

Energy changes – GCSE Chemistry

1. No.10

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This question is about temperature changes.

A student investigated the change in temperature of a solution when different masses of ammonium nitrate were dissolved in water.

This is the method used.

1. Measure 200 cm³ of water into a polystyrene cup.
2. Measure the temperature of the water.
3. Add 4.0 g of ammonium nitrate to the water.
4. Stir the solution until all the ammonium nitrate has dissolved.
5. Measure the lowest temperature reached by the solution.
6. Repeat steps 1 to 5 with different masses of ammonium nitrate.

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Give the independent variable and the dependent variable in the investigation.

[2 marks]

Independent variable _____

Dependent variable _____

1 0 . 1

Give the independent variable and the dependent variable in the investigation.

[2 marks]

Independent variable _____

Dependent variable _____

Table 6 shows the results.

Table 6

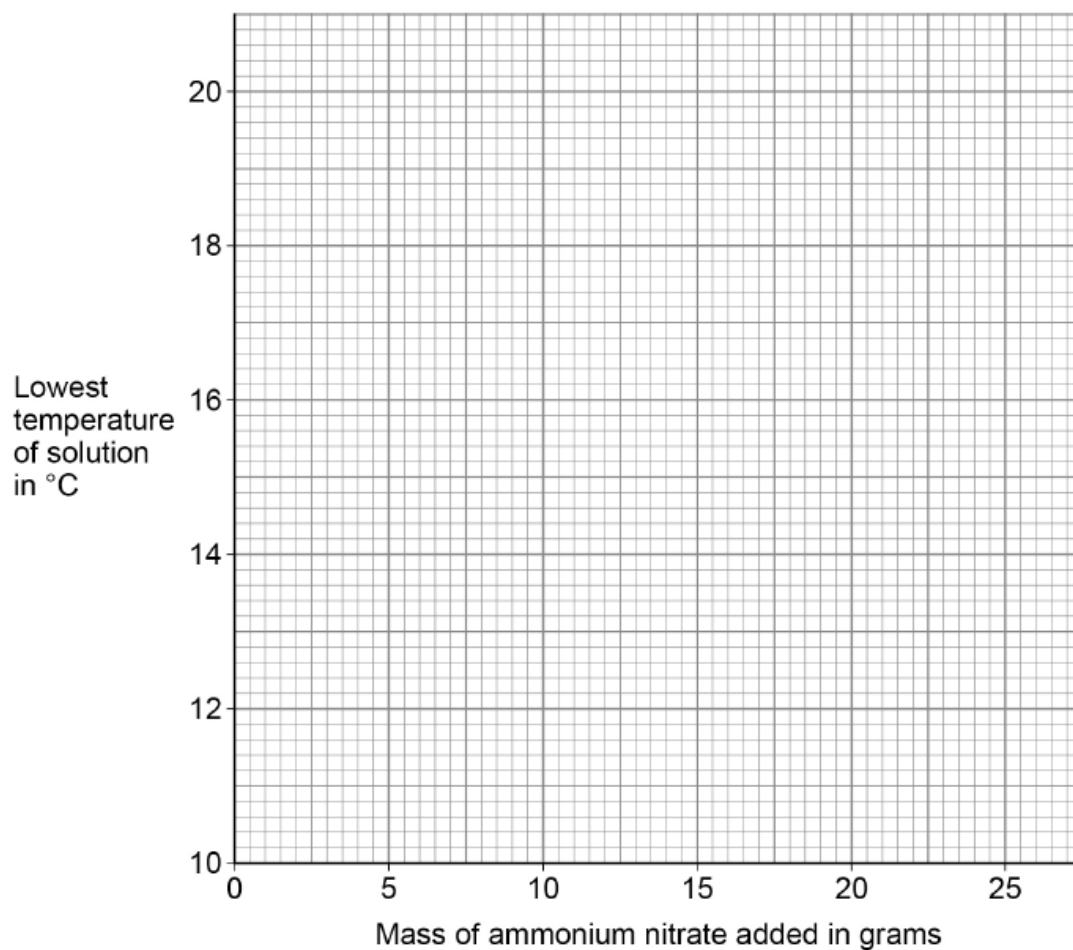
Mass of ammonium nitrate added in grams	Lowest temperature of solution in °C
4.0	18.2
8.0	16.2
12.0	15.2
16.0	13.6
20.0	12.4
24.0	10.6

1 0 . 2 Plot the data from **Table 6** on **Figure 11**.

Draw a line of best fit.

[3 marks]

Figure 11



1 0 . 3 Determine the initial temperature of the water.

You should extend your line of best fit on **Figure 11**.

[2 marks]

Initial temperature of the water = _____ °C

1 0 . 4 How do the results show that dissolving ammonium nitrate in water is endothermic?

[1 mark]

The student repeated the experiment three more times.

Table 7 shows the results for 8.0 g of ammonium nitrate.

Table 7

	Trial 1	Trial 2	Trial 3	Trial 4	Mean
Lowest temperature of solution in °C	16.2	16.6	16.8	16.4	16.5

- 10.5 The student recorded the mean lowest temperature of the solution for 8.0 g of ammonium nitrate as 16.5 ± 0.3 °C.

Explain why the student included ± 0.3 °C after the mean lowest temperature.

[2 marks]

- 10.6 What type of error is shown by the results in Table 7?

[1 mark]

Tick (✓) one box.

Random error

☐

Systematic error

☐

Zero error

☐

2. No.2

0 2

This question is about temperature changes.

A student investigated the change in temperature of a solution when different masses of ammonium nitrate were dissolved in water.

This is the method used.

1. Measure 200 cm³ of water into a polystyrene cup.
2. Measure the temperature of the water.
3. Add 4.0 g of ammonium nitrate to the water.
4. Stir the solution until all the ammonium nitrate has dissolved.
5. Measure the lowest temperature reached by the solution.
6. Repeat steps 1 to 5 with different masses of ammonium nitrate.

0 2

1

Give the independent variable and the dependent variable in the investigation.

[2 marks]

Independent variable _____

Dependent variable _____

Table 2 shows the results.

Table 2

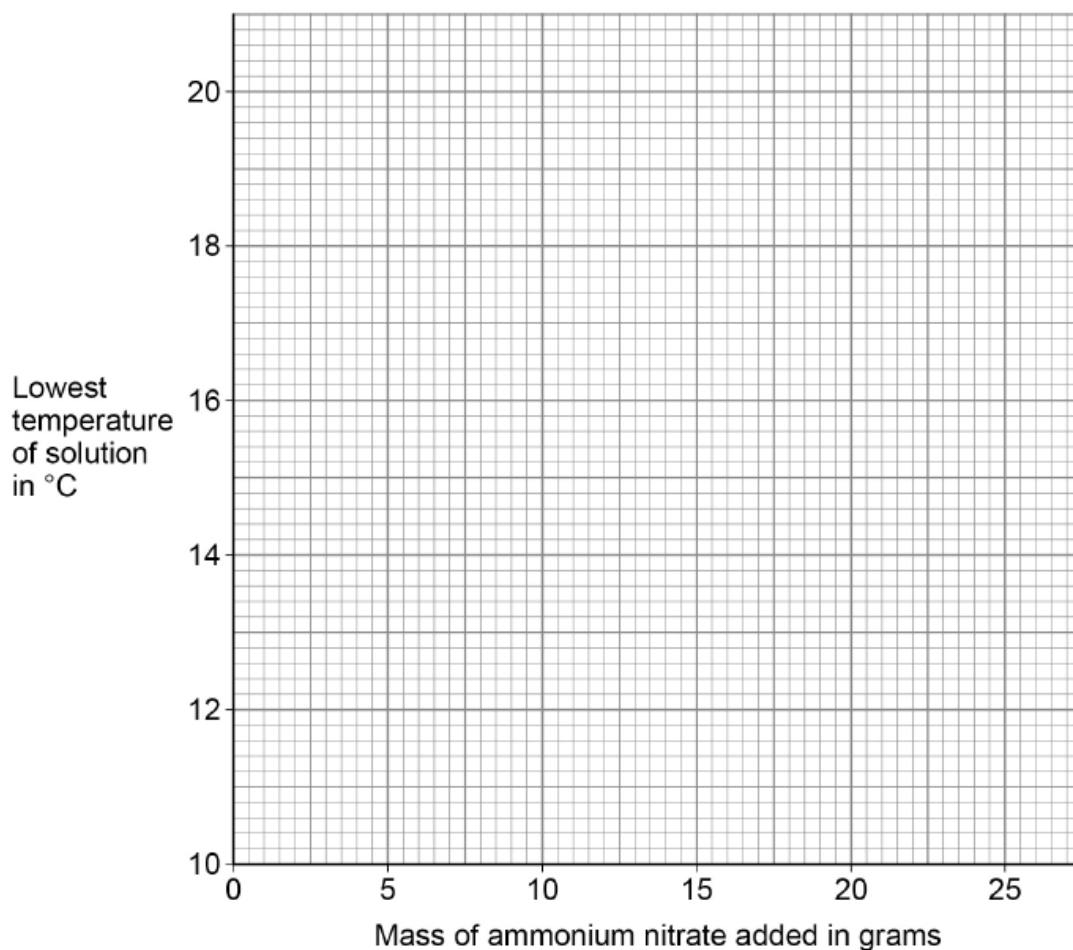
Mass of ammonium nitrate added in grams	Lowest temperature of solution in °C
4.0	18.2
8.0	16.2
12.0	15.2
16.0	13.6
20.0	12.4
24.0	10.6

0 2 . 2 Plot the data from **Table 2** on **Figure 2**.

Draw a line of best fit.

[3 marks]

Figure 2



0 2 . 3 Determine the initial temperature of the water.

You should extend your line of best fit on **Figure 2**.

[2 marks]

Initial temperature of the water = _____ °C

0 2 . 4 How do the results show that dissolving ammonium nitrate in water is endothermic?

[1 mark]

The student repeated the experiment three more times.

Table 3 shows the results for 8.0 g of ammonium nitrate.

Table 3

	Trial 1	Trial 2	Trial 3	Trial 4	Mean
Lowest temperature of solution in °C	16.2	16.6	16.8	16.4	16.5

0 2 . 5

The student recorded the mean lowest temperature of the solution for 8.0 g of ammonium nitrate as 16.5 ± 0.3 °C.

Explain why the student included ± 0.3 °C after the mean lowest temperature.

[2 marks]

0 2 . 6

What type of error is shown by the results in Table 3?

[1 mark]

Tick (✓) **one** box.

Random error

☐

Systematic error

☐

Zero error

☐

3. No.4

0 4

This question is about hydrogen and compounds of hydrogen.

Figure 3 shows the displayed formulae for the reaction between hydrogen and chlorine.

Figure 3



Table 4 shows the bond energies.

Table 4

Bond	H — H	Cl — Cl	H — Cl
Bond energy in kJ/mol	436	346	432

0 4 . 1

Which expression shows how to calculate the overall energy change for the reaction in **Figure 3**?

Use **Table 4**.

[1 mark]

Tick (✓) **one** box.

436 + 346 + 432 kJ/mol

☐

436 + 346 + (2 × 432) kJ/mol

☐

436 + 346 – 432 kJ/mol

☐

436 + 346 – (2 × 432) kJ/mol

☐

The reaction between hydrogen and chlorine is exothermic.

0 4 . 2

Explain why this reaction releases energy to the surroundings.

[2 marks]

0 4 . 3

Figure 4 shows part of a reaction profile for the reaction between hydrogen and chlorine.

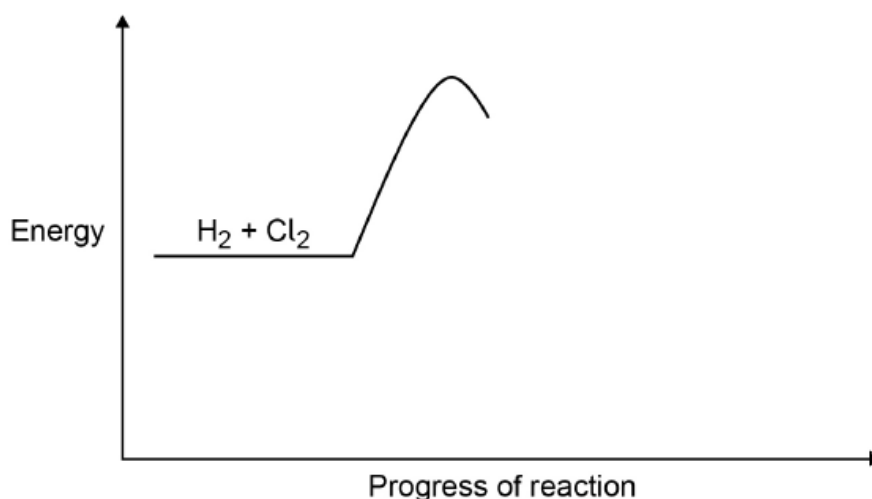
Complete the reaction profile in **Figure 4**.

You should:

- label the activation energy
- label the overall energy change.

[3 marks]

Figure 4



0 4 . 4

Draw a dot and cross diagram for a molecule of hydrogen chloride (HCl).

Show the outer shell electrons only.

[2 marks]

0 4 . 5 Figure 5 represents molecules of methane and of poly(ethene).

Figure 5



Methane is a gas at room temperature but poly(ethene) is a solid at room temperature.

Explain why methane and poly(ethene) exist in different states at room temperature.

[4 marks]
