

EXPERIMENT NO. 7

- 2 In this experiment you will determine the value of x in the formula for hydrated manganese(II) sulfate, $\text{MnSO}_4 \cdot x\text{H}_2\text{O}$, where x is an integer. You will do this by measuring the mass lost when a sample of hydrated manganese(II) sulfate is heated.



FA 4 is hydrated manganese(II) sulfate, $\text{MnSO}_4 \cdot x\text{H}_2\text{O}$.

(a) Method

- Weigh the crucible with a lid and record the mass.
- Add all the **FA 4** to the crucible.
- Reweigh the crucible with the lid and **FA 4**. Record the mass. Describe the appearance of **FA 4**.

appearance of **FA 4** *Pale Pink solid*

- Place the crucible in the pipe-clay triangle on top of the tripod.
- Heat the crucible **gently** with the lid on for approximately 1 minute.
- Remove the lid and then heat more strongly for a further 4 minutes.
- Replace the lid and allow the crucible to cool.
- Once the crucible has cooled, reweigh the crucible with the lid and contents. Record the mass.
- Calculate and record the mass of **FA 4** added to the crucible, the mass of the residue and the mass of water lost.
- Describe the appearance of the residue.

appearance of the residue *off-white solid*

mass of crucible + lid /g	46.21
mass of crucible + lid + FA4 /g	48.12
mass of crucible + lid + FA4 after heating /g	47.86
mass of FA4 added /g	1.91
mass of residue left /g	1.65
mass of water lost /g	0.26

I	
II	
III	
IV	
V	
VI	

[6]

(b) Calculations

- (i) Calculate the number of moles of manganese(II) sulfate present in the residue. You may assume all the water of crystallisation has been removed.

$$n = \frac{m}{M_r}$$
$$= \frac{1.65}{151}$$

moles of $\text{MnSO}_4 = 0.0109$ mol [1]

- (ii) Calculate the number of moles of water lost.

$$n = \frac{m}{M_r}$$
$$= \frac{0.26}{18}$$

moles of water lost = 0.0144 mol [1]

- (iii) Calculate the value of x in $\text{MnSO}_4 \cdot x\text{H}_2\text{O}$.

$$n \text{ of } \text{MnSO}_4 : n \text{ of } \text{H}_2\text{O}$$

$$0.0109 : 0.0144$$

$$1 : x$$

1	:	1.32 ≈ 1
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x = 1 [1]

- (c) It is possible that **FA 4** did not lose all of the water of crystallisation in your experiment.

- (i) Explain how you could modify the experiment to ensure all water has been removed.

Reheat the contents to get constant mass [1]

- (ii) Explain why your calculated value of x might not change if a small amount of water of crystallisation remained in the residue.

The changes in masses will be too small to change the integer value of x. [1]

[Total: 11]