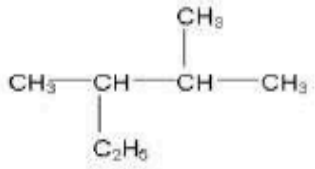
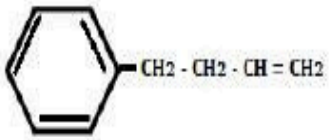
Class 11 Chemistry Sample Paper 2022-23 Solution

Answers

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.
   i. $^{138}_{56}Ba$
   ii. $^{55}_{26}Fe$

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.

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

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

7.

a) LuF_3

b) AlI_3

c) SiO_2

d) 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

Density = 1.25g/mL

Mass of NaCl in 1L solution

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

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

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

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

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

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.

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.

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.

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:

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

b) Enthalpy of formation of carbon dioxide:

$C_{(graphite)} + O_2\ (g) \rightarrow CO_2\ (g)\ ;\ \Delta H = -393\ kJ/mol$ ---------- (2)

c) Enthalpy of formation of water:

$H_2\ (g) + \frac{1}{2}\ O_2\ (g) \rightarrow H_2O\ (l);\ \Delta H = -286\ kJ/mol$ ---------- (3)

d) Required reaction:

$C_{(graphite)} + 2H_2\ (g) + 1/2\ O_2 \rightarrow CH_3OH\ (l)\ ;\ \Delta H = ?$ ---------- (4)

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

17.

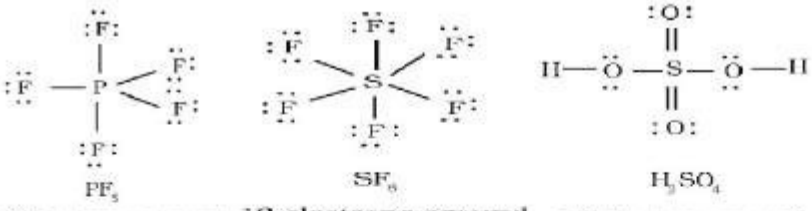
a) It is used in water softening, laundering and cleaning.

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 3*s* and 3*p* orbitals, 3*d* 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. 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.

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

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

20.

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

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

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

$$[NH_4OH] = 0.1M$$

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

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

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

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

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

Let x mol/L be the solubility of AgCN

Thus $[Ag^+] = x$

$[CN^-] = x$

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

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

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

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

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

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

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

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

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

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

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

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

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

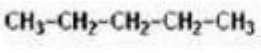
Or

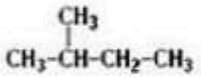
a) Here, $HCOO^-$ is common ion. So when small amount of hydrogen ions are added, it combines with $HCOO^-$ which are in excess to form HCOOH and H^+ remains the same. So pH remains constant. When a small amount of hydroxide ions are added, hydroxide ions take up hydrogen ions and so dissociation of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

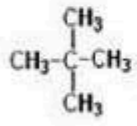
constant. When a small amount of hydroxide ions are added, ammonium ions which are in excess will combine with hydroxide ions to form ammonium hydroxide back so as to maintain hydroxide constant. So, pH remains constant.

21.

i. There are three structural isomers of pentane:


n-Pentane


2-Methylbutane


2,2-Dimethylpropane

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.

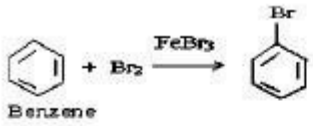
iii) The strength of the electrical or magnetic field — the deflection of electrons from its original path increases with the increase in the voltage across the electrodes, or the strength of the magnetic field.

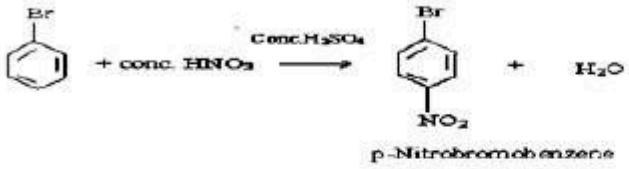
23. Since villagers were washing clothes around the lake and at some places waste materials from houses were thrown into lake and so the lake was covered with algae and it was giving stinking smell due to the decomposition of domestic waste material. It may be also due to eutrophication. The phosphate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

24.

a)

(i) Benzene to p-Nitrobromobenzene





ii) Ethyl chloride to ethane

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

a) Mechanism of addition of HBr to propene

Step – 1

$CH_3 - CH = CH_2 + H^+ \rightarrow CH_3 - CH_2 - \overset{+}{C}H_2$ (Primary carbocation, less stable)

Step – 2

$CH_3 - CH = CH_2 + H^+ \rightarrow CH_3 - \overset{+}{C}H - CH_3$ (Secondary carbocation, more stable)

Step – 3

$CH_3 - \overset{+}{C}H - CH_3 + Br^- \rightarrow CH_3 - CH(Br) - CH_3$ (Major product)

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.

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

Or

a) Write the oxidation no. of each atom

$$\underset{+6}{Cr_2}O_7^{2-} + \underset{-1}{C_2}H_4O \rightarrow \underset{0}{C_2}H_4O_2 + \underset{+3}{Cr^{3+}}$$

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:

$\overset{+6}{Cr_2}O_7^{2-} \rightarrow \overset{+3}{Cr}^{3+}$

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,

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

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

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

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

a) $C_6H_6 \xrightarrow{CH_3Cl/anAlCl_3} C_6H_5CH_3 \xrightarrow{(O)/KMnO_4} C_6H_5COOH$

b) $CH_3CH_2Br \xrightarrow{Wurtz\ Reaction} CH_3CH_2CH_2CH_3 \xrightarrow{Cl_2/hv} CH_3CH_2CH_2CH_2Cl$

$\xrightarrow{KOH} CH_3CH_2CH_2CH_2OH$

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

$\xrightarrow{4[H]} CH_3CH_2CH_2NH_2 \xrightarrow{HNO_2} CH_3CH_2CH_2OH \xrightarrow{alc.KOH} CH_3\text{-}CH = CH_2$

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) $CH_3 - CH = CH_2 + HBr \rightarrow CH_3 - CH(Br) - CH_3 + aq.KOH \rightarrow CH_3 - CH(OH) - CH_3$

26.

a)

Carbon monoxide:

Industrial preparation:

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

Laboratory preparation:

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

Carbon dioxide:

Industrial preparation:

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

Laboratory preparation:

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

b)

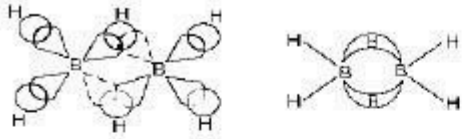
i. Forms the most acidic oxide = Carbon (i.e. CO_2).

ii. Used as semiconductor = Silicon and Germanium.

c)

Each boron atom in diborane is sp^3hybridised. 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.

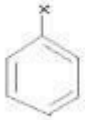


Or

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.