CBSE SAMPLE PAPER-02

CBSE Class – XI

CHEMISTRY

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.

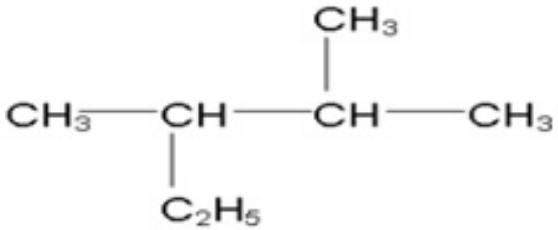
1. Draw the structure of

a) 2,3-Dimethylpentane

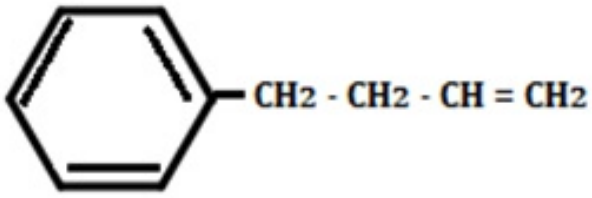
b) 4-Phenylbut-1-ene

Ans.

a)



b)



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?

Ans. 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. Express 32.392800 to four significant figures.

Ans. 32.93.

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.

Ans. (i) $^{138}_{56}\mathrm{Ba}$

(ii) $^{55}_{26}\mathrm{Fe}$

5. Why is Ga smaller in size than Al?

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

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.

Ans. (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.

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

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

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.

Ans. (a) LuF_3

(b) AlI_3

(c) SiO_2

(d) PF_5

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8. Why the bottle containing hydrogen peroxide should be cooled before opening?

Ans. 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.

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9. Why Be and Mg does not give colour to flame than the alkaline earth metals?

Ans. 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.

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10. Calculate the molality of the solution if the density of 3M solution of NaCl is 1.25g/mL.

Ans. Molarity = 3M

Density = 1.25g/mL

Mass of NaCl in 1L solution

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

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

Mass of 1L NaCl solution = 1.25 x 1000 = 1250g

Mass of water in solution

= 1250-175.5 = 1074.5g = 1.0745 kg

Molality = $\frac{\text{No. of moles of solute}}{\text{Mass of water}}$

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

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.

Ans. (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. (a) Define:

i) Intensive properties

ii) Adiabatic process

(b) Derive $\Delta G = -T\Delta S_{total}$ from the relationship G=H – TS.

Ans. (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, $\Delta S = S_2 - S_1$,

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

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

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

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

Multiply by T,

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

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

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

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_4, O_3, 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.

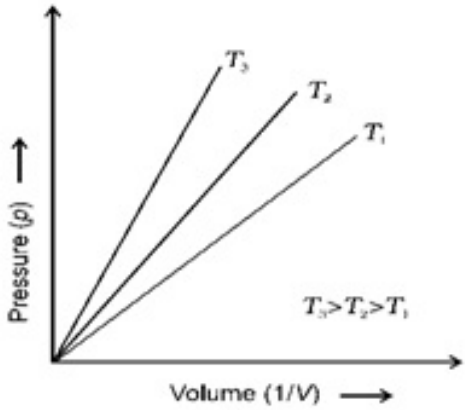
c) Will the use of solar energy solve our problems? Comment.

Ans. (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. Comment on the graph below.



Ans. 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.

15. If the density of 3M solution of NaCl is 1.25g/mL, calculate the molality of the solution.

Ans. Molarity = 3M

Density = 1.25g/mL

Mass of NaCl in 1L solution

= Molarity $\times$ molar mass = = 3 $\times$ 58.5 = 175.5g

Density = Mass/Volume

Mass of 1LNaCl solution = 1.25 $\times$ 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 m

16. Calculate the standard enthalpy of formation of one mole of CH_3OH (l), if the combustion of one mole of methanol takes place at 298 K and 1 atm and after combustion CO_2 (g) and H_2O (l) are produced and 726 kJ of heat is liberated. Assume that the standard enthalpies of formation of CO_2 (g) and H_2O (l) are - 393 kJ/mol and -286 kJ mol respectively.

Ans. Combustion of methanol:

(a) CH_3OH (l) + 3/2O_2 (g) $\rightarrow$ CO_2 (g) + 2H_2O (l); ΔH = -726 kJ/mol --- (1)

(b) Enthalpy of formation of carbon dioxide:

C(graphite) + O_2 (g) $\rightarrow$ CO_2 (g) ; ΔH = - 393 kJ/mol --- (2)

(c) Enthalpy of formation of water:

H_2 (g) + ½ O_2 (g) $\rightarrow$ H_2O (l); ΔH = - 286 kJ/mol --- (3)

(d) Required reaction:

C(graphite) + 2H_2 (g) + 1/2 O_2 $\rightarrow$ CH_3OH (l) ; ΔH = ? --- (4)

ΔH = (– 572 – 393) – 726 = – 239 kJ/mol

17. What are the uses of sodium carbonate?

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

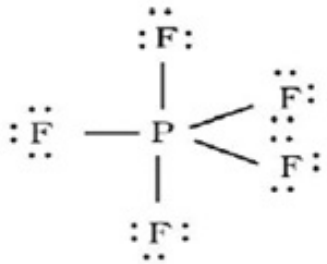
(b) It is used in the manufacture of glass, soap, borax and caustic soda.

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

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

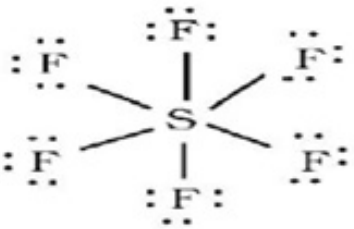
18. Describe in detail the expanded octet with suitable examples.

Ans. 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_5, SF_6, H_2SO_4 and a number of coordination compounds.



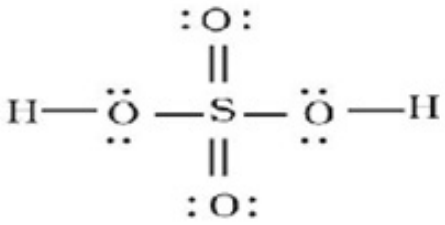
PF_5

10 electrons around the P atom



SF_6

12 electrons around the S atom



H_2SO_4

12 electrons around the S atom

19. How would you prepare alkanes from alkenes?

Ans. 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 catalyses the reaction at room temperature but relatively higher temperature and pressure are required with nickel catalysts.

$$CH_2 = CH_2 + H_2 \xrightarrow{Pt\,/\,Pd\,/\,Ni} CH_3\text{-}\,CH_3$$

$$CH_3\text{-}\,CH = CH_2 + H_2 \xrightarrow{Pt\,/\,Pd\,/\,Ni} CH_3\text{-}\,CH_2\text{-}\,CH_3$$

20. (a) Caculate the concentration of hydroxyl ion in 0.1 M solution of ammonium hydroxide having K_b = 1.8 x 10^{-5}, if K_{sp} value of two sparingly soluble salts $Ni(OH)_2$ and AgCN are 2 x 10^{-15} and 6.0 x 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.

Ans.

(a) $NH_4OH(aq) \Leftrightarrow NH_4{}^+(aq) + OH^-(aq)$

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

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

$[NH_4OH] = 0.1M$

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

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

$= 0.18 \text{ x } 10^{-5}$

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

ii. $AgCN \Leftrightarrow Ag^+ + CN^-$

Let x mol/L be the solubility of AgCN

Thus $[Ag^+] = x$

$[CN^-] = x$

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

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

$= \sqrt{6.0 \text{ x } 10^{-17}}$

$= 7.75 \text{ x } 10^{-9}$

$Ni(OH)_2 \Leftrightarrow Ni^{2+} + 2OH^-$

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

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

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

= y x $(2y)^2$ = 4 y^3

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

$y = \left(\frac{2x10^{-1}}{4}\right)^{1/3}$

$y = \sqrt[3]{0.5x10^5}$

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

Or

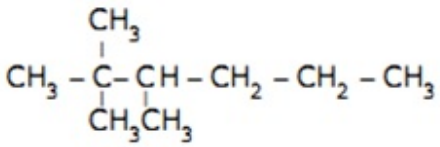
a) Here, $HCOO^-$ is common ion. So when small amount of hydrogen ions are added, it combines with $HCOO^-$ which are in excess to form HCOOH and H^+ remains the same. So pH remains constant. When a small amount of hydroxide ions are added, hydroxide ions take up hydrogen ions and so dissociation of 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 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.

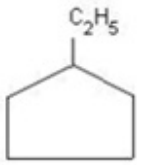
21. (i) Draw the structural isomers of pentane.

(ii) Give the IUPAC names of the following compounds.

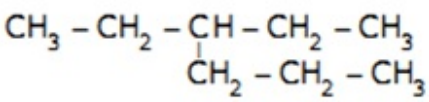
a)



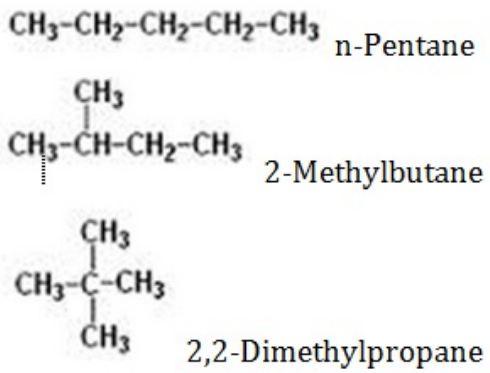
b)



c)



Ans. i. There are three structural isomers of pentane:



ii.a) 2, 2, 3-Trimethylhexane

b) Ethylcyclopentane

c) 3-Ethylhexane

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?

Ans. (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. 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.

Ans. 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) Convert :

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.

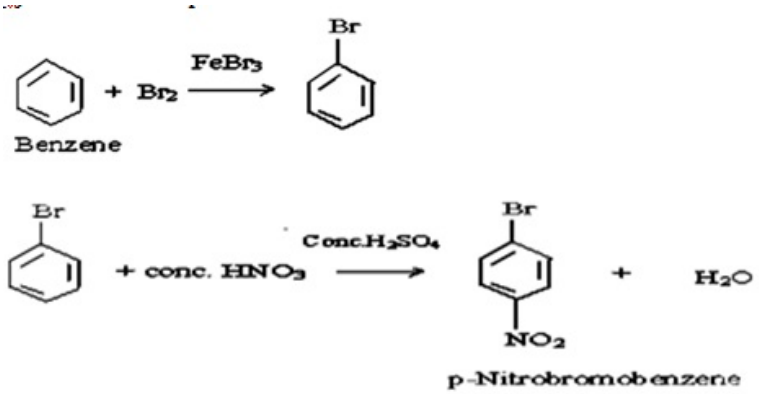
Or

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

$Cr_2O_7{}^{2-} + C_2H_4O \rightarrow C_2H_4O_2 + Cr^{3+}$

Ans. a)

(i) Benzene to p-Nitrobromobenzene



ii) Ethyl chloride to ethane

CH_3CH_2Cl + Alc. KOH $\rightarrow$ CH_2 = CH_2 + KCl + H_2O

b) Mechanism of addition of HBr to propene

Step – 1

$$\mathrm{CH_3\text{-}\ CH = CH_2 + H^+ \rightarrow CH_3\text{-}\ CH_2\text{-}\ \overset{+}{C}H_2}$$

(Primary carbocation, less stable)

Step – 2

$$\mathrm{CH_3\text{-}\ CH = CH_2 + H^+ \rightarrow CH_3\text{-}\ \overset{+}{C}H\text{-}\ CH_3}$$

(Secondary carbocation, more stable)

Step – 3

$$\mathrm{CH_3\text{-}\ \overset{+}{C}H\text{-}\ CH_3 + Br^- \rightarrow}$$

CH_3 – CH (Br) – CH_3 (Major product)

c) 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.

$$\mathrm{C_6H_6 + CH_3Cl \xrightarrow{Anhy.AlCl_3} C_6H_5CH_3 + HCl}$$

Or

a) Write the oxidation no. of each atom

$$\underset{+6}{Cr_2O_7}^{2-} + \underset{-1}{C_2}H_4O \rightarrow \underset{0}{C_2}H_4O_2 + \underset{+3}{Cr}^{3+}$$

b) Write separately oxidation & reduction half reactions

Oxidation half reaction:

$$\underset{-1}{C_2}H_4O \rightarrow \underset{0}{C_2}H_4O_2$$

Reduction half reaction:

$$\underset{+6}{Cr_2O_7}^{2-} \rightarrow \underset{+3}{Cr}^{3+}$$

c) Balance Cr atoms in reduction half reaction

$$Cr_2O_7{}^{2-} \rightarrow 2Cr^{3+}$$

d) Balance O atoms and H atoms

$$C_2H_4O + H_2O \rightarrow C_2H_4O_2 + 2H^+ + 2e^-$$

$$Cr_2O_7{}^{2-} + 14H^+ \rightarrow 2Cr^{3+} + 7H_2O$$

e) Balance the charges

$$C_2H_4O + H_2O \rightarrow C_2H_4O_2 + 2H^+ + 2e^-$$

$$Cr_2O_7{}^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$$

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

$$3C_2H_4O + 3H_2O \rightarrow 3C_2H_4O_2 + 6H^+ + 6e^-$$

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

$$3C_2H_4O + 3H_2O \rightarrow 3C_2H_4O_2 + 6H^+ + 6e^-$$

$$Cr_2O_7{}^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$$

$$3C_2H_4O + Cr_2O_7{}^{2-} + 8H^+ \rightarrow 3C_2H_4O_2 + 2Cr^{3+} + 4H_2O$$

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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

Ans. (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

$$a)\ C_6H_6 \xrightarrow{CH_3Cl/an.AlCl_3} C_6H_5CH_3 \xrightarrow{(O)/KMnO_4} C_6H_5COOH$$

$$b)\ CH_3CH_2Br \xrightarrow{\text{Wurtz Reaction}} CH_3CH_2CH_2CH_3 \xrightarrow{Cl_2/hv}$$

$$CH_3CH_2CH_2CH_2Cl \xrightarrow{KOH} CH_3CH_2CH_2CH_2OH$$

$$c)\ CH_2 = CH_2 \xrightarrow{HI} CH_3CH_2I \xrightarrow{KCN} CH_3CH_2CN$$

$$\xrightarrow{4[H]} CH_3CH_2CH_2NH_2 \xrightarrow{HNO_2} CH_3CH_2CH_2OH$$

$$\xrightarrow{alc.KOH} CH_3 - CH = CH_2$$

$$d)\ CH \equiv CH \xrightarrow{H_2O/HgSO_4 or H_2SO_4} CH_3CHO$$

$$\xrightarrow{(O)/KMnO_4} CH_3COOH \xrightarrow{NaOH} CH_3COONa$$

$$\xrightarrow{decarboxylation/NaOH/CaO} CH_4$$

$$e)\ CH_3 - CH = CH_2 + HBr \grave{a} CH_3 - CH(Br) - CH_3 + aq.KOH$$

$$\rightarrow CH_3 - CH\ (OH) - CH_3$$

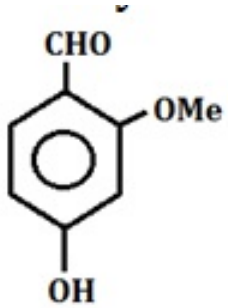
26. (a) Give one method forindustrial preparationandone forlaboratory preparation of CO and CO_2 each.

(b) Select themember(s) of group 14that 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?

Ans.

(a)Carbon monoxide:

Industrial preparation:

$$2C(s) + O_2(g) \xrightarrow{\text{Limited air}} 2CO(g)$$

Laboratory preparation:

$$HCOOH \xrightarrow{\text{Conc. sulphuric acid}} CO(g) + H_2O$$

Carbon dioxide:

Industrial preparation:

$$C(s) + O_2(g) \xrightarrow{\text{Excess air}} CO_2(g)$$

Laboratory preparation:

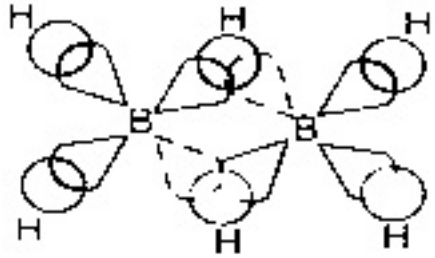
$CaCO_3$ (s) + 2HCl (aq) $\rightarrow$ $CaCl_2$(aq) + CO_2 (g) + H_2O (l)

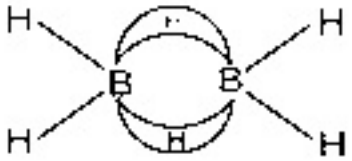
(b) i. Forms the most acidic oxide = Carbon (i.e. CO_2).

ii. Used as semiconductor = Silicon and Germanium.

(c) Each boron atom in diborane is sp^3 hybridised. Four 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 while the two bridge (B-H-B) bonds are can be described in terms of three centre–two electron bonds.

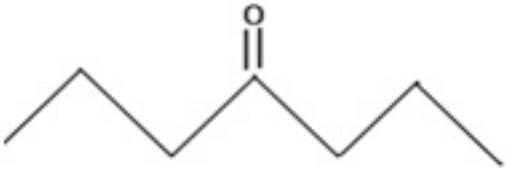




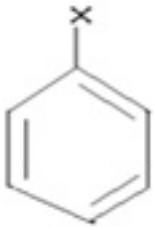
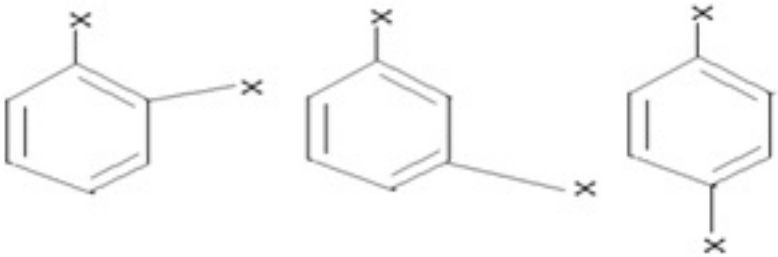
Or

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.