14 Information about two reactions is given.

- The neutralisation reaction between citric acid and sodium hydrogencarbonate is endothermic.
- The displacement reaction between magnesium and carbon dioxide is exothermic.

Which statements about the two reactions are correct?

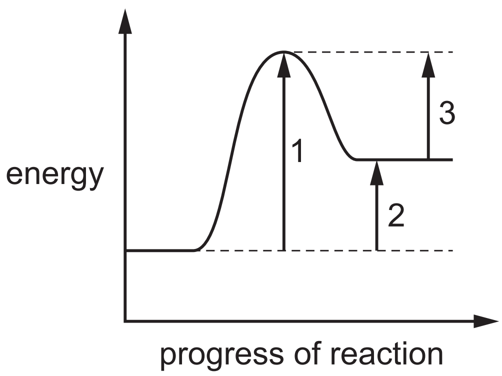
1 The energy of the products formed in the neutralisation reaction is greater than the energy of the reactants.

2 The energy of magnesium and carbon dioxide is greater than the energy of magnesium oxide and carbon.

3 In an exothermic reaction, the energy required to break the bonds is greater than the energy released when the new bonds are formed.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

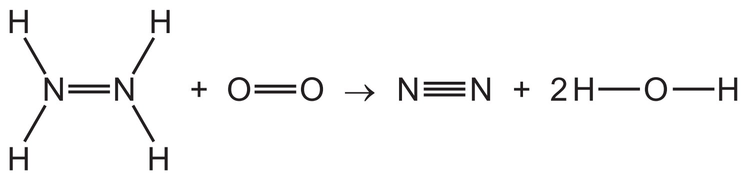
15 The reaction pathway diagram for a reaction is shown.



Which row identifies the activation energy, E_a, and the enthalpy change, ΔH, for this reaction?

	E_a	ΔH
A	1	2
B	1	3
C	2	3
D	3	1

14 The equation for the combustion of hydrazine, N_2H_4, is shown.



bond	bond energy in kJ / mol
N–H	391
N=N	409
N≡N	944
O–H	463
O=O	496

What is the overall enthalpy change for the combustion of one mole of hydrazine?

A –327 kJ / mol

B –111 kJ / mol

C +111 kJ / mol

D +327 kJ / mol

15 Dissolving ammonium chloride in water is an endothermic change.

Which row shows the energy change and temperature change of the mixture during the dissolving of ammonium chloride?

	energy change	temperature change
A	energy is absorbed	decrease
B	energy is absorbed	increase
C	energy is released	decrease
D	energy is released	increase

2 A student investigates the temperature change when a 5 cm length of coiled magnesium ribbon reacts with excess dilute sulfuric acid.

The student does five experiments.

Experiment 1

- Rinse a burette with distilled water and then with dilute sulfuric acid.
- Fill the burette with dilute sulfuric acid. Run some of the dilute sulfuric acid out of the burette so that the level of the dilute sulfuric acid is on the 0.0 cm^3 mark.
- Use the burette to add 30.0 cm^3 of dilute sulfuric acid to a boiling tube.
- Use a thermometer to measure the initial temperature of the acid.
- Record the initial temperature.
- Add a coil of magnesium ribbon to the boiling tube. At the same time start a stop-watch.
- Continually stir the contents of the boiling tube using the thermometer.
- After 1 minute, measure the temperature of the mixture in the boiling tube.
- Record this temperature.

Experiment 2

- Refill the burette with dilute sulfuric acid. Run some of the dilute sulfuric acid out of the burette so that the level of the dilute sulfuric acid is on the 0.0 cm^3 mark.
- Use the burette to add 25.0 cm^3 of dilute sulfuric acid to a new boiling tube.
- Use the thermometer to measure the initial temperature of the acid.
- Record the initial temperature.
- Add a coil of magnesium ribbon to the boiling tube. At the same time start the stop-watch.
- Continually stir the contents of the boiling tube using the thermometer.
- After 1 minute, measure the temperature of the mixture in the boiling tube.
- Record this temperature.

Experiment 3

- Repeat Experiment 2, using 20.0 cm^3 of dilute sulfuric acid instead of 25.0 cm^3.

Experiment 4

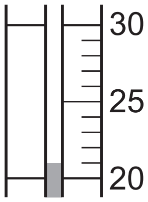
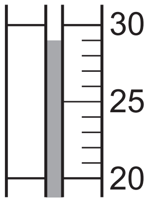
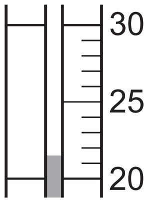
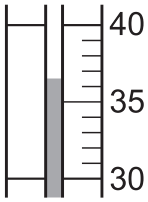
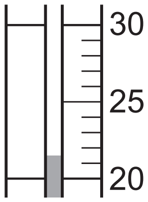
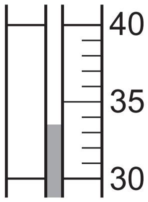
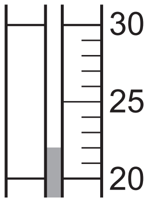
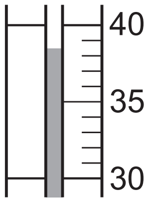
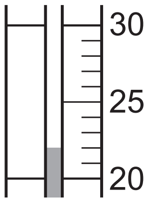
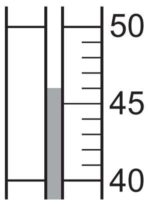
- Repeat Experiment 2, using 15.0 cm^3 of dilute sulfuric acid instead of 25.0 cm^3.

Experiment 5

- Repeat Experiment 2, using 10.0 cm^3 of dilute sulfuric acid instead of 25.0 cm^3.

(a) Use the thermometer diagrams to complete Table 2.1.

Table 2.1

experiment	volume of dilute sulfuric acid / cm^3	thermometer diagram for initial temperature / °C	initial temperature / °C	thermometer diagram for temperature after 1 minute / °C	temperature after 1 minute / °C	temperature increase / °C
1	30.0					
2	25.0					
3	20.0					
4	15.0					
5	10.0					

[4]

(b) On Fig. 2.1, complete a suitable scale on the *y*-axis and plot the results from Experiments 1 to 5. Draw a line of best fit.

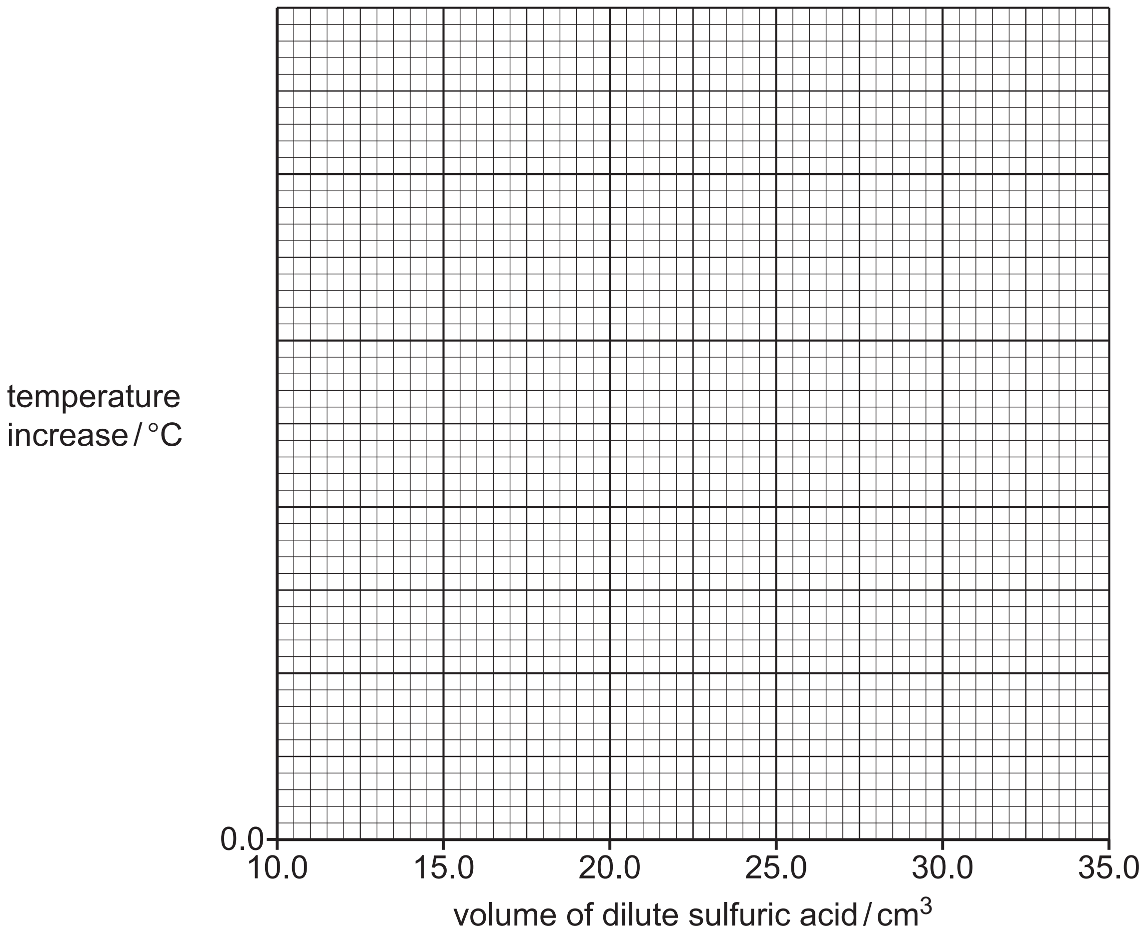


Fig. 2.1

[4]

(c) Explain why the temperature increase changes as the volume of dilute sulfuric acid changes.

....

....

.... [2]

(d) Extrapolate the line of best fit on your graph in Fig. 2.1 to deduce the temperature increase if 33.0 cm^3 of dilute sulfuric acid is used.

Show clearly **on Fig. 2.1** how you worked out your answer.

temperature increase = ... [3]

(e) The investigation is repeated using 2.5 cm lengths of coiled magnesium ribbon instead of 5 cm lengths.

On Fig. 2.1, sketch a line to show the results you would expect. Label this line **E**. [1]

(f) **(i)** Give **one** reason why a burette, rather than a measuring cylinder, is used to measure the volume of the dilute sulfuric acid.

....

.... [1]

(ii) Explain why the contents of the boiling tube are stirred during each experiment.

....

.... [1]

(g) Describe **one** change to the apparatus that will give more accurate results.

Explain your answer.

change to apparatus ....

....

explanation ....

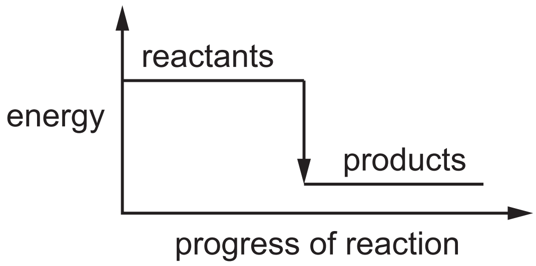
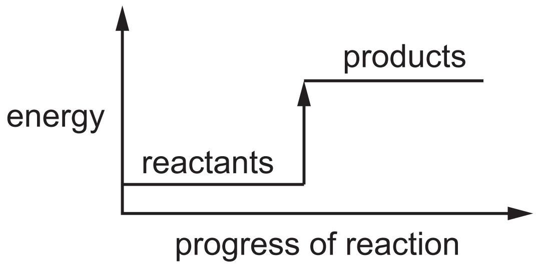
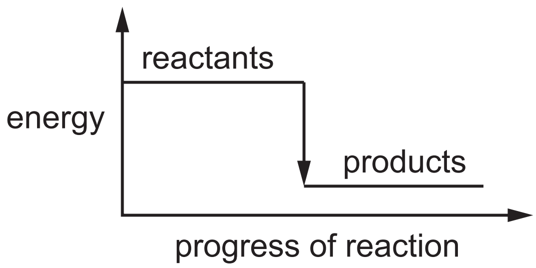
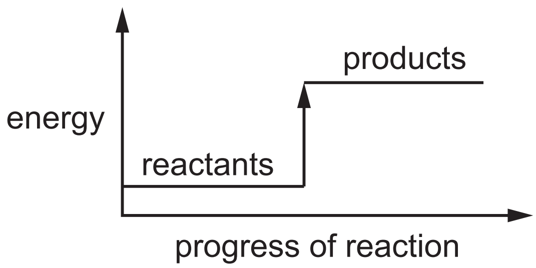
....
[2]

[Total: 18]

13 Water is added to anhydrous copper(II) sulfate in a test-tube.

The mixture becomes hot.

Which type of reaction and reaction pathway diagram apply to this reaction?

	type of reaction	reaction pathway diagram
A	endothermic	
B	endothermic	
C	exothermic	
D	exothermic	

IGCSE Chemistry: **s25 22**

14 The average bond energy for the C–H bond is 413 kJ / mol.

What is the enthalpy change when 1.0 mol of methane molecules is formed from carbon and hydrogen atoms?

A –1652 kJ **B** –413 kJ **C** +413 kJ **D** +1652 kJ

13 Which row describes an exothermic reaction?

	sign of enthalpy change, ΔH	temperature of the surroundings
A	positive	decreases
B	positive	increases
C	negative	decreases
D	negative	increases

IGCSE Chemistry: **m25 22**

17 The equation for the complete combustion of methane is shown.

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$$

The table shows some bond energies.

bond	bond energy in kJ / mol
C–H	410
C=O	805
O=O	496
O–H	460

What is the enthalpy change for this reaction?

A –1458 kJ / mol

B –818 kJ / mol

C –359 kJ / mol

D +102 kJ / mol