

Revision - Moles and Molecules

1)

Types of Matter

Pure Substances

Mixtures

Elements

e.g. copper

Carbon

Aluminium

Compounds

e.g. Salt

Water

~~Aluminium~~

Homogenous

e.g. Salt water

Brass

Heterogenous

e.g. Pizza

concrete

2) $m_{\text{sucrose}} = 500 \text{ g}$

$N_{\text{sucrose}} = ?$

$$M_w = (12 \times 12) + (22 \times 1) + (11 \times 16)$$

$$= 144 \text{ g/mol} + 22 \text{ g/mol} + 176 \text{ g/mol}$$

$$= 342 \text{ g/mol}$$

$$n = \frac{m}{M_w}$$

$$n_{\text{sucrose}} = \frac{500 \text{ g}}{342 \text{ g/mol}}$$

$$= 1.46 \text{ mol}$$

$$N_{\text{sucrose}} = n \times N_A$$

$$= 1.46 \text{ mol} \times 6.022 \times 10^{23} \text{ molecules/mol}$$

$$= 8.79 \times 10^{23} \text{ molecules}$$

3) $m_{\text{glucose}} = ?$

$$n_{\text{glucose}} = 0.63 \text{ mol}$$

$$\begin{aligned} M_w(\text{glucose}) &= (6 \times 12) + (12 \times 1) + (6 \times 16) \\ &= 72 \text{ g/mol} + 12 \text{ g/mol} + 96 \text{ g/mol} \\ &= 180 \text{ g/mol} \end{aligned}$$

$$m = n \times M_w$$

$$= 0.63 \text{ mol} \times 180 \text{ g/mol}$$

$$= 113.4 \text{ g}$$

4) $n_{\text{NaOH}} = 0.05 \text{ mol}$

$$m_{\text{NaOH}} = ?$$

$$\begin{aligned} M_w(\text{NaOH}) &= (1 \times 22.99) + (1 \times 16) + (1 \times 1) \\ &= 22.99 \text{ g/mol} + 16 \text{ g/mol} + 1 \text{ g/mol} \\ &= 39.99 \text{ g/mol} \end{aligned}$$

$$m = n \times M_w$$

$$= 0.05 \text{ mol} \times 39.99 \text{ g/mol}$$

$$= 1.9995 \text{ g}$$

$$\approx 2.0 \text{ g}$$

$$\begin{aligned}
 5) \quad m &= 27 \text{ metric tonnes} \\
 &= 27 \text{ t} \times 1000000 \text{ g/t} \\
 &= 27000000 \text{ g}
 \end{aligned}$$

$$N_{\text{Cu}} = ?$$

$$M_w(\text{Cu}) = 63.55 \text{ g/mol}$$

$$n_{\text{Cu}} = ?$$

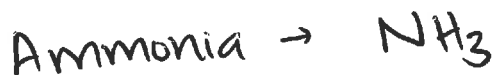
$$\begin{aligned}
 n_{\text{Cu}} &= \frac{m}{M_w} \\
 &= \frac{27000000 \text{ g}}{63.55 \text{ g/mol}}
 \end{aligned}$$

$$= 424862.31 \text{ mol}$$

$$\begin{aligned}
 N_{\text{Cu}} &= n \times N_A \\
 &= 424862.31 \text{ mol} \times 6.022 \times 10^{23} \\
 &= 2.56 \times 10^{29} \text{ atoms}
 \end{aligned}$$

$$6) \% \text{N} = ?$$

$$\begin{aligned}
 M_w(\text{NH}_3) &= 14.01 \text{ g/mol} + 3 \times 1 \text{ g/mol} \\
 &= 17.01 \text{ g/mol}
 \end{aligned}$$



$$\begin{aligned}
 \% \text{N by mass} &= \frac{M_w(\text{N})}{M_w(\text{NH}_3)} \times 100 \\
 &= \frac{14.01 \text{ g/mol}}{17.01 \text{ g/mol}} \times 100 \\
 &= 82.4\%
 \end{aligned}$$

$$\begin{aligned}
 7) \% \text{Fe by mass} &= \frac{M_w(\text{Fe})}{M_w(\text{heme})} \times 100 \\
 &= \frac{55.9 \text{ g/mol}}{857.9 \text{ g/mol}} \times 100 \\
 &= 6.56\%
 \end{aligned}$$

$$\begin{aligned}
 M_w(\text{Fe}) &= 55.9 \text{ g/mol} \\
 M_w(\text{heme}) &= 857.9 \text{ g/mol}
 \end{aligned}$$

$$8) m_{\text{NaCl}} = ?$$

$$M_w(\text{NaCl}) = 22.99 + 35.45 \\ = 58.44 \text{ g/mol}$$

$$N_{\text{NaCl}} = 1.5 \times 10^{22} \text{ molecules}$$

$$n_{\text{NaCl}} = \frac{N}{N_A} \\ = \frac{1.5 \times 10^{22} \text{ molecules}}{6.022 \times 10^{23} \text{ molecules/mol}} \\ = 0.025 \text{ mol}$$

$$m_{\text{NaCl}} = n \times M_w \\ = 0.025 \text{ mol} \times 58.44 \text{ g/mol} \\ = 1.46 \text{ g}$$

$$1) m_c = 200 \text{ g}$$

$$M_w(\text{C}) = 12.01 \text{ g/mol}$$

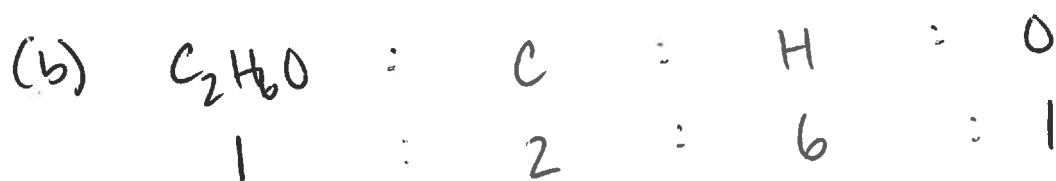
$$n_c = \frac{m}{M_w} \\ = \frac{200 \text{ g}}{12.01 \text{ g/mol}} \\ = 16.65 \text{ mol}$$

$$N_c = n \times N_A \\ = 16.65 \text{ mol} \times 6.022 \times 10^{23} \text{ atoms/mol} \\ = 1.0 \times 10^{25} \text{ atoms}$$

$$10) m_{\text{EtOH}} = 100.0 \text{ g}$$

$$M_w(\text{EtOH}) = (2 \times 12) + (6 \times 1) + (1 \times 16) \\ = 46 \text{ g/mol}$$

$$(a) n_{\text{EtOH}} = \frac{m}{M_w} \\ = \frac{100.0 \text{ g}}{46 \text{ g/mol}} \\ = 2.17 \text{ mol}$$



$$2.17 \text{ mol} : 2 \times 2.17 \text{ mol} : 6 \times 2.17 \text{ mol} : 2.17 \text{ mol} \\ = 4.34 \text{ mol} : 13.02 \text{ mol}$$

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$$(c) m_{\text{EtOH}} = 100.0 \text{ g}$$

$$n_{\text{EtOH}} = 2.17 \text{ mol}$$

	C	H	O
n	4.34 mol	13.02 mol	2.17 mol
M _w	12.01 g/mol	1 g/mol	16.00 g/mol
m	n × M _w = 4.34 mol × 12 g/mol = 52.08 g	13.02 mol × 1 g/mol = 13.02 g	2.17 mol × 16.00 g/mol = 34.72 g

$$\text{Check} \rightarrow 52.08 \text{ g} + 13.02 \text{ g} + 34.72 \text{ g} \\ = 99.82 \text{ g} \sim 100 \text{ g} \quad \checkmark$$

$$11) \quad m_{\text{glycerine}} = 0.500 \text{ g} \quad N_c = ?$$

$$\begin{aligned} M_w(\text{glycerine}) &= 2 \times C + 5 \times H + 2 \times O + 1 \times N \\ &= (2 \times 12 \text{ g/mol}) + (5 \times 1 \text{ g/mol}) + (2 \times 16 \text{ g/mol}) + (1 \times 14.01 \text{ g/mol}) \\ &= 75 \text{ g/mol} \end{aligned}$$

$$\begin{aligned} n_{\text{glycerine}} &= \frac{0.500 \text{ g}}{75 \text{ g/mol}} \\ &= 0.0067 \text{ mol} \end{aligned}$$

To calculate moles of carbon:



$$\begin{aligned} 0.0067 \text{ mol} & : 2 \times 0.0067 \text{ mol} \\ & = 0.0134 \text{ mol} \end{aligned}$$

Number of C atoms \rightarrow

$$\begin{aligned} N &= n \times N_A \\ &= 0.0134 \text{ mol} \times 6.022 \times 10^{23} \text{ atoms/mol} \\ &= 8.07 \times 10^{21} \text{ atoms} \end{aligned}$$

$$12) (a) \quad M_w(\text{NH}_3) = 14 \text{ g/mol} + 3 \times 1 \text{ g/mol} \\ = 17 \text{ g/mol}$$

$$M_w(\text{H}_2\text{O}) = 16 \text{ g/mol} + 2 \times 1 \text{ g/mol} \\ = 18 \text{ g/mol}$$

FALSE \rightarrow H_2O has a molar mass of 18 g/mol
 $>$ NH_3 at 17 g/mol .

(b) TRUE $\rightarrow 1.09 \text{ mol CO}_2 > 1 \text{ mol C}$

$$m_{\text{CO}_2} = 48 \text{ g}$$

$$M_w(\text{CO}_2) = 12 + 2 \times 16 \\ = 44 \text{ g/mol}$$

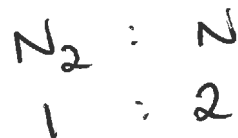
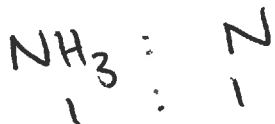
$$n_{\text{CO}_2} = \frac{48 \text{ g}}{44 \text{ g/mol}} \\ = 1.09 \text{ mol}$$

$$m_{\text{C}} = 12 \text{ g}$$

$$M_w(\text{C}) = 12 \text{ g/mol}$$

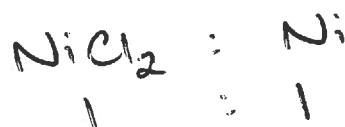
$$n_{\text{C}} = \frac{12 \text{ g}}{12 \text{ g/mol}} \\ = 1 \text{ mol}$$

(c) FALSE \rightarrow One mole of NH_3 contains 1 mol N
 compared to 2 mol N in 1 mol N_2 .



(d) FALSE \rightarrow CuO is heavier than Cu \therefore there
 will be less Cu atoms in 100 g CuO than in
 100 g Cu .

(e) TRUE



(f) FALSE $\text{NH}_3 : \text{H}$
 $1 : 3 \rightarrow 6 \text{ moles}$

$\text{CH}_4 : \text{H}$
 $1 : 4 \rightarrow 8 \text{ moles}$