MOLE CONCEPT

1. 4.5 g of compound A (MW = 90) was used to make 250 mL of its aqueous solution. The molarity of the solution in M is $x \times 10^{-1}$. The value of x is _____. (Rounded off to the nearest integer)

2. The number of significant figures in 50000.020×10^{-3} is _____.

3. The $NaNO_3$ weighed out to make 50 mL of an aqueous solution containing 70.0 mg Na^+ per mL is _____g. (Rounded off to the nearest integer)
[Given : Atomic weight in g mol^{-1} – Na : 23 ; N : 14 ; O : 16]

4. Complete combustion of 750 g of an organic compound provides 420 g of CO_2 and 210 g of H_2O. The percentage composition of carbon and hydrogen in organic compound is 15.3 and ____ respectively. (Round off to the Nearest Integer)

5. In Duma's method of estimation of nitrogen, 0.1840 g of an organic compound gave 30 mL of nitrogen collected at 287 K and 758 mm of Hg pressure. The percentage composition of nitrogen in the compound is _____. (Round off to the Nearest Integer).
[Given : Aqueous tension at 287 K = 14 mm of Hg]

6. The number of chlorine atoms in 20 mL of chlorine gas at STP is_____10^{21}. (Round off to the Nearest Integer).
[Assume chlorine is an ideal gas at STP
R = 0.083 L bar mol^{-1} K^{-1}, $N_A = 6.023 \times 10^{23}$]

7. Complete combustion of 3 g of ethane gives $x \times 10^{22}$ molecules of water. The value of x is _____. (Round off to the Nearest Integer).
[Use : $N_A = 6.023 \times 10^{23}$; Atomic masses in u : C : 12.0 ; O : 16.0 ; H : 1.0]

8. 250 mL of 0.5 M NaOH was added to 500 mL of 1 M HCl. The number of unreacted HCl molecules in the solution after complete reaction is _____ $\times 10^{21}$. (Nearest integer)
($N_A = 6.022 \times 10^{23}$)

9. 4g equimolar mixture of NaOH and Na_2CO_3 contains x g of NaOH and y g of Na_2CO_3. The value of x is _____ g. (Nearest integer)

10. When 0.15 g of an organic compound was analyzed using Carius method for estimation of bromine, 0.2397 g of AgBr was obtained. The percentage of bromine in the organic compound is _____. (Nearest integer)
[Atomic mass : Silver = 108, Bromine = 80]

11. 100 ml of 0.0018% (w/v) solution of Cl^- ion was the minimum concentration of Cl^- required to precipitate a negative sol in one h. The coagulating value of Cl^- ion is _____ (Nearest integer)

12. Methylation of 10 g of benzene gave 9.2 g of toluene. Calculate the percentage yield of toluene _____. (Nearest integer)

13. If the concentration of glucose ($C_6H_{12}O_6$) in blood is 0.72 g L^{-1}, the molarity of glucose in blood is _____ $\times 10^{-3}$M. (Nearest integer)
[Given : Atomic mass of C = 12, H = 1, O = 16 u]

14. Consider the complete combustion of butane, the amount of butane utilized to produce 72.0 g of water is _____ $\times 10^{-1}$ g.
(in nearest integer)

15. The number of significant figures in 0.00340 is _____.

16. 0.8 g of an organic compound was analysed by Kjeldahl's method for the estimation of nitrogen. If the percentage of nitrogen in the compound was found to be 42%, then _____ mL of 1 M H_2SO_4 would have been neutralized by the ammonia evolved during the analysis.

17. The density of NaOH solution is 1.2 g cm^{-3}. The molality of this solution is _____ m.
(Round off to the Nearest Integer)
[Use : Atomic masses : Na : 23.0 u O : 16.0 u H : 1.0 u Density of H_2O : 1.0 g cm^{-3}]

18. An organic compound is subjected to chlorination to get compound A using 5.0 g of chlorine. When 0.5 g of compound A is reacted with $AgNO_3$ [Carius Method], the percentage of chlorine in compound A is _____ when it forms 0.3849 g of AgCl. (Round off to the Nearest Integer)

(Atomic masses of Ag and Cl are 107.87 and 35.5 respectively)

19. The ratio of number of water molecules in Mohr's salt and potash alum is _____ $\times 10^{-1}$. (Integer answer)

20. 100 g of propane is completely reacted with 1000 g of oxygen. The mole fraction of carbon dioxide in the resulting mixture is $x \times 10^{-2}$. The value of x is _____. (Nearest integer)

[Atomic weight : H = 1.008; C = 12.00; O = 16.00]

21. The number of atoms in 8 g of sodium is $x \times 10^{23}$. The value of x is_____. (Nearest integer)

[Given : $N_A = 6.02 \times 10^{23}$ mol^{-1}

Atomic mass of Na = 23.0 u]

SOLUTION

1. Official Ans. by NTA (2)

Sol. $M = \frac{4.5/90}{250/1000} = 0.2$

$= 2 \times 10^{-1}$

2. Official Ans. by NTA (8)

Sol. $\underline{50000.02}0 \times 10^{-3}$

3. Official Ans by NTA (13)

Sol. Na^+ present in 50 ml

$= \frac{70mg}{1ml} \times 50ml = 3500$ mg $= 3.5$ gm

moles of $Na^+ = \frac{3.5}{23}$ = moles of $NaNO_3$

weight of $NaNO_3 = \frac{3.5}{23} \times 85 = 12.993gm$

5. Official Ans. by NTA (3)

Sol. 44 gm CO_2 have 12 gm carbon

So, 420 gm $CO_2 \Rightarrow \frac{12}{44} \times 420$

$\Rightarrow \frac{1260}{11}$ gm carbon

$\Rightarrow 114.545$ gram carbon

So, % of carbon $= \frac{114.545}{750} \times 100$

$\simeq 15.3\%$

18 gm $H_2O \Rightarrow 2$ gm H_2

210 gm $\Rightarrow \frac{2}{18} \times 210$

$= 23.33$ gm H_2

So, % $H_2 \Rightarrow \frac{23.33}{750} \times 100 = 3.11\%$

$\approx 3\%$

5. Official Ans. by NTA (19)

Sol. In Duma's method of estimation of Nitrogen.

0.1840 gm of organic compound gave 30 mL of nitrogen which is collected at 287 K & 758 mm of Hg.

Given ;

Aqueous tension at 287 K = 14 mm of Hg.

Hence actual pressure = (758 – 14)

= 744 mm of Hg.

Volume of nitrogen at STP $= \frac{273 \times 744 \times 30}{287 \times 760}$

V = 27.935 mL

$\because$ 22400 mL of N_2 at STP weighs = 28 gm.

$\therefore$ 27.94 mL of N_2 at STP weighs

$= \left(\frac{28}{22400} \times 27.94\right)$gm

= 0.0349 gm

Hence % of Nitrogen $= \left(\frac{0.0349}{0.1840} \times 100\right)$

$= 18.97\ \%$

Rond off. Answer = 19%

6. Official Ans. by NTA (1)

Sol. PV = nRT

$1.0 \times \frac{20}{1000} = \frac{N}{6.023 \times 10^{23}} \times 0.083 \times 273$

$\therefore$ Number of Cl_2 molecules, $N = 5.3 \times 10^{20}$

Hence, Number of Cl-atoms $= 1.06 \times 10^{21}$

$\approx 1 \times 10^{21}$

7. Official Ans. by NTA (18)

Sol.

C_2H_6	$\rightarrow$	$3H_2O$
0.1 mol		$0.3 = 0.3 \times 6 \times 10^{23} = 18 \times 10^{22}$ mol

No. of molecules $= 0.3 \times 6.023 \times 10^{23}$

$= 18.069 \times 10^{22}$

8. Official Ans. by NTA (226)

Sol. We known that no. of moles = $V_{litre} \times$ Molarity

& No. of millimoles = $V_{ml} \times$ Molarity

so millimoles of NaOH = 250×0.5

$= 125$

Millimoles of HCl = $500 \times 1 = 500$

Now reaction is

$NaOH + HCl \rightarrow NaCl + H_2O$

t = 0	125	500	0	0
t = t	0	375	125	125

so millimoles of HCl left = 375

Moles of HCl = 375×10^{-3}

No. of HCl molecules

$= 6.022 \times 10^{23} \times 375 \times 10^{-3}$

$= 225.8 \times 10^{21}$

$\simeq 226 \times 10^{21} = 226$

9. **Official Ans. by NTA (1)**

Sol. Total mass = 4g

Now

NaOH : a mol $\quad W_{NaOH} + W_{Na_2CO_3} = 4$

Na_2CO_3 : 'a' mol $\quad \Rightarrow 40a + 106\,a = 4$

$$\Rightarrow a = \frac{4}{146}\text{mol}$$

$$\Rightarrow \text{therefore mass of NaOH is : } \frac{4}{146}\times 40\text{g}$$

$$= 1.095 \approx 1$$

10. Official Ans. by NTA (68)

Sol. Moles of Br = Moles of AgBr obtained

$$\Rightarrow \text{ Mass of Br} = \frac{0.2397}{188}\times 80\text{g}$$

therefore % Br in the organic compound

$$= \frac{W_{Br}}{W_T}\times 100$$

$$= \frac{0.2397\times 80}{188\times 0.15}\times 100 = 0.85\times 80$$

$$= 68$$

$\Rightarrow$ Nearest integer is '68'

11. Official Ans. by NTA (1)

12. Official Ans. by NTA (78)

Sol. $C_6H_6 + CH_3Cl \longrightarrow C_6H_5CH_3 + HCl$

$\frac{10}{78} \qquad \left(\frac{10}{78}\times 92\right)\text{gm} \Rightarrow$

$$\frac{A_y}{T_y} = \%\text{yield} = \frac{9.2}{920}\times 78\times 100 \Rightarrow 78\%$$

13. Official Ans. by NTA (4)

Sol. $$[\text{Glucose}] = \frac{C(\text{gm}/\ell)}{M(\text{gm/mol})} = \frac{0.72}{180} = 4\times 10^{-3}\text{M}$$

14. Official Ans. by NTA (464)

Sol. $C_4H_{10} + \frac{13}{2}O_2 \longrightarrow 4CO_2 + 5H_2O$

$$\text{Moles of } H_2O = \frac{72}{18} = 4$$

$$\text{Moles of } C_4H_{10} \text{ used} = \frac{1}{5}\times 4$$

$$\text{Weight of } C_4H_{10} \text{ used} = \frac{4}{5}\times 58$$

= 46.4 gm

15 Official Ans. by NTA (3)

Sol. Number of significant figures = 3

16. Official Ans. by NTA (12)

Sol. Organic compound : 0.8 gm

$$\text{wt. of N} = \left(\frac{42}{100}\times 0.8\right)\text{gm}$$

$$\text{mole of N} = \frac{42\times 0.8}{100\times 14} = \frac{2.4}{100}\text{mol}$$

$$\text{moles of } NH_3 = \frac{2.4}{100}$$

$$2NH_3 + H_2SO_4 \longrightarrow (NH_4)_2SO_4$$

$$\downarrow$$

$\frac{2.4}{100}$mole $\qquad \frac{1.2}{100}$mole

$$\frac{1.2}{100} = 1\times V(\ell)$$

$$\Rightarrow V_{H_2SO_4} = \frac{1.2}{100}\ell = 12\,\text{m}\ell$$

17. Official Ans. by NTA (5)

Sol. Consider 1ℓ solution

mass of solution = (1.2 × 1000)g

= 1200 gm

Neglecting volume of NaOH

Mass of water = 1000 gm

$\Rightarrow$ Mass of NaOH = (1200 – 1000)gm

= 200 gm

$$\Rightarrow \text{Moles of NaOH} = \frac{200\text{g}}{50\text{g/mol}} = 5\text{ mol}$$

$$\Rightarrow \text{molality} = \frac{5\text{mol}}{1\text{kg}} = 5\text{ m}$$

18. Official Ans. by NTA (19)

Sol. $n_{c\ell}$ in compound = $n_{AgCl} = \frac{0.3849g}{(107.87+35.5)}$ g/mol

$\Rightarrow$ mass of chlorine = $n_{Cl} \times 35.5 = 0.0953$ gm

$\Rightarrow$ % wt of chlorine $= \frac{0.0953}{0.5} \times 100$

$= 19.06\%$

OR

Sol. Mass of organic compound = 0.5 gm.

mass of formed AgCl = 0.3849 gm

$$\%\text{of Cl} = \frac{\text{atomic mass of Cl} \times \text{mass formed AgCl}}{\text{molecular mass of AgCl} \times \text{mass of organic compound}} \times 100$$

$$= \frac{35.5 \times 0.3849}{143.37 \times 0.5} \times 100$$

$= 19.06$

$\boxed{\approx 19}$

19. Official Ans. by NTA (5)

Sol. **(5)** Mohr's salt : $(NH_4)_2\,Fe(SO_4)_2.6H_2O$

The number of water molecules in Mohr's salt = 6

Potash alum : $KAl(SO_4)_2.12H_2O$

The number of water molecules in potash alum = 12

So ratio of number of water molecules in Mohr's salt and potash alum = $\frac{6}{12}$

$= \frac{1}{2}$

$= 0.5$

$= 5 \times 10^{-1}$

20. Official Ans. by NTA (19)

Sol. $C_3H_{8(g)} + 5O_{2(g)} \longrightarrow 3CO_{2(g)} + 4H_2O_{(\ell)}$

t = 0 2.27 mole 31.25 mol

t = ∞ 0 19.9 mol 6.81 mol 9.08 mol

mole fraction of CO_2 in the final reaction mixture (heterogenous)

$$X_{CO_2} = \frac{6.81}{19.9+6.81+9.08}$$

$= 0.1902 = 19.02 \times 10^{-2} \quad \Rightarrow 19$

21. Official Ans. by NTA (2)

Sol. No. of atoms = $\frac{8}{23} \times 6.02 \times 10^{23} = 2.09 \times 10^{23}$

$\simeq 2 \times 10^{23}$

$= x \times 10^{23}$

$x = 2$