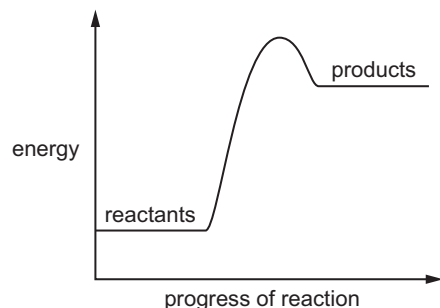


13 A reaction pathway diagram is shown.



Which row identifies the type of reaction and how the temperature of the surroundings changes during the reaction?

|   | type of reaction | temperature of the surroundings |
|---|------------------|---------------------------------|
| A | endothermic      | decreases                       |
| B | endothermic      | increases                       |
| C | exothermic       | decreases                       |
| D | exothermic       | increases                       |

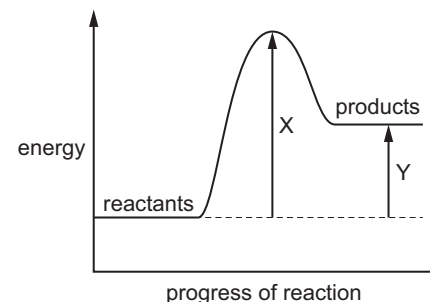
11 Two statements about hydrogen are listed.

- 1 Hydrogen is used as a fuel.
- 2 When hydrogen burns in the air to form water, thermal energy is produced.

Which conclusion about these statements is correct?

- A Both statements are correct, and statement 2 explains statement 1.  
 B Both statements are correct, but statement 2 does **not** explain statement 1.  
 C Statement 1 is correct, but statement 2 is **not** correct.  
 D Statement 2 is correct, but statement 1 is **not** correct.

14 A reaction pathway diagram is shown.



Which row shows the correct labels for X and Y and the type of reaction taking place?

|   | X                 | Y                 | type of reaction |
|---|-------------------|-------------------|------------------|
| A | enthalpy change   | activation energy | exothermic       |
| B | activation energy | enthalpy change   | endothermic      |
| C | activation energy | enthalpy change   | exothermic       |
| D | enthalpy change   | activation energy | endothermic      |

6 This question is about the Periodic Table.

(a) State the name given to Group VII elements.

..... [1]

(b) State which Group VII element is most reactive.

..... [1]

(c) Give the physical state and colour of iodine at room temperature and pressure.

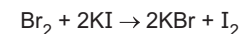
state .....

colour .....

[2]

(d) When bromine is added to aqueous potassium iodide a displacement reaction occurs.

The equation for the reaction is shown.

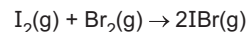


(i) Write an ionic equation for the reaction.

..... [2]

- (ii) Iodine and bromine react at high temperatures to form iodine monobromide, IBr.

The equation is shown.



The structures of the molecules involved in the reaction are I–I, Br–Br and I–Br.

**Table 6.1**

| bond  | bond energy in kJ/mol |
|-------|-----------------------|
| I–I   | 150                   |
| Br–Br | 193                   |
| I–Br  | 175                   |

Calculate the enthalpy change,  $\Delta H$ , for the reaction using the bond energies in Table 6.1.

Use the following steps.

- Calculate the **total** amount of energy required to break the bonds in 1 mol of  $\text{I}_2(\text{g})$  and 1 mol of  $\text{Br}_2(\text{g})$ .

..... kJ

- Calculate the total amount of energy released when the bonds in 2 mol of IBr(g) are formed.

..... kJ

- Calculate the enthalpy change,  $\Delta H$ , for the reaction.  
Your answer should include a sign.

..... kJ/mol  
[3]

- (e) Sodium is in Group I of the Periodic Table.

When sodium is added to water a chemical reaction occurs.

- (i) Give **two** observations when sodium is added to water.

1 .....

2 .....

[2]

- (ii) Thymolphthalein is added to the solution when the reaction has finished.

State the final colour of the thymolphthalein in the solution.

..... [1]

[Total: 12]

## Group

the volume of one mole of any gas is  $24 \text{ dm}^3$  at room temperature and pressure (r.t.p.).

The student does five experiments.

## Experiment 1

- Use a 50 cm<sup>3</sup> measuring cylinder to pour 40 cm<sup>3</sup> of distilled water into a 100 cm<sup>3</sup> beaker.
- Use a thermometer to measure the initial temperature of the water.
- Add a 2.0 g sample of anhydrous lithium chloride to the water in the beaker.
- Continually stir the mixture in the beaker using the thermometer.
- Measure the highest temperature reached by the mixture in the beaker.
- Empty the beaker and rinse the beaker with distilled water.

## Experiment 2

- Repeat Experiment 1 using 30 cm<sup>3</sup> of distilled water instead of 40 cm<sup>3</sup>.

### Experiment 3

- Repeat Experiment 1 using 25 cm<sup>3</sup> of distilled water instead of 40 cm<sup>3</sup>.

## Experiment 4

- Repeat Experiment 1 using 20 cm<sup>3</sup> of distilled water instead of 40 cm<sup>3</sup>.

## Experiment 5

- Repeat Experiment 1 using 15 cm<sup>3</sup> of distilled water instead of 40 cm<sup>3</sup>.

- (a) Use the information in the description of the experiments and the thermometer diagrams to complete Table 2.1.

Table 2.1

| experiment | mass of anhydrous lithium chloride /g | volume of distilled water /cm <sup>3</sup> | initial temperature /°C | thermometer diagram for highest temperature reached /°C | highest temperature reached /°C | temperature change /°C |
|------------|---------------------------------------|--------------------------------------------|-------------------------|---------------------------------------------------------|---------------------------------|------------------------|
| 1          | 2.0                                   | 40                                         | 22.5                    |                                                         |                                 |                        |
| 2          |                                       | 30                                         | 22.5                    |                                                         |                                 |                        |
| 3          |                                       | 25                                         | 22.5                    |                                                         |                                 |                        |
| 4          |                                       | 20                                         | 22.0                    |                                                         |                                 |                        |
| 5          |                                       | 15                                         | 22.0                    |                                                         |                                 |                        |

(7)

[4]

- (b) Complete a suitable scale on the y-axis and plot your results from Experiments 1 to 5 on Fig. 2.1.

Draw a line of best fit.

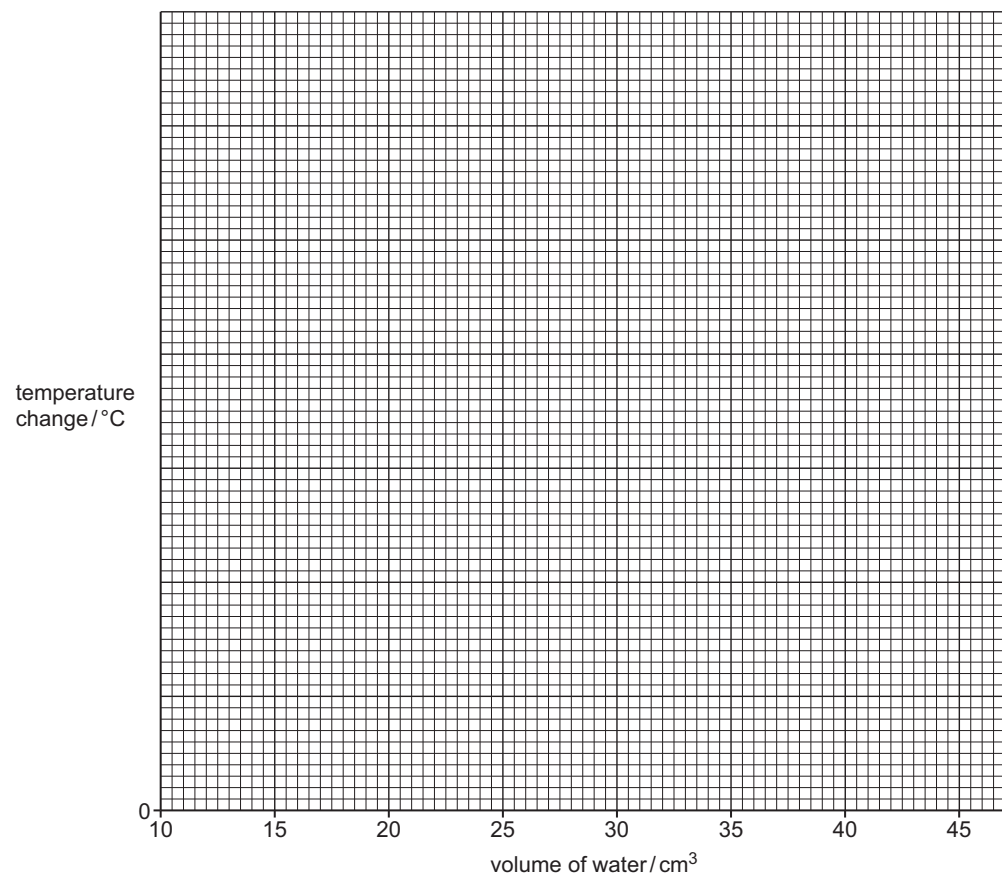


Fig. 2.1

[4]

- (c) Extrapolate the line on your graph in Fig. 2.1 to deduce the temperature change when Experiment 1 is repeated with 45 cm<sup>3</sup> of water instead of 40 cm<sup>3</sup> of water.

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

temperature change = ..... [3]

(8)

- (d) The energy, in J, given out when 2.0g of anhydrous lithium chloride dissolves is calculated using the equation shown.

$$\text{energy given out} = \text{temperature change} \times 4.2 \times \text{volume of water}$$

Calculate the energy given out when 2.0g of anhydrous lithium chloride dissolves in Experiment 5.

$$\text{energy given out} = \dots\dots\dots \text{ J [1]}$$

- (e) Estimate the temperature change when Experiment 1 is repeated using 4.0g of anhydrous lithium chloride instead of 2.0g.

Give a reason for your answer.

temperature change .....

reason .....

..... [2]

- (f) Explain why the results obtained would be more accurate if the beaker used in each experiment was replaced by a polystyrene cup.

.....

.....

..... [2]

- (g) (i) Explain why using a burette instead of a measuring cylinder is an improvement.

.....

..... [1]

- (ii) Explain why standing the beaker in a water-bath is **not** an improvement.

.....

..... [1]

[Total: 18]