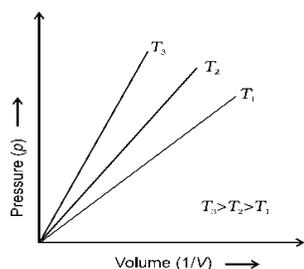
1. Draw the structure of
  - a) 2,3-Dimethylpentane
  - b) 4-Phenylbut-1-ene
2. If a tank is full of water coming in and out at the same rate, then what will happen to the level of water in a tank?
3. Express 32.392800 to four significant figures.
4. Write the correct symbol for the nucleus with:
  - i. Atomic number 56 and mass number 138
  - ii. Atomic number 26 and mass number 55.
5. Why is Ga smaller in size than Al?
6. (a) Name the energy which arises due to motion of atoms or molecules in a body.  
(b) How is this energy affected when the temperature is increased?

**Or**

Give the relationship between isothermal and free expansion of an ideal gas.

7. Predict the formulae of the stable binary compounds that would be formed by the combination of the following pairs of elements:
    - a) Element 71 and F
-

- 
- b) Al and I  
c) Si and O  
d) P and F.
8. Why the bottle containing hydrogen peroxide should be cooled before opening?
9. Why Be and Mg does not give colour to flame than the alkaline earth metals?
10. Calculate the molality of the solution if the density of 3M solution of NaCl is 1.25g/mL.
11. (a) Give the importance of measuring BOD of a water body.  
(b) What is desirable concentration of fluoride ion pH of drinking water?  
(c) Give the harmful effect of nitrogen dioxide.
12. (a) Define:  
i) Intensive properties  
ii) Adiabatic process  
(b) Derive  $\Delta G = -T\Delta S_{\text{total}}$  from the relationship  $G = H - TS$ .
13. We know that 75% of solar energy reaching the earth, is absorbed by earth's surface increases its temperature. The rest of heat radiates back to the atmosphere. Some of the heat is trapped by gases such as CO, CH<sub>4</sub>, O<sub>3</sub>, CFC's and water vapours present in the atmosphere. This causes global warming.  
a) Suggest some measures to decrease CO gas in the atmosphere.  
b) Give a method to save ozone layer.  
c) Will the use of solar energy solve our problems? Comment.
14. Comment on the graph below.

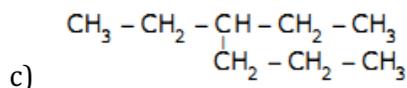
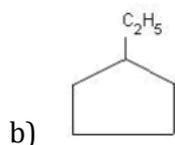
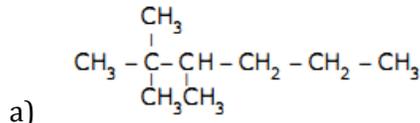


15. If the density of 3M solution of NaCl is 1.25g/mL, calculate the molality of the solution.
16. Calculate the standard enthalpy of formation of one mole of CH<sub>3</sub>OH (l), if the combustion of one mole of methanol takes place at 298 K and 1 atm and after combustion CO<sub>2</sub> (g) and H<sub>2</sub>O (l) are produced and 726 kJ of heat is liberated. Assume that the standard enthalpies of formation of CO<sub>2</sub> (g) and H<sub>2</sub>O (l) are - 393 kJ/mol and -286 kJ mol respectively.
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17. What are the uses of sodium carbonate?
18. Describe in detail the expanded octet with suitable examples.
19. How would you prepare alkanes from alkenes?
20. (a) Calculate the concentration of hydroxyl ion in 0.1 M solution of ammonium hydroxide having  $K_b = 1.8 \times 10^{-5}$ , if  $K_{sp}$  value of two sparingly soluble salts  $Ni(OH)_2$  and  $AgCN$  are  $2 \times 10^{-15}$  and  $6.0 \times 10^{-17}$  respectively.
- (b) Which salt is more soluble?

Or

- a) When certain buffer is made by mixing sodium formate and formic acid in water, explain how it neutralizes an addition of a small amount of an acid or a base.
- b) When a basic buffer is made by mixing ammonium hydroxide and ammonium nitrate in water, explain how it resists change in its pH on addition of a small amount of an acid or a base.
21. (i) Draw the structural isomers of pentane.
- (ii) Give the IUPAC names of the following compounds.

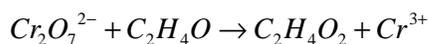


22. What are the factors made Thomson to argue about the amount of deviation of the particles from their path in the presence of electrical or magnetic field depends upon?
23. During an educational trip, class XI students saw a beautiful lake in a village. They noticed that some villagers were washing clothes around the lake and at some places waste material from houses was destroying its beauty. After few years back, one of the student went to the same lake again and saw the lake was covered with algae, stinking smell and the water becomes unusable. Explain the reason for this condition.
24. a) Convert :
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- 
- i) Benzene to p-nitrobromobenzene  
ii) Ethyl chloride to ethene.
- b) Give mechanism of addition of HBr to propene.
- c) Write a note on Friedel-Crafts alkylation.

**Or**

Balance the following equation in acidic medium by half reaction method.



25. From the structures given below, answer the questions.

- I.  $CH_3 - CH_2 - CH(OH) - CH_3$   
II.  $(CH_3)_2 - C(OH) - CH_3$   
III.  $CH_3 - CH_2 - CH_2 - CH_2 - OH$   
IV.  $CH_3 - O(CH_3) - CH - CH_3$   
V.  $CH_3 - O - CH_2 - CH_2 - CH_3$   
VI.  $CH_3 - CH_2 - O - CH_2 - CH_3$   
VII.  $CH_3 - CH(CH_3) - CH_2 - OH$
- a) The pair of compounds that represent chain isomerism.  
b) The pair of compounds that represent position isomerism.  
c) The pairs of compounds which are functional group isomers.  
d) The compounds that form pairs of metamers.  
e) Distinguish between position and functional isomerism with an example.

**Or**

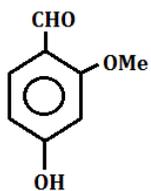
Convert the following:

- a) Benzene to Benzoic acid  
b) Bromoethane to Butan-1-ol  
c) Ethene to Propene  
d) Ethyne to Methane  
e) Propene to Propan-2-ol
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26. (a) Give one method for industrial preparation and one for laboratory preparation of  $\text{CO}$  and  $\text{CO}_2$  each.
- (b) Select the member(s) of group 14 that i) forms the most acidic dioxide ii) used as semiconductors.
- (c) Explain structure of Diborane.

Or

- a) Identify the functional groups in the following:



- b) Draw the bond notation of heptan-4-one.
- c) Give the possible isomers for mono substituted
- d) Give the possible isomers for di substituted benzene?
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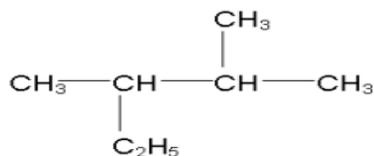
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Time allowed: 3 hours

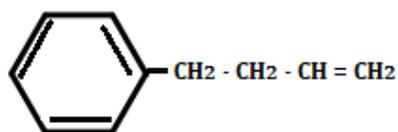
**Answers**

Maximum Marks: 70

1.



a)

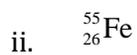
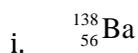


b)

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.



5. Due to poor screening effect of 10 d electrons, effective nuclear charge in Ga increases leading to decrease in size.

6.

a) Kinetic energy.

b) It increases with increase in temperature.

Or

Work done in isothermal reversible expansion of an ideal gas

$$W = -2.303 nRT \log V_2/V_1 = -2.303 nRT \log P_1/P_2$$

In the free expansion of an ideal gas,  $w = 0$  because ideal gases have negligible force of attraction, therefore work done is zero in free expansion because no external force is acting.

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$$W = - P_{\text{ext}}\Delta V$$

$$P_{\text{ext}} = 0; w = 0$$

7.

- a)  $\text{LuF}_3$
- b)  $\text{AlI}_3$
- c)  $\text{SiO}_2$
- d)  $\text{PF}_5$

8. Hydrogen peroxide is unstable and so decomposes in water and oxygen on long standing or heating. Hence to lower the vapour pressure inside the bottle, it is cooled before opening.

9. Due to small size, the ionization energy of Be and Mg are much higher than alkaline earth metals. So they need large amount of energy for excitation of electrons to higher energy levels. This energy is not available in Bunsen flame and so do not impart any colour to the flame.

10. Molarity = 3M

$$\text{Density} = 1.25\text{g/mL}$$

Mass of NaCl in 1L solution

$$= \text{Molarity} \times \text{molar mass} = 3 \times 58.5 = 175.5\text{g}$$

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

$$\text{Mass of 1L NaCl solution} = 1.25 \times 1000 = 1250\text{g}$$

$$\text{Mass of water in solution} = 1250 - 175.5 = 1074.5\text{g} = 1.0745 \text{ kg}$$

$$\text{Molality} = \frac{\text{No. of moles of solute}}{\text{Mass of water}} = \frac{3}{1.0745} = 2.79 \text{ m}$$

11.

- a) BOD is a measure of level of pollution caused by organic biodegradable material. Low value of BOD means water is less polluted.
- b) 1 ppm is desirable concentration of fluoride ions in drinking water. The pH of drinking water should be between 5.5 – 9.5.
- c) Nitrogen dioxide is extremely toxic to living tissues and harmful to plants, paints, textiles and metals. It causes acid rain. It produces photochemical smog.

12.

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a)

- i) The properties which depend only on the nature of the substance and not on the amount of the substance are called intensive properties. Example: Density.
- ii) A process in which no heat flows between the system and the surroundings is called an adiabatic process i.e.  $q=0$ .

b) Change in Gibbs energy,  $\Delta G = G_2 - G_1$ ,

Enthalpy change,  $\Delta H = H_2 - H_1$ ,

Entropy change,  $\Delta S = S_2 - S_1$ ,

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

$$\Delta S_{\text{total}} = \Delta S_{\text{system}} + \Delta S_{\text{surrounding}}$$

$$\Delta S_{\text{total}} = \Delta S_{\text{system}} - \frac{\Delta H_{\text{sys}}}{T}$$

$$\Delta S_{\text{total}} = \Delta S - \frac{\Delta H}{T}$$

Multiply by T,

$$T\Delta S_{\text{total}} = T\Delta S - \Delta H$$

$$T\Delta S_{\text{total}} = \Delta H - T\Delta S = \Delta G$$

Therefore,  $\Delta G = -T\Delta S_{\text{total}}$

13.

- a) Using CNG as a fuel, using public transports, electric cars and bicycles and avoiding burning of dry leaves, plastic bags etc.
- b) Banning CFCs used in refrigerators, AC etc., and using less amount of diesel and petrol.
- c) Yes. Solar energy reduces pollution. By making green building, a lot of natural light and natural cooling and heating takes place which save lot of energy and environment.

14. It represents the graph between  $p$  and  $1/V$ . It is a straight line passing through origin. However at high pressures, gases deviate from Boyle's law and under such conditions a straight line is not obtained in the graph.

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15. Molarity = 3M

Density = 1.25g/mL

Mass of NaCl in 1L solution

= Molarity x molar mass = 3 x 58.5 = 175.5g

Density = Mass/Volume

Mass of 1LNaCl solution = 1.25 x 1000 = 1250g

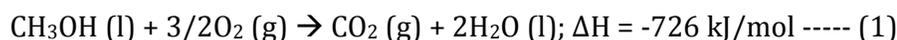
Mass of water in solution = 1250-175.5 = 1074.5g = 1.0745 kg

Molality = No. of moles of solute/Mass of water

$$= \frac{3}{1.0745} = 2.79 \text{ m}$$

16.

a) Combustion of methanol:



b) Enthalpy of formation of carbon dioxide:



c) Enthalpy of formation of water:



d) Required reaction:



$$\Delta\text{H} = (-572 - 393) - 726 = -239 \text{ kJ/mol}$$

17.

a) It is used in water softening, laundering and cleaning.

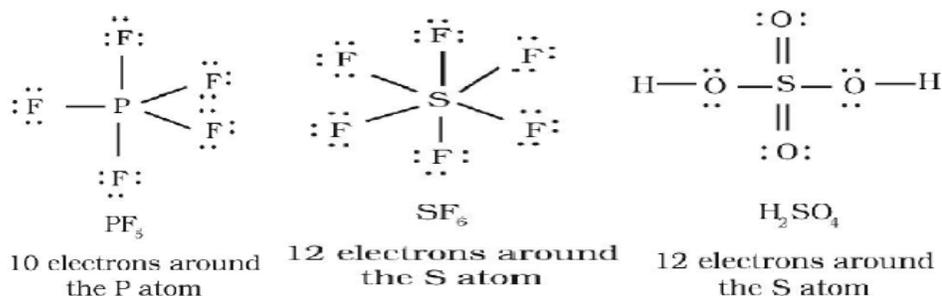
b) It is used in the manufacture of glass, soap, borax and caustic soda.

c) It is used in paper, paints and textile industries.

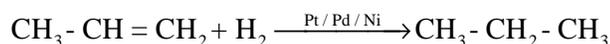
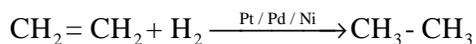
d) It is an important laboratory reagent both in qualitative and quantitative analysis.

18. Elements in and beyond the third period of the periodic table have, apart from 3s and 3p orbitals, 3d orbitals also available for bonding. In a number of compounds of these elements there are more than eight valence electrons around the central atom. This is termed as the expanded octet. Obviously the octet rule does not apply in such cases. Some of the examples of such compounds are: PF<sub>5</sub>, SF<sub>6</sub>, H<sub>2</sub>SO<sub>4</sub> and a number of coordination compounds.

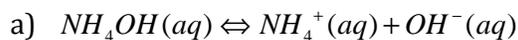
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19. Dihydrogen gas adds to alkenes and alkynes in the presence of finely divided catalysts like platinum, palladium or nickel to form alkanes. This process is called hydrogenation. These metals adsorb dihydrogen gas on their surfaces and activate the hydrogen – hydrogen bond. Platinum and palladium catalyze the reaction at room temperature but relatively higher temperature and pressure are required with nickel catalysts.



20.



$$K_b = \frac{[NH_4^+][OH^-]}{[NH_4OH]}$$

$$[NH_4^+] = [OH^-]$$

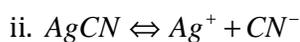
$$[NH_4OH] = 0.1M$$

$$K_b = \frac{[OH^-]^2}{[NH_4OH]}$$

$$[OH^-]^2 = 1.8 \times 10^{-5} \times 0.1$$

$$= 0.18 \times 10^{-5}$$

$$\therefore [OH^-] = 1.34 \times 10^{-3} \text{ mol/L}$$



Let x mol/L be the solubility of AgCN

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Thus  $[Ag^+] = x$

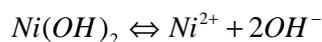
$[CN^-] = x$

$$K_{SP} = [Ag^+][CN^-] = X^2$$

$$x = \sqrt{K_{SP}}$$

$$= \sqrt{6.0 \times 10^{-17}}$$

$$= 7.75 \times 10^{-9}$$



Let  $y$  mol/L be the solubility of  $Ni(OH)_2$

Thus  $[Ni^{2+}] = y$  &  $[OH^-] = 2y$

$$K_{SP} = [Ni^{2+}][OH^-]^2$$

$$= y \times (2y)^2 = 4y^3$$

$$y = \left(\frac{K_{SP}}{4}\right)^{1/3}$$

$$y = \left(\frac{2 \times 10^{-17}}{4}\right)^{1/3}$$

$$y = \sqrt[3]{0.5 \times 10^{-17}}$$

Since solubility of  $Ni(OH)_2$  is more than  $AgCN$ ,  $Ni(OH)_2$  is more soluble than  $AgCN$ .

Or

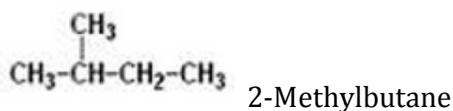
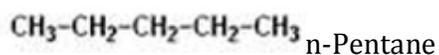
- a) Here,  $HCOO^-$  is common ion. So when small amount of hydrogen ions are added, it combines with  $HCOO^-$  which are in excess to form  $HCOOH$  and  $H^+$  remains the same. So pH remains constant. When a small amount of hydroxide ions are added, hydroxide ions take up hydrogen ions and so dissociation of  $HCOOH$  will increase so as to maintain concentration of hydroxide ions. So pH is not affected.
  - b) Here, ammonium ions are common ions. So when a small amount of hydrogen ions are added, hydrogen ion will take up hydroxide ion and dissociation of ammonium hydroxide will increase so as to maintain hydroxide constant. So, pH remains
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constant. When a small amount of hydroxide ions are added, ammonium ions which are in excess will combine with hydroxide ions to form ammonium hydroxide back so as to maintain hydroxide constant. So, pH remains constant.

21.

- i. There are three structural isomers of pentane:



ii.

- a) 2, 2, 3-Trimethylhexane  
b) Ethylcyclopentane  
c) 3-Ethylhexane

22.

- i) The magnitude of the negative charge on the particle, greater the magnitude of the charge on the particle, greater is the interaction with the electric or magnetic field and thus greater is the deflection.
- ii) The mass of the particle — lighter the particle, greater the deflection.
- iii) The strength of the electrical or magnetic field — the deflection of electrons from its original path increases with the increase in the voltage across the electrodes, or the strength of the magnetic field.

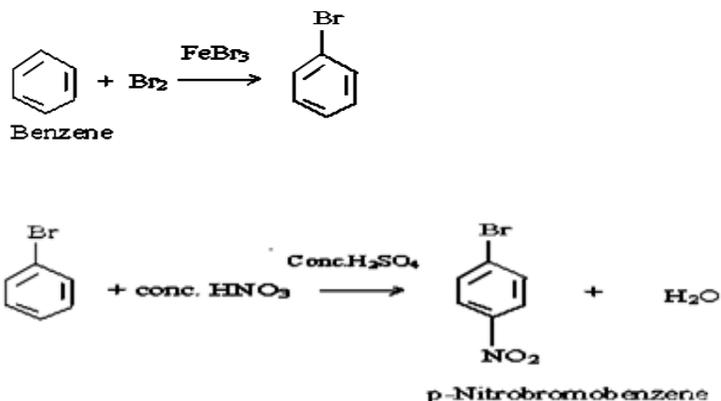
23. Since villagers were washing clothes around the lake and at some places waste materials from houses were thrown into lake and so the lake was covered with algae and it was giving stinking smell due to the decomposition of domestic waste material. It may be also due to eutrophication. The phosphate from detergents and organic matter enters the lake along with the domestic waste.

24.

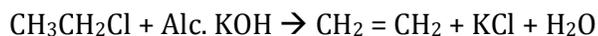
- a)
-

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(i) Benzene to p-Nitrobromobenzene



ii) Ethyl chloride to ethane



a) Mechanism of addition of HBr to propene

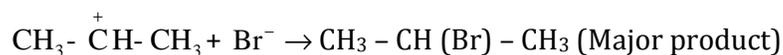
Step - 1



Step - 2



Step - 3

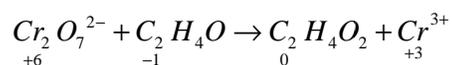


b) Friedel-Crafts alkylation - It is the reaction of benzene with alkyl halide in presence of anhydrous aluminium chloride. The reaction results in the formation of alkyl benzene.



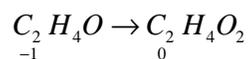
Or

a) Write the oxidation no. of each atom



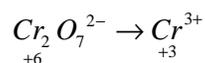
b) Write separately oxidation & reduction half reactions

Oxidation half reaction:

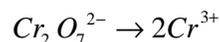


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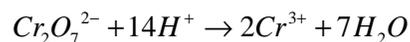
Reduction half reaction:



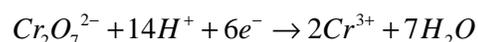
c) Balance Cr atoms in reduction half reaction



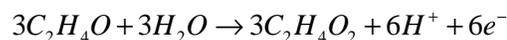
d) Balance O atoms and H atoms



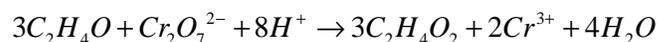
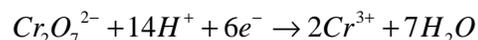
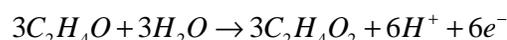
e) Balance the charges



f) Equalize the electrons lost and gained by multiplying the oxidation half reaction with 3



Adding the oxidation half reaction and reduction half reaction we get,



25.

a) I and III

b) I and III

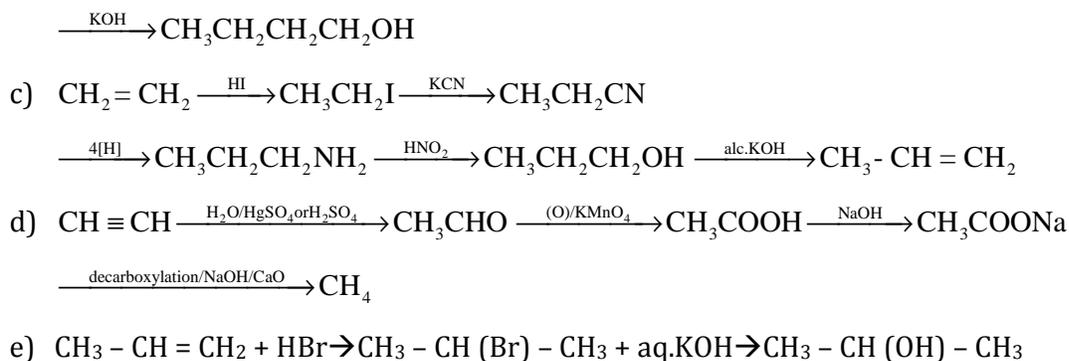
c) VI and VII

d) V and VI

e) Those isomers which differ in position of functional groups are called position isomers. Eg - But-1-ene and But-2-ene and those isomers which differ in functional groups are called functional isomers. Eg - Ethanol and Dimethyl ether.

Or



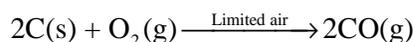


26.

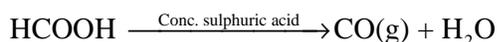
a)

Carbon monoxide:

Industrial preparation:

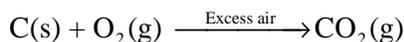


Laboratory preparation:



Carbon dioxide:

Industrial preparation:



Laboratory preparation:



b)

- i. Forms the most acidic oxide = Carbon (i.e.  $\text{CO}_2$ ).
- ii. Used as semiconductor = Silicon and Germanium.

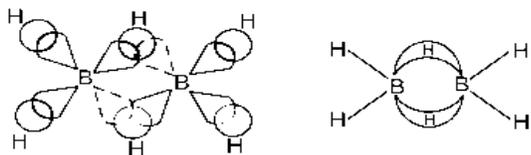
c)

Each boron atom in diborane is  $\text{sp}^3$  hybridised. Four  $\text{sp}^3$  hybrid orbitals adopt tetrahedral arrangement. Two hybrid orbitals of each B atom overlaps with 1s orbital of two H atoms. Of the two hybrid orbitals left on each B atom one contains an unpaired electron while other is vacant. Hybrid orbital containing unpaired electron of one boron atom and vacant hybrid orbital of second boron atom overlaps simultaneously with 1s orbital of H atom to form B-H-B bond, a three centre electron pair bond. The four terminal B-H bonds are regular two centre-two electron bonds

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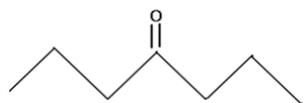
while the two bridge (B-H-B) bonds are can be described in terms of three centre-two electron bonds.



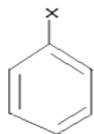
Or

a) The principal functional group is aldehydic group -CHO and the secondary functional group is alcoholic group -OH and methoxy (- OMe) group.

b)



c) For monosubstituted benzene, there is only one isomer.



d) For disubstituted benzene, there are three isomers.

