

**Chemistry**  
**Standard level**  
**Paper 1B**

Practice paper

**Topic: Stoichiometric Relationships (Topic 1)**

1. A student carried out an experiment to determine the value of  $x$  in hydrated copper(II) sulfate,  $\text{CuSO}_4 \cdot x\text{H}_2\text{O}$ .

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| Mass of crucible / g                         | 15.25 |
| Mass of crucible + hydrated salt / g         | 20.24 |
| Mass of crucible + residue after heating / g | 18.44 |

(a) Calculate the mass of water lost from the salt. [1]

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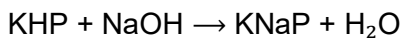
(b) Determine the number of moles of anhydrous  $\text{CuSO}_4$  and water in the sample. [2]

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(c) Calculate the value of  $x$  in the formula  $\text{CuSO}_4 \cdot x\text{H}_2\text{O}$ . [1]

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2. A titration was conducted to determine the concentration of a sodium hydroxide (NaOH) solution using a primary standard of potassium hydrogen phthalate (KHP,  $M_r = 204.22$ ) according to the following equation:



Buret readings for NaOH (initial =  $0.00 \text{ cm}^3$ ):

Trial 1:  $22.45 \text{ cm}^3$

Trial 2:  $21.95 \text{ cm}^3$

Trial 3:  $22.05 \text{ cm}^3$

(a) Calculate the average titre, considering concordant results only.

**[1]**

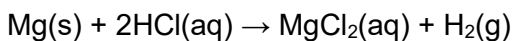
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(b) If  $0.450 \text{ g}$  of KHP was neutralized by the average titre of NaOH, calculate the concentration of the NaOH solution.

**[3]**

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3. Magnesium reacts with excess hydrochloric acid to produce hydrogen gas:



0.050 g of Mg was reacted, and 52 cm<sup>3</sup> of H<sub>2</sub> was collected at 20 °C and 101 kPa.

(a) Calculate the number of moles of hydrogen gas expected theoretically from 0.050 g of Mg. **[1]**

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(b) Use the ideal gas law ( $PV = nRT$ ) to calculate the number of moles of hydrogen gas actually collected. ( $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$ ). **[2]**

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(c) Calculate the percentage yield of the reaction. **[1]**

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