# CALCULATIONS MIXTURE 1

1) Sodium reacts with oxygen as shown: $4Na + O_2 \rightarrow 2Na_2O$

Find the $M_r$ of the following substances involved in this reaction.

a) sodium **Na** **23**

b) oxygen **$O_2$** **2(16) = 32**

c) sodium oxide **$Na_2O$** **2(23) + 16 = 62**

2) a) How many moles in the following:

i) 21.3 g of chlorine, $Cl_2$ $\frac{mass}{M_r} = \frac{21.3}{71}$ = **0.3 mol**

ii) 5.34 kg of aluminium bromide, $AlBr_3$ $\frac{mass}{M_r} = \frac{5340}{267}$ = **20 mol**

b) What is the mass of 0.25 moles of sulfur dioxide, $SO_2$? **$M_r$ x moles = 64 x 0.25 = 16 g**

3) What mass of bromine reacts with 2.3 g of sodium to form sodium bromide? $2Na + Br_2 \rightarrow 2NaBr$

**moles Na** = $\frac{mass}{M_r} = \frac{2.3}{23}$ = **0.1 mol**

**moles $Br_2$** = $\frac{0.1}{2}$ = **0.05 mol**

**mass $Br_2$ = $M_r$ x moles = 160 x 0.05 = 8.0 g**

4) What mass of oxygen reacts with 280 g of iron to form iron oxide? $2Fe + 3O_2 \rightarrow 2Fe_2O_3$

**moles Fe** = $\frac{mass}{M_r} = \frac{280}{56}$ = **5 mol**

**moles $O_2$** = 5 x $\frac{3}{2}$ = **7.5 mol**

**mass $O_2$ = $M_r$ x moles = 32 x 7.5 = 240 g**

5) What is the percentage atom economy to make tungsten (W) from tungsten oxide in this reaction? $WO_3 + 3H_2 \rightarrow W + 3H_2O$

| | $WO_3$ + | $3H_2$ → | W + | $3H_2O$ |
|---|---|---|---|---|
| $M_r$ | 232 | 2 | 184 | |
| Mass | 232 g | 3(2) g | 184g | |

% atom economy = $\frac{mass\ of\ desired\ product}{total\ mass\ of\ all\ reactants}$ x 100 = $\frac{184}{232+3(2)}$ x 100 = **77.3%**

6) a) What is the maximum mass of calcium hydroxide that can be formed by reaction of 2.8 g of calcium oxide with water?

$CaO + H_2O \rightarrow Ca(OH)_2$

**moles CaO = $\frac{mass}{M_r}$ = $\frac{2.8}{56}$ = 0.05 mol**

**moles $Ca(OH)_2$ = 0.05 mol**

**mass $Ca(OH)_2$ = $M_r$ x moles = 74 x 0.05 = 3.7 g**

b) In a reaction, 2.6 g of calcium hydroxide was formed from 2.8 g of calcium oxide. Calculate the percentage yield.

**% yield = $\frac{mass\ formed}{maximum\ mass\ possible}$ x 100 = $\frac{2.6}{3.7}$ x 100 = 70.3%**

7) 1.95 g of potassium is reacted with 5.08 g of iodine. Work out which is the limiting reagent and then calculate the mass of potassium iodide formed.

$2K + I_2 \rightarrow 2KI$

**moles K = $\frac{mass}{M_r}$ = $\frac{1.95}{39}$ = 0.05 mol**

**moles $I_2$ = $\frac{mass}{M_r}$ = $\frac{5.08}{254}$ = 0.02 mol**

**$2K + I_2 \rightarrow 2KI$**

**0.05 moles of K needs 0.025 moles of $I_2$ for all the K to react, but we don't have this much $I_2$**

**therefore $I_2$ is the limiting reagent (so the K is in excess and does not all react)**

**therefore only 0.04 moles of K reacts with the 0.02 moles of $I_2$, and forms 0.04 moles of KI**

**mass KI = $M_r$ x moles = 166 x 0.04 = 6.64 g**

8) 1.20 g of hydrated tin chloride decompose to form 1.01 g of anhydrous tin chloride on heating. Calculate the value of *x*.

$SnCl_2.xH_2O \rightarrow SnCl_2 + xH_2O$

**moles $SnCl_2$ = $\frac{1.01}{190}$ = 0.005316 mol**

**mass $H_2O$ = 1.20 – 1.01 = 0.19 g**

**moles $H_2O$ = $\frac{0.19}{18}$ = 0.01056 mol**

**Ratio of moles $SnCl_2 : H_2O$ = 0.005316 : 0.01056 = $\frac{0.005316}{0.005316}$ $\frac{0.01056}{0.005316}$ = 1 : 2**

**∴ x = 2 (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 | | | Understands limiting reagents | | |
| Gives units | | | Can work out mass from moles | | | Water of crystallisation calculations | | |