

**Chemistry**  
**Higher level**  
**Paper 1B**

2 hours [Paper 1A and 1B]

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**Instructions to candidates**

- Do not open the examination paper until instructed to do so.
- Answer all questions
- Answers must be written in the answer boxes provided.
- A calculator is required for this paper.
- A clean copy of the **chemistry data booklet** is required for this paper.
- The maximum mark for paper 1B is **[35 marks]**.
- The maximum mark for paper 1A and paper 1B is **[75 marks]**.

## Section B

Answer **all** questions. Answers must be written in the answer boxes provided.

1. A student is conducting a series of tests to classify four solutions, labelled A, B, C and D, as weak or strong acids or bases.

(a) The results of the first test, electrical conductivity, are shown in the table.

Solution	Brightness of bulb
A	Bright
B	Dim
C	Dim
D	Bright

Classify A and B as weak or strong bases. Give a reason for your answer. [2]

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(b) In the second test, the student measures the pH of the solutions. The results are shown in the table.

Solution	pH
A	14
B	9
C	5
D	1

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- (i) Calculate the  $[H^+]$  in solutions A and C. [2]

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- (ii) Use your answer to part (i) to determine the difference in  $[H^+]$  between solutions A and C. [1]

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(c) The final test involved the student adding small pieces of magnesium to solutions C and D.

- (i) Predict the rate of reaction of magnesium with solutions C and D. [1]

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- (ii) Classify C and D as weak or strong acids, giving a reason in each case. [2]

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(iii) Suggest why the student did not add magnesium to solutions A and B. [1]

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2. Brass is an alloy composed of copper and zinc.

(a) Explain how brass is harder than pure metals such as copper or zinc. [2]

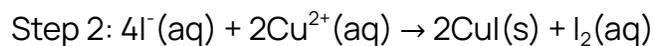
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(b) A student carries out an experiment to calculate the percentage by mass of copper in a sample of brass with a mass of 0.750 g. The three steps of the reaction are shown.



Deduce the change in the oxidation state of the copper and the reducing agent in step 2. [2]

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(c) The  $I_2$  produced in step 3 is titrated with  $31.50 \text{ cm}^3$  of  $1.00 \text{ mol dm}^{-3} \text{ Na}_2\text{S}_2\text{O}_3(\text{aq})$ .

(i) Calculate the amount, in mol, of  $\text{S}_2\text{O}_3^{2-}(\text{aq})$  used in the titration. [1]

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(ii) Determine the mole ratio of  $\text{S}_2\text{O}_3^{2-}(\text{aq})$  in step 3 to  $\text{Cu}(\text{s})$  in step 1. [1]

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(iii) Determine the mass of copper in the sample of brass. [2]

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(iv) Calculate the percentage composition by mass of copper and zinc in the sample of brass. [2]

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3. The boiling points and solubilities of five members of the alcohol homologous series are shown in the table.

Alcohol	Formula	Boiling point (°C)	Solubility (g / 100 g)
Ethanol	CH <sub>3</sub> CH <sub>2</sub> OH	78	Completely soluble
Propan-1-ol	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> OH	97	Completely soluble
Butan-1-ol	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> OH	117	9
Pentan-1-ol	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> OH	138	2.7
Hexan-1-ol	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> OH	158	0.6

- (a) State the general formula of the alcohol homologous series. [1]

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- (b) Explain the increase in the boiling points of the five members of the alcohol homologous series. [2]

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(c) Suggest a reason why the solubility of the alcohol decreases from ethanol to hexan-1-ol. [1]

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(d) Predict the boiling point and solubility of decan-1-ol, the tenth member of the alcohol homologous series. [2]

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4. Potassium hydrogen carbonate,  $\text{KHCO}_3$ , reacts with hydrochloric acid as shown.



(a) Determine the limiting reactant in the reaction if 6.96 g of  $\text{KHCO}_3$  is reacted with  $50.0 \text{ cm}^3$  of  $2.00 \text{ mol dm}^{-3}$   $\text{HCl}(\text{aq})$ . [2]

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(b) Determine the heat released, in J, for the reaction using the data in the table below. [2]

Initial temperature of solution / °C	25.5
Final temperature of solution / °C	15.5
Specific heat capacity of solution / J g <sup>-1</sup> °C	4.18

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(c) Calculate the enthalpy change,  $\Delta H$ , for the reaction in kJ mol<sup>-1</sup>. [2]

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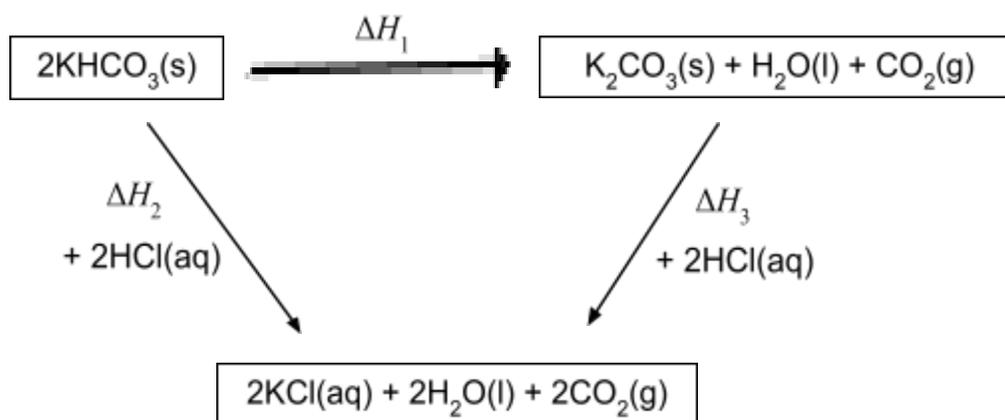
(d) Suggest the main source of error in the experiment. [1]

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- (e) An energy cycle for the reaction is shown below. The enthalpy change for  $\Delta H_3$  was determined to be  $-34.0 \text{ kJ mol}^{-1}$ . Calculate the value of  $\Delta H_1$  using this value and your answer to part (c). [3]



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