



# CALCULATIONS MIXTURE 2

1) Find the  $M_r$  of the following substances.

a) bromine,  $\text{Br}_2$

$$2(80) = 160$$

b) magnesium nitrate,  $\text{Mg}(\text{NO}_3)_2$

$$24 + 2(14) + 6(16) = 148$$

2) a) How many moles in the following:

i) 120 g of oxygen,  $\text{O}_2$

$$\frac{120}{32} = 3.75 \text{ mol}$$

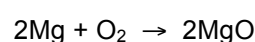
ii) 2.6 kg of iron oxide,  $\text{Fe}_2\text{O}_3$

$$\frac{2600}{160} = 16.25 \text{ mol}$$

b) What is the mass of 0.015 moles of ammonia,  $\text{NH}_3$ ?

$$17 \times 0.015 = 0.255 \text{ g}$$

3) What mass of oxygen reacts with 3.6 g of magnesium to form magnesium oxide?

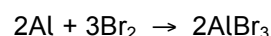


$$\text{moles Mg} = \frac{3.6}{24} = 0.150 \text{ mol}$$

$$\text{moles O}_2 = \frac{0.150}{2} = 0.075 \text{ mol}$$

$$\text{mass O}_2 = 32 \times 0.075 = 2.40 \text{ g}$$

4) What mass of bromine reacts with 16.2 g of aluminium?

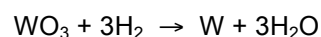


$$\text{moles Al} = \frac{16.2}{27} = 0.60 \text{ mol}$$

$$\text{moles Br}_2 = 0.60 \times \frac{3}{2} = 0.90 \text{ mol}$$

$$\text{mass Br}_2 = 160 \times 0.90 = 144 \text{ g}$$

5) a) What is the maximum mass of tungsten that can be formed from 200 g of tungsten oxide?



$$\text{moles WO}_3 = \frac{200}{232} = 0.86 \text{ mol}$$

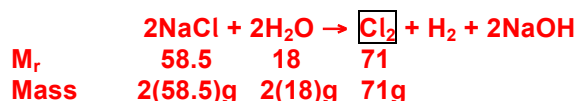
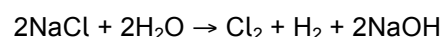
$$\text{moles W} = 0.86 \text{ mol}$$

$$\text{mass W} = 184 \times 0.86 = 159 \text{ g}$$

b) In a reaction, 115 g of tungsten was formed from 200 g of tungsten oxide. Calculate the percentage yield.

$$\% \text{ yield} = \frac{115}{159} \times 100 = 72.3\%$$

6) Calculate the percentage atom economy to form chlorine in this reaction.



$$\% \text{ atom economy} = \frac{71}{2(58.5)+2(18)} \times 100 = 46.4\%$$

- 7) Calculate the percentage atom economy to form the fertiliser ammonium sulfate in this reaction.  $2\text{NH}_3 + \text{H}_2\text{SO}_4 \rightarrow (\text{NH}_4)_2\text{SO}_4$

$$\% \text{ atom economy} = 100\%$$

- 8) 7.8 g of potassium (K) reacts with 1.6 g of oxygen ( $\text{O}_2$ ). Find the simplest molar ratio in which potassium reacts with oxygen.

$$\text{Moles of K} = \frac{7.8}{39} = 0.20 \text{ mol} \qquad \text{Moles of O}_2 = \frac{1.6}{32} = 0.05 \text{ mol}$$

$$\text{Reacting ratio K : O}_2 = 0.20 : 0.05 = \frac{0.20}{0.05} : \frac{0.05}{0.05} = 4 : 1$$



- 9) 1.7 g of phosphine ( $\text{PH}_3$ ) reacts with 3.2 g of oxygen ( $\text{O}_2$ ) to form 3.55 g of phosphorus oxide ( $\text{P}_2\text{O}_5$ ) and 1.35 g of water ( $\text{H}_2\text{O}$ ). By finding the moles of each substance taking part in the reaction, derive the balanced equation for the reaction.

$$\text{Moles of PH}_3 = \frac{1.7}{34} = 0.050 \text{ mol} \qquad \text{Moles of P}_2\text{O}_5 = \frac{3.55}{142} = 0.025 \text{ mol}$$

$$\text{Moles of O}_2 = \frac{3.2}{32} = 0.100 \text{ mol} \qquad \text{Moles of H}_2\text{O} = \frac{1.35}{18} = 0.075 \text{ mol}$$

$$\text{Reacting ratio PH}_3 : \text{O}_2 : \text{P}_2\text{O}_5 : \text{H}_2\text{O} = 0.050 : 0.100 : 0.025 : 0.075$$

$$= \frac{0.050}{0.025} : \frac{0.100}{0.025} : \frac{0.025}{0.025} : \frac{0.075}{0.025} = 2 : 4 : 1 : 3$$



- 10) 3.74 g of hydrated copper sulfate decompose to form 2.39 g of anhydrous copper sulfate on heating. Calculate the value of x.  $\text{CuSO}_4 \cdot x\text{H}_2\text{O} \rightarrow \text{CuSO}_4 + x\text{H}_2\text{O}$

$$\text{moles CuSO}_4 = \frac{2.39}{159.5} = 0.0150 \text{ mol}$$

$$\text{mass H}_2\text{O} = 3.74 - 2.39 = 1.35 \text{ g}$$

$$\text{moles H}_2\text{O} = \frac{1.35}{18} = 0.075 \text{ mol}$$

$$\text{Ratio of moles CuSO}_4 : \text{H}_2\text{O} = 0.0150 : 0.0750 = \frac{0.0150}{0.0150} : \frac{0.0750}{0.0150} = 1 : 5$$

$$\therefore x = 5 \text{ (nearest whole number)}$$

Area	Strength	To develop	Area	Strength	To develop	Area	Strength	To develop
Done with care and thoroughness			Can convert units			Use equation to find reacting moles		
Shows suitable working			Which numbers are part of formula			Can work out % atom economy		
Does not round too much			Can work out $M_r$			Can work out % yield		
Can use sig figs			Work out moles from mass			Can deduce reacting ratios		
Gives units			Can work out mass from moles			Water of crystallisation calculations		