

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 $\text{YSO}_4 \cdot 7\text{H}_2\text{O}$.

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.



FA 4 is the hydrated sulfate of **Y**, $\text{YSO}_4 \cdot 7\text{H}_2\text{O}$.

(a) Method

- Weigh the crucible with its lid and record the mass.
- Tip between 1.80g and 2.00g 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 + FAA/g	36.51
mass of FAA used /g	1.90
mass of crucible + Lid + FAA after heating/g	35.60
mass of anhydrous FAA/residue /g	0.99
mass of water lost/g	0.91

[4]

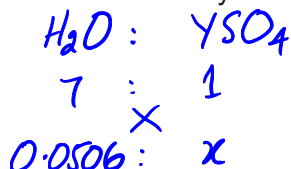
(b) Calculations

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

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

moles of H₂O lost = 0.0506 mol [1]

- (ii) Deduce the number of moles of anhydrous YSO₄ that are formed when this water is lost.



moles of YSO₄ = 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.

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

$$\begin{aligned} A_r \text{ of } Y &= M_r \text{ of } YSO_4 - M_r \text{ of } SO_4 \\ &= 137 - 96.1 \\ &= \boxed{40.9} \end{aligned}$$

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 YSO₄.

[2]

[Total: 11]