EXPERIMENT NO. 6

2 You will now investigate a different hydrated salt with the formula **M**SO_4•$7H_2O$, where **M** is a Group 2 metal. By heating a sample of **M**SO_4•$7H_2O$ to produce anhydrous **M**SO_4 you will determine its relative formula mass and hence identify **M**.

FB 4 is the hydrated salt **M**SO_4•$7H_2O$.

(a) Method

- Weigh the crucible with its lid. Record the mass.
- Place between 1.80 g and 2.20 g of **FB 4** in the crucible.
- Reweigh the crucible, its lid and contents and record the mass.
- Without the lid, place the crucible on the pipe-clay triangle and heat gently for approximately 1 minute and then strongly for approximately 4 minutes.
- Place the lid on the crucible and leave it to cool.
- Reweigh the crucible, its lid and contents and record the mass.
- Calculate, and record, the mass of **FB 4**, the mass of residue after heating and the mass of water lost.

mass of crucible + lid / g	42.06
mass of crucible + lid + FB4 / g	44.06
mass of crucible + lid + FB4 after heating / g	43.07
mass of FB4 used / g	2.00
mass of residue / g	1.01
mass of water lost / g	0.99

[4]

(b) Calculations

(i) Calculate the number of moles of water lost when your sample of **M**SO_4•$7H_2O$ was heated.

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

$$= \frac{0.99}{18}$$

moles of water = ... 0.0550 ..... mol [1]

(ii) Write the equation for the reaction that occurs when **M**SO_4•$7H_2O$ is heated. Include state symbols.

$MSO_4 \cdot 7H_2O_{(s)} \xrightarrow{\text{heat}} MSO_{4(s)} + 7H_2O_{(g)}$

Deduce the number of moles of anhydrous salt, **M**SO_4, left after the heating.

mole ratio

MSO_4	:	H_2O
1	:	7
x	:	0.0500

moles of **M**SO_4 = ... 7.857×10^{-3} ..... mol [1]

(iii) Calculate the relative formula mass, M_r, of **M**SO_4•$7H_2O$.

mole ratio
MSO_4 : $MSO_4.7H_2O$
1 : 1

$M_r = \frac{m}{n} = \frac{2.00}{7.857 \times 10^{-3}}$

M_r of **M**SO_4•$7H_2O$ = 254.6 [1]

(iv) Determine the relative atomic mass, A_r, of **M** and hence identify **M**.
Show your working.

A_r of M = M_r of $MSO_4.7H_2O$ − M_r of $SO_4.7H_2O$
= 254.6 − 222.1
= 32.5

A_r = 32.5

M is Ca
[2]

(c) **(i)** In the method used above, the lid was placed on the crucible when the crucible was left to cool.

Explain why the lid was placed on the crucible.

To avoid water/moisture being picked from air. [1]

(ii) Suggest and explain the effect on the calculated value of the relative atomic mass of **M** if the lid had not been placed on the crucible during cooling.

Higher Ar. Less mass of water lost so less moles of water so higher Mr. [1]

[Total: 11]