EXPERIMENT NO. 1

In this question you will use a method involving measuring masses. You will find the identity of a Group 2 element, **Y**, whose hydrated sulfate has the formula $\mathbf{Y}SO_4.7H_2O$.

When heated, the hydrated sulfate loses its water of crystallisation to form anhydrous sulfate. The anhydrous sulfate does not decompose at the temperature of the Bunsen flame.

$$\mathbf{Y}SO_4.7H_2O(s) \rightarrow \mathbf{Y}SO_4(s) + 7H_2O(g)$$

FA 4 is the hydrated sulfate of **Y**, $\mathbf{Y}SO_4.7H_2O$.

(a) Method

- Weigh the crucible with its lid and record the mass.
- Tip between 1.80 g and 2.00 g of **FA 4** into the crucible.
- Weigh and record the mass of crucible, lid and **FA 4**.
- Place the crucible on the pipe-clay triangle on the tripod. Put the lid on the crucible and heat gently for about 1 minute.
- Use tongs to remove the lid and heat the crucible strongly for about 4 minutes. Replace the lid and then leave to cool.
- When cool, reweigh the crucible with its lid and contents and record the mass.
- Calculate and record the mass of **FA 4** before heating, the mass of residue after heating and the mass of water lost.

mass of crucible + lid / g	34.61
mass of crucible + lid + FA4 / g	36.51
mass of FA4 used / g	1.90
mass of crucible + lid + FA4 after heating / g	35.60
mass of anhydrous FA4 / residue / g	0.99
mass of water lost / g	0.91

[4]

(b) Calculations

(i) Calculate the number of moles of water lost on heating **FA 4**.

$n = \frac{m}{M_r} = \frac{0.91}{18}$

moles of H_2O lost = 0.0506 mol [1]

(ii) Deduce the number of moles of anhydrous **Y**SO_4 that are formed when this water is lost.

H_2O : YSO_4

7 : 1

× ×

0.0506 : x

moles of **Y**SO_4 = 7.23×10^{-3} mol [1]

(iii) Use your answer to **(ii)** and the mass of residue left after heating **FA 4** to determine the relative atomic mass, A_r, of **Y**.

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

$M_r = \frac{m}{n} = \frac{0.99}{7.23 \times 10^{-3}} =$ M_r of YSO_4 = 137

A_r of Y = M_r of YSO_4 − M_r of SO_4

= 137 − 96.1

= 40.9

A_r of **Y** = 40.9 [2]

(iv) Identify **Y**.

Y is Calcium [1]

(c) A student did not heat the sample of **FA 4** for long enough to remove all the water.

What would be the effect of this on the calculated value of the relative atomic mass of **Y**?

Explain your answer.

The A_r of Y would be larger as moles of water will be less so the moles of YSO_4.

[2]

[Total: 11]