Grade 10_ Kerala _Chemistry_2017

Q1. This question has choice. Answer any one of them only.

(A) The electrons in atoms are arranged in the sub shells.

(a) Which are the sub shells present in the third shell or the M shell ?

(b) Complete the table given below. (The symbols given are not real)

Element	Sub shell electronic configuration	Highest shell number in the sub shell electronic configuration	Period
$_5X$	$1\ s^2 2\ s^2 2p^1$	2	2
$_{11}Y$	$1\ s^2 2\ s^2 2p^6 3\ s^1$	3	____
$_{19}Z$	____	4	____

Solution:

(a) The third shell (M shell) contains the following subshells: 3s, 3p, and 3d.

(b)

Element	Sub shell electronic configuration	Highest shell number in the sub shell electronic configuration	Period
$_5X$	$1\ s^2 2\ s^2 2p^1$	2	2
$_{11}Y$	$1\ s^2 2\ s^2 2p^6 3\ s^1$	3	3
$_{19}Z$	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1$	4	4

The highest shell number is the largest number in the electronic configuration (e.g., $1\ s^2 2\ s^2 2p^6 3\ s^1 \rightarrow$ highest shell is 3). The period number is the same as the highest shell number.

(or)

(B) The sub shell electronic configuration of an element is given as $[Ar]3d^5\ 4s^1$.

(a) How many shells of this element has electrons in it?

(b) Which is the sub shell to which the last electron is added ?

(c) What is the atomic number of the element?

(d) What is the group number of the element?

Solution:

(a) The notation [Ar]$3d^5$ $4s^1$ represents the electronic configuration of Argon ($1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^6$), meaning electrons are present in the 1st, 2nd, and 3rd shells. The extra electrons ($3d^5$ and $4s^1$) indicate that the 4th shell also has electrons.

(b) The given configuration is [Ar] $3d^5$ $4s^1$, meaning after Argon's core electrons, additional electrons go into 4s and 3d. The last electron is added to 3d subshell because 3d is filled after 4s in transition metals.

(c) Argon (Ar) has atomic number 18. After Argon's 18 electrons, we add 6 more electrons ($3d^5$ $4s^1$), so: 18+6=24.
Element with atomic number 24 is Chromium (Cr).

(d) Chromium is a transition metal and belongs to Group 6 in the periodic table.

Q2. This question has choice. Answer any one of them only.

(A) Atomic mass of H = 1 and O = 16

(a)

(i) Calculate the gram molecular mass of O_2

(ii) How many molecules are present in 16 grams of O_2?

(b) In reaction

$$2H_2 + O_2 \rightarrow 2H_2O$$

(i) How many moles of O_2 are required to produce 10 moles of H_2O ?

(ii) What volume of O_2 gas at STP is required to produce 2 moles of water?

Solution:

(a)

(i) Oxygen molecule (O_2) consists of two oxygen atoms.

Molecular mass of $O_2 = 2 \times$ Atomic mass of $O = 2 \times 16 = 32$ g/mol

(ii) By using Avogadro's number:

1 mole of $O_2 = 6.022 \times 10^{23}$ molecules

$$\text{Moles of } O_2 \text{ in 16 g} = \frac{\text{Given mass}}{\text{Molar mass}}$$

$$= \frac{16}{32} = 0.5 \text{ moles}$$

Now,

Number of molecules $= 0.5 \times 6.022 \times 10^{23}$

$= 3.011 \times 10^{23}$ molecules

(b)

(i) Moles of O_2 required to produce 10 moles of H_2O

From the equation:

$$2H_2 + O_2 \rightarrow 2H_2O$$

2 moles of H_2O need 1 mole of O_2

For 10 moles of H_2O:

$\frac{1}{2} \times 10 = 5$ moles of O_2

5 moles of O_2 are required.

(ii) Volume of O_2 gas at STP required to produce 2 moles of H_2O

At STP, 1 mole of gas = 22.4 L

2 moles of H_2O need 1 mole of O_2

1 mole of O_2 = 22.4 L

So, Volume of O_2 gas at STP required to produce 2 moles of H_2O is 22.4 L

(or)

(B)

(a) Calculate the number of molecules in each of the following:

(i) 22.4 L of CO_2 gas at STP

(ii) 4/g of H_2 (atomic mass of H = 1)

(b) The gram molecular mass of glucose ($C_6H_{12}O_6$) is 180 g . Find the mass of glucose dissolved in 500 mL of 1 M solution of glucose.

Solution:

(a)

(i) At STP (Standard Temperature and Pressure), 1 mole of any gas occupies 22.4 L and contains Avogadro's number of molecules (6.022×10^{23} molecules).

$$\text{Moles of } CO_2 = \frac{\text{Given volume}}{\text{Molar volume at STP}}$$

$$= \frac{22.4}{22.4} = 1 \text{ mole}$$

Now, Number of molecules $= 1 \times 6.022 \times 10^{23}$

The number of molecules of CO_2 is 6.022×10^{23}

(ii) Number of molecules in 4g of H_2

Molar mass of $H_2 = 2 \times 1 = 2$ g/mol

$$\text{Moles of } H_2 = \frac{\text{Given mass}}{\text{Molar mass}}$$

$$= \frac{4}{2} = 2 \text{ moles}$$

Now,

Number of molecules $= 2 \times 6.022 \times 10^{23}$

$= 1.2044 \times 10^{24}$ molecules

(b) Given:

Molar mass of glucose ($C_6H_{12}O_6$) = 180 g/mol

Volume of solution = 500 mL = 0.5 L

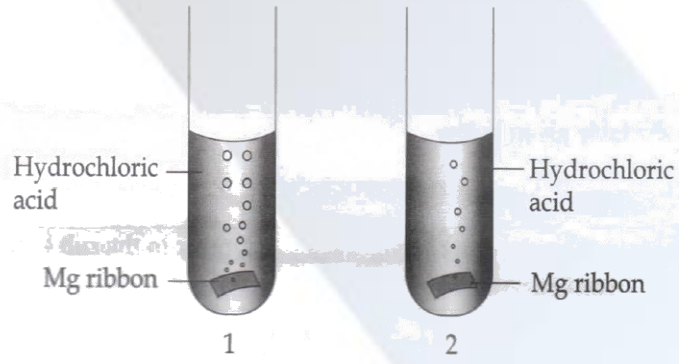
Molarity (M) = 1M

Formula:

$$\text{Mass of solute} = \text{Molarity} \times \text{Volume (L)} \times \text{Molar mass}$$
$$= 1 \times 0.5 \times 180 = 90 \text{ g}$$

90 g of glucose is dissolved in 500 mL of 1 M solution.

Q3. See the figure given below.



The Mg (Magnesium) ribbons are of equal mass and size. The reaction is faster in test tube 1 and slower in test tube 2. Now answer the following questions.

(a) Give reason for the faster rate of reaction in test tube 1 than in test tube 2.

(b) Write balanced chemical equation for the reaction.

Solution:

(a) The reaction is faster in test tube 1 because it has a higher concentration of HCl or a higher temperature than test tube 2.

(b) Balanced Chemical Equation:

$$Mg + 2HCl \rightarrow MgCl_2 + H_2 \uparrow$$

Q4. Examine the reaction

$$N_2O_{4(g)}\text{(Dinitrogen tetroxide)} \underset{\text{Exothermic}}{\overset{\text{Endothermic}}{\rightleftharpoons}} 2NO_{2(g)}\text{ (Nitrogen dioxide).}$$

(a) Which of these is a brown coloured gas ?

(b) How does the colour of the brown gas change when a test tube filled with this gas and closed with a cork is immersed in

(i) a vessel containing ice pieces.

(ii) a veśsel containing hot water

Solution:

(a) Nitrogen dioxide (NO_2) is a brown-colored gas whereas Dinitrogen tetroxide (N_2O_4) is colorless.

(b)

(i) In ice water: The brown color fades as NO_2 converts to colorless N_2O_4.
(ii) In hot water: The brown color darkens as more NO_2 forms from N_2O_4.

Q5. A freshly cut piece of sodium when exposed to air for sometime looses its lustre in the freshly cut portion.
(a) What may be the reason for this?
(b) Write any two chemical equations to substantiate your answer.

Solution:

(a) Sodium reacts with oxygen and moisture in the air, forming a dull layer of sodium oxide (Na_2O) or sodium hydroxide (NaOH), which covers the shiny surface.
(b) Chemical Equations:
(1) Reaction with oxygen:

$$4Na + O_2 \rightarrow 2Na_2O$$

(2) Reaction with water:

$$Na_2O + H_2O \rightarrow 2NaOH$$

Q6. The reactivity series of a few metals are given below :
$Mg > Zn > Fe > Cu > Ag$
(a) What happens
(i) when a piece of magnesium (Mg) is dipped in copper sulphate ($CuSO_4$) solution.
(ii) when a piece of silver (Ag) is dipped in Zinc sulphate ($ZnSO_4$) solution.
(b) If a galvanic cell is constructed using Fe and Ag electrodes, which will be the positive electrode?

Solution:

(a)
(i) When a piece of magnesium (Mg) is dipped in copper sulphate ($CuSO_4$) solution, the magnesium displaces copper from the solution as it is more reactive than copper.

$$Mg + CuSO_4 \rightarrow MgSO_4 + Cu$$

(ii) No reaction occurs when Silver (Ag) is dipped in $ZnSO_4$ solution as the Ag is less reactive than Zn.
(b) In a galvanic cell using Fe (iron) and Ag (silver) electrodes, the metal with a higher reduction potential acts as the positive electrode (cathode).
Standard reduction potential of $Fe^{2+}/Fe = -0.44$ V
Standard reduction potential of $Ag^{+}/Ag = +0.80$ V
Since Ag^{+} has a higher reduction potential, silver (Ag) will be the positive electrode (cathode) where reduction occurs.

Q7. Bauxite ($Al_2O_3 \cdot 2H_2O$) and clay ($Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$) are two naturally occurring minerals of aluminium.

(a) Which one of these is an ore of aluminium?

(b) Give two reasons for your answer.

Solution:

(a) Bauxite ($Al_2O_3 \cdot 2H_2O$) is an ore of aluminium.

(b) Bauxite contains a high percentage of aluminium oxide (Al_2O_3), which is easily extracted whereas clay has impurities like silica (SiO_2), making aluminium extraction difficult.

Q8. Electricity and Carbon monoxide (CO) are reducing agents used to extract metals from their ores.

(a) Which of these is used to extract sodium from sodium chloride ? Why?

(b) Which reducing agent is used to extract iron from haematite (Fe_2O_3) ?

Solution:

(a) Sodium is a highly reactive metal and is extracted by electrolysis of molten NaCl because it cannot be reduced by carbon monoxide (CO).

$$2NaCl \rightarrow 2Na + Cl_2 \uparrow$$

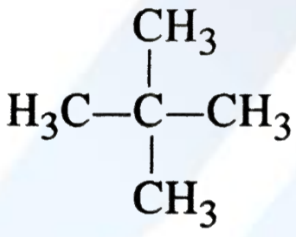
(b) Carbon monoxide (CO) is used to extract iron from haematite (Fe_2O_3).

Reaction:

$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

CO acts as a reducing agent by removing oxygen from Fe_2O_3 to produce iron (Fe).

Q9. (a) Write IUPAC name of the following hydrocarbon:



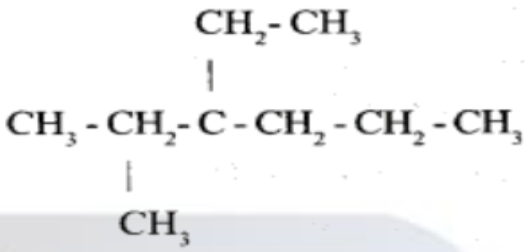
(b) Write the structural formula of the compound given below

3 - Ethyl -2 - Methylhexane

Solution:

(a) The IUPAC name of the given hydrocarbon is 2, 2-dimethylpropane.

(b) Structural formula of the compound 3 - Ethyl -2 – Methylhexane is

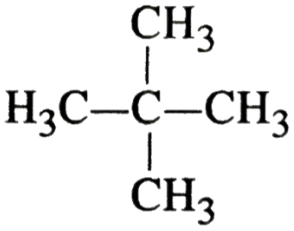


Q10. Examine the structural formulae of the compounds given below and tabulate all the isomer pairs. Name the type of isomerism in each pair.

(a) $CH_3 - CH_2 - CH_2 - CH_2 - CH_3$

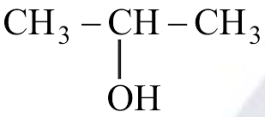
(b) $CH_3 - CH_2 - CH_2 - OH$

(c)



(d) $CH_3 - CH_2 - O - CH_3$

(e)



Solution:

Isomers have the same molecular formula but different structures or functional groups, leading to different properties.

Isomer Pair	Type of Isomerism
(a) Pentane & (c) Neopentane	Chain Isomerism (Different carbon chain arrangement)
(b) Propanol & (e) Isopropyl	Position Isomerism (Same molecular formula, different position of -OH group)
(b) Propanol & (d) Ethoxyethane	Functional Isomerism (Alcohol vs Ether)

Q11. (a) Complete the following equations by writing the formula/name of the products.

(i) $CH_3 - CH = CH_2 + Cl_2 \rightarrow \cdots \ldots$

(ii) $C_2H_6 + Cl_2 \overset{sunlight}{\rightarrow} \_\_\_\_ + HCl$

(iii)

$$n\ CH_2 = CH_2 \xrightarrow[\text{catalyst}]{\text{High temp. pressure}} \ldots\ldots$$

(b) Write balanced equations for the combustion of the fuel propane (C_3H_8).

Solution:

(i) Reaction of Propene with Chlorine:

$$CH_3 - CH = CH_2 + Cl_2 \rightarrow CH_3 - CHCl - CH_2Cl$$

The name of the product is 1,2-Dichloropropane

(ii) Reaction of Ethane with Chlorine (Substitution Reaction):

$$C_2H_6 + Cl_2 \overset{sunlight}{\rightarrow} C_2H_5Cl + HCl$$

The name of the product is Chloroethane and Hydrogen Chloride

(iii)

$$n\ CH_2 = CH_2 \xrightarrow[\text{catalyst}]{\text{High temp. pressure}} (-CH_2 - CH_2 -)_n$$

The name of the product is Polyethylene (Polythene, $(C_2H_4)_n$)

(b) The balanced equation for the combustion of propane (C_3H_8) is:

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$ + Heat

Q12. Chemistry contributes a lot in allopathic medicines. What are the functions of the following types of medicines?

(a) Analgesics

(b) Antibiotics

(C) Antipyretics

Solution:

(a) Analgesics are the type of medicine that relieve pain without causing loss of consciousness.

(b) Antibiotics are the drugs which are used to kill or inhibit the growth of bacteria to treat infections.

(c) Antipyretics are medicines that reduce fever by lowering body temperature.