

①

Moles + Calculations

Date

No.

Avogadro

→ constant = 6.02×10^{23} atoms per mole

$$\text{Moles} = \frac{\text{mass (g)}}{\text{RFM/RAM}}$$

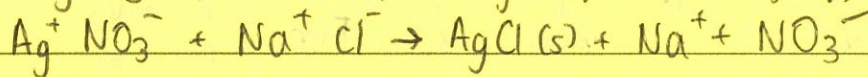
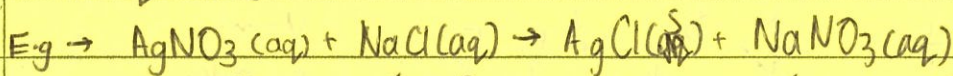
Relative Atomic Mass (RAM)

→ Average mass of all isotopes of an element compared to $\frac{1}{12}$ the mass of a C_{12} atom

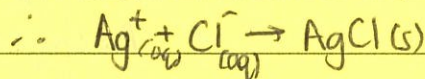
Relative Molecular Mass (RMM)

→ mass of all atoms in a molecule compared to $\frac{1}{12}$ the mass of C_{12} atom

Ionic Equations



Cancel out ions that stay ions on RHS + LHS



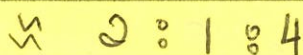
Empirical Formula

E.g. 50g of a compound contains 22.4g of K, 9.2g of S and the remaining Oxygen. Find the remaining empirical formula

$$50 - 22.4 - 9.2 = 18.4$$

<u>K</u>	<u>S</u>	<u>O</u>
22.4g	9.2g	18.4g
39	32	16
0.574	0.288	1.15

↓
= all by smallest number



Hence the formula is K_2SO_4

Atom economy

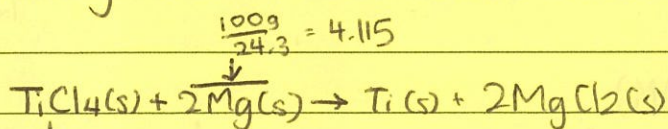
$$\frac{\text{Desired Product Mass}}{\text{Total Products mass}} \times 100\%$$

Yield

$$\frac{\text{Mass of products}}{\text{max theoretical mass}} \times 100\%$$

Limiting Reagents \rightarrow reagent not in excess

$2\text{SO}_2 + \text{E-g}$ In making Ti, what mass of Ti can be formed when 1kg of TiCl_4 reacts with 0.1kg of Mg



$$\frac{1000\text{g}}{189.9} = 5.266$$

$$\frac{100\text{g}}{24.3} = 4.115$$

From this we can see that half of Mg moles ($\frac{2}{2} = 0.57$) is less than 1 mole of Ti. Hence Mg is limiting reagent

$$\therefore \frac{4.115}{2} \times 47.9 = 98.6\text{g}$$

Ideal Gas Equation

Avogadro's Law $\rightarrow V \propto n$

Boyle's $\rightarrow V \propto \frac{1}{P}$

Charles's $\rightarrow V \propto T$

Pressure moles

$$\Rightarrow \underset{\substack{\uparrow \\ \text{volume}}}{P} V = \underset{\substack{\uparrow \\ 8.31}}{n} R \underset{\substack{\uparrow \\ \text{Temp}}}{T}$$

$$P = \text{Pa}$$

$$V = \text{m}^3$$

$$n = \text{moles}$$

$$R = 8.31$$

$$T = \text{K}$$

Assumptions

- 1) Gas molecules do not interact with each other
- 2) $V \neq 0$

$$PV = nRT \text{ but } n = \frac{\text{Mass}}{M_r}$$

$$\frac{PV}{M_r} = \frac{mRT}{M_r}$$

$$n = \frac{PV}{RT}$$

$$\frac{m}{M_r} = \frac{PV}{RT}$$

$$M_r = \frac{mRT}{PV}$$

$$M_r = \frac{\text{density}(\text{g/m}^3) \times R \times T}{P}$$

Changing the conditions \rightarrow divide $PV = nRT$ by factor that is changing & isolate changes on LHS

$PV = nRT \rightarrow$ lets say that pressure is changed. However, n, R, T are constant. $\therefore P_1 V_1 = P_2 V_2$

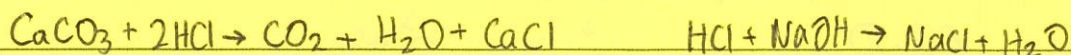
$PV = nRT \rightarrow$ lets say that temperature is changed, $\therefore \frac{PV}{T} = n \times R$ hence $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$PV = nRT \rightarrow$ lets say that volume is changed, $\therefore \frac{P}{V} = \frac{nRT}{V} \therefore \frac{P_1}{T_1} = \frac{P_2}{T_2}$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

Back Titration

e.g. What % of limestone is CaCO_3 ? 1g sample reacts with 100cm^3 0.2mol/dm^3 HCl. Excess HCl required 24.8cm^3 of 0.100mol/dm^3 of NaOH to be neutralised



$$100\text{cm}^3 \times 0.2\text{mol/dm}^3 - 24.8\text{cm}^3 \times 0.1\text{mol/dm}^3 = 0.02\text{ moles of HCl total}$$

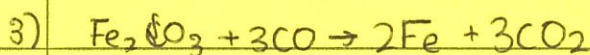
$$0.0248 \times 0.1\text{mol/dm}^3 = 0.00248\text{ moles of NaOH and HCl used in neutralisation}$$

$$\therefore 0.02\text{ mol} - 0.00248 = 0.01752\text{ mol of HCl reacted with CaCO}_3$$

$$\frac{0.01752}{2} \times (40 + 48 + 12) = 0.876\text{g of CaCO}_3$$

$$\frac{0.876}{1.000} \times 100\% = 86.7\%$$

Practise Questions [Calculations Allsorts]

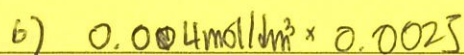


$$\frac{1000\text{g}}{56 + 48} = 9.62\text{ moles} \times 3$$

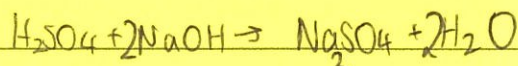
$$28.8\text{ moles}$$

$$\downarrow \times (12 + 16)$$

$$807.806.0\text{g}$$



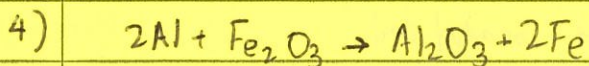
$$= 1 \times 10^{-4}\text{ moles}$$



$$5 \times 10^{-5}\text{ moles of H}_2\text{SO}_4$$

$$0.002075$$

$$0.0241\text{ mol/dm}^3$$



$$\frac{8\text{g}}{104} = 0.0769\text{ moles}$$

$$2(56) + (48) \times 2 = 0.154 \times 0.1$$

$$0.154 \times (26.98) = 4.15\text{g} \quad 2.698 \quad 2.70$$



$$0.005875\text{ moles} \times 10 = 0.05875$$

$$0.05875 \times 13.8$$

$$\frac{13.8}{0.05875} = 234.9$$

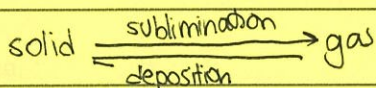
$$n = \frac{13.8}{?}$$

$$? \cdot n = 13.8$$

$$? = \frac{13.8}{n}$$

VIP → Mixtures form when substances combine without chemical interaction, homogenous, → same phase of matter; hetero is opposite

4

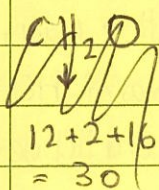
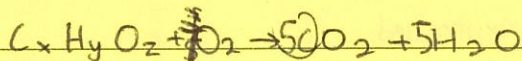


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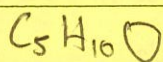
4) X has CHO only Mr=85

0.43g



$$\begin{array}{c} (1.10) \\ \downarrow \\ 44 \\ \downarrow \\ 0.025 \end{array} \quad \begin{array}{c} 0.45g \\ \downarrow \\ 18 \\ \downarrow \\ 0.025 \end{array}$$

$$1.1 + 0.45 - 0.43$$



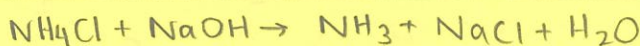
$$1.1 + 0.02 = 1.12$$

$$\frac{1.12}{32} = 0.035$$

5) $0.05 \times 0.250 = 0.0125 \text{ moles}$

$0.1 \times 1 \text{ mol/dm}^3 = 0.1 \text{ mol}$

$$0.1 - 0.0125 = 0.0875$$

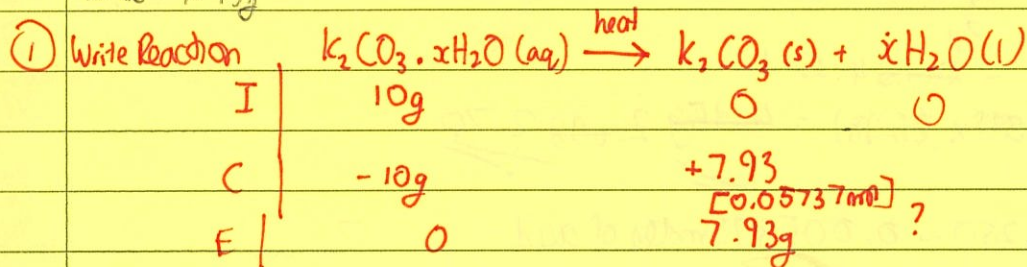


$$0.0875 \text{ moles} \times (14 + 4 + 35.5)$$

$$= 4.68125 \approx 4.68$$

Hydrate Questions

◦ E.g: A sample has formula $K_2CO_3 \cdot xH_2O$. 10g of it is heated and converted into an anhydrous salt, that was weighed and was found to be 7.93g



② Moles of K_2CO_3

$$\frac{7.93g}{138.21} = 0.057376 \text{ moles}$$

∴ it is $K_2CO_3 \cdot 2H_2O$

$$\text{moles of } K_2CO_3 \cdot xH_2O = 0.057376$$

$$0.057376 = \frac{10g}{138.21 + 18x} \quad \therefore 138.21 + 18x = 174.29$$

$$18x = 36$$

$$x = 2$$