Temperature changes in reactions

Chemistry required practical | AQA Combined Science 8464 and AQA GCSE Chemistry 8462 | 14 questions, 35 marks

GCSE science required practicals

This practical online

Name: _____ **Date:** _____ **Score:** _____ **/ 35**

Aim: To find out how the volume of sodium hydroxide solution added to hydrochloric acid affects the temperature change of the neutralisation reaction.

Equipment: polystyrene cup with a lid that has a hole for the thermometer; 250 cm^3 beaker to hold the cup steady; thermometer (-10 to 50 °C, 0.1 °C divisions) or temperature probe; two 50 cm^3 measuring cylinders; dilute hydrochloric acid; sodium hydroxide solution; glass stirring rod; safety goggles.

Results

Zara added different volumes of sodium hydroxide solution to 25 cm^3 portions of hydrochloric acid in a polystyrene cup, and recorded the highest temperature each time.

Volume of sodium hydroxide added in cm^3	Starting temperature in °C	Highest temperature in °C	Temperature rise in °C
5	19.8	23.9	4.1
10	20.1	27.4	7.3
15	19.6	26.5	6.9
20	19.9	31.3	?
25	20.0	32.6	12.6
30	19.7	31.4	11.7
35	20.2	30.8	10.6
40	19.8	29.6	9.8

Questions

1 Name the independent variable and the dependent variable in Zara's investigation. (2 marks)

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2 Give one control variable and explain why it must be kept the same. (2 marks)

3 Explain why the reaction is done in a polystyrene cup with a lid instead of a glass beaker. (2 marks)

4 Give one hazard in this practical and a way of reducing the risk. (2 marks)

5 Calculate the missing temperature rise for 20 cm^3 of sodium hydroxide. (1 mark)

6 Is the reaction between hydrochloric acid and sodium hydroxide exothermic or endothermic? Explain how the table shows this. (2 marks)

7 Identify the anomalous result and explain how you can tell. (2 marks)

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8 Describe the pattern in the temperature rise as more sodium hydroxide is added, and explain why it changes after 25 cm^3.

(3 marks)

9 Zara repeated the 25 cm^3 experiment twice more and got temperature rises of 12.9 °C and 12.4 °C. Calculate the mean temperature rise for 25 cm^3, using all three results. Give your answer to 1 decimal place. Show your working.

(3 marks)

10 **Higher tier**

The reaction between hydrochloric acid and sodium hydroxide is exothermic. Explain why, in terms of the energy needed to break bonds and the energy released when bonds are made.

(3 marks)

11 **Higher tier**

Zara's results go up in steps of 5 cm^3, so she cannot be sure that the peak is exactly at 25 cm^3. Suggest how she could find the volume for the maximum temperature rise more precisely.

(2 marks)

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12 Zara's thermometer has 0.1 °C divisions. Kai repeated the investigation with a thermometer that has only 1 °C divisions. Explain why Zara's results are better for comparing temperature rises, and give one further advantage of using a temperature probe and data logger.

(3 marks)

13 Zara's results are lower than the true values because some energy is always lost through the open top of the cup. Is this a random or a systematic error? Explain your answer.

(2 marks)

14 When magnesium powder is added to copper(II) sulfate solution, the temperature rises. Plan an investigation to find out how the mass of magnesium powder affects the temperature rise.

(6 marks)

End of questions | Total 35 marks | The answers sheet has the full method as revision notes.

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