AQA GCSE Chemistry

Energy changes · Higher tier

Questions only

The newest questions on the Higher papers, about an hour. All 7 are in the exam generator.

Questions	Total marks	Time allowed
5	**56**	**59 min**

Name _____ Class or teacher _____ Date _____

Instructions

- Answer all questions in the spaces provided.
- Use black ink. Show your working for every calculation.
- You may use a scientific calculator and the periodic table insert.
- Print the separate mark scheme when you are ready to mark your answers.

For marking

Q	Source	Marks	Score
1	2023 P1H Q2 / P1F Q10	11	
2	2024 P1H Q4	14	
3	2024 P1H Q6	11	
4	2024 P1H Q8	9	
5	2025 P1H Q7	11	

Total _____ / 56 **Percentage** _____ %

Questions from AQA GCSE past papers, 2023–2025, reproduced for revision. Practise these topics online, with instant marking:
`whiteboardchemistry.com/revision/gcse-chemistry/exam-questions?topics=c5-energy-changes&demand=standard,high&len=0`

Questions

Energy changes · Higher tier · 5 questions · 56 marks · time allowed 59 min

Q1 · June 2023 · Paper 1 Foundation · Q10 · Paper 1 Higher · Q2 · [11 marks]

This question also needs Quantitative chemistry.

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 cm^3 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.

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

[2 marks]

Independent variable

Dependent variable

10.2 Table 6 shows the results.

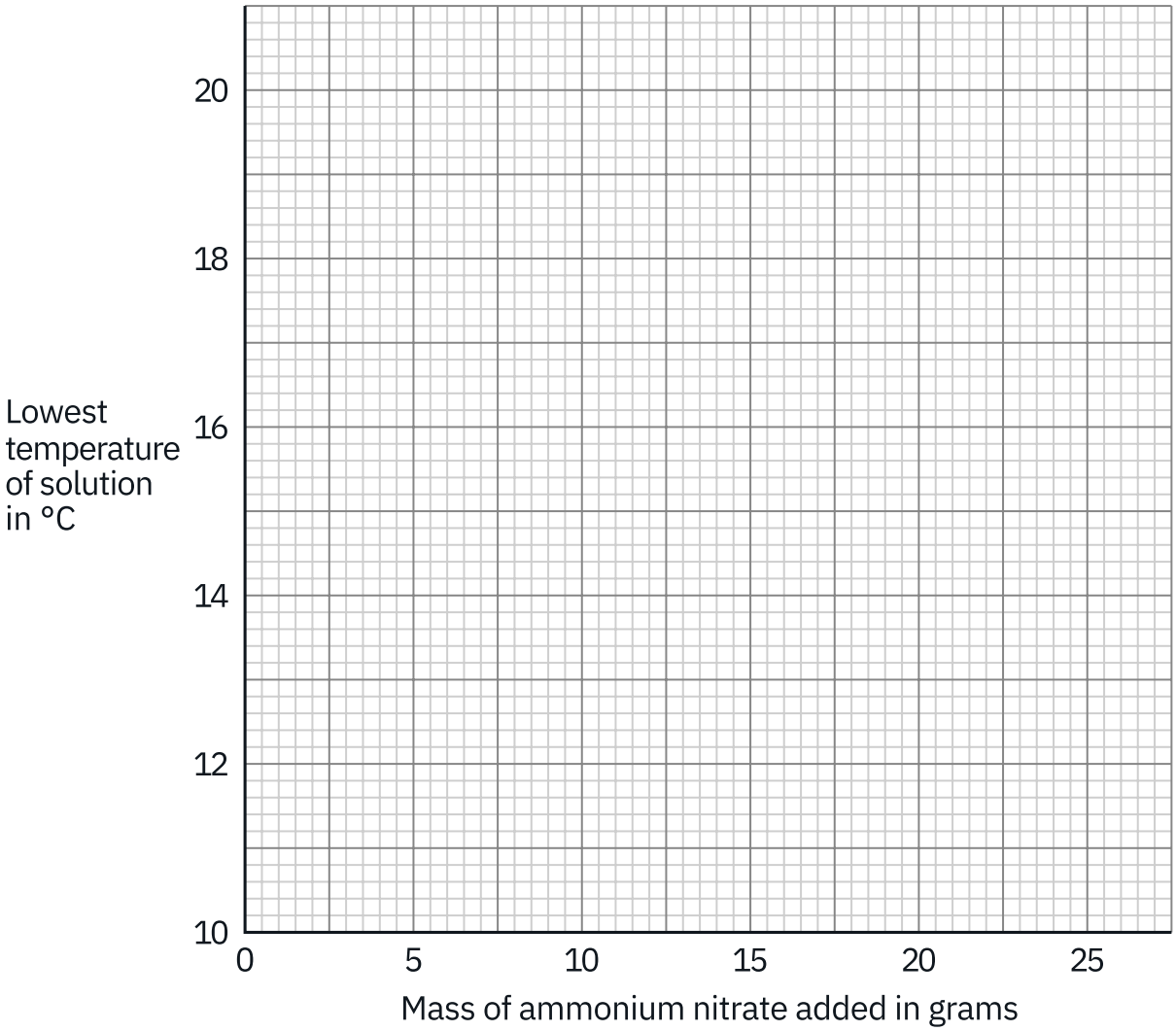
Table 6

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

Plot the data from Table 6 on Figure 11.

Draw a line of best fit.

Figure 11



[3 marks]

Draw your answer on the figure above.

10.3 Determine the initial temperature of the water.

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

Initial temperature of the water = _____ °C

[2 marks]

10.4 How do the results show that dissolving ammonium nitrate in water is endothermic?

[1 mark]

10.5 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

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?

Tick (✓) **one** box.

Random error	☐
Systematic error	☐
Zero error	☐

[1 mark]

Q2 · June 2024 · Paper 1 Higher · Q4 · [14 marks]

This question also needs Atomic structure and the periodic table, Bonding, structure, and the properties of matter, Chemical changes and Quantitative chemistry.

A student investigated the energy change of the reaction between zinc and copper sulfate solution.

This is the method used.

1. Measure 25 cm^3 of copper sulfate solution into a polystyrene cup.

2. Measure the temperature of the copper sulfate solution.

3. Add 0.20 g of zinc powder to the copper sulfate solution.

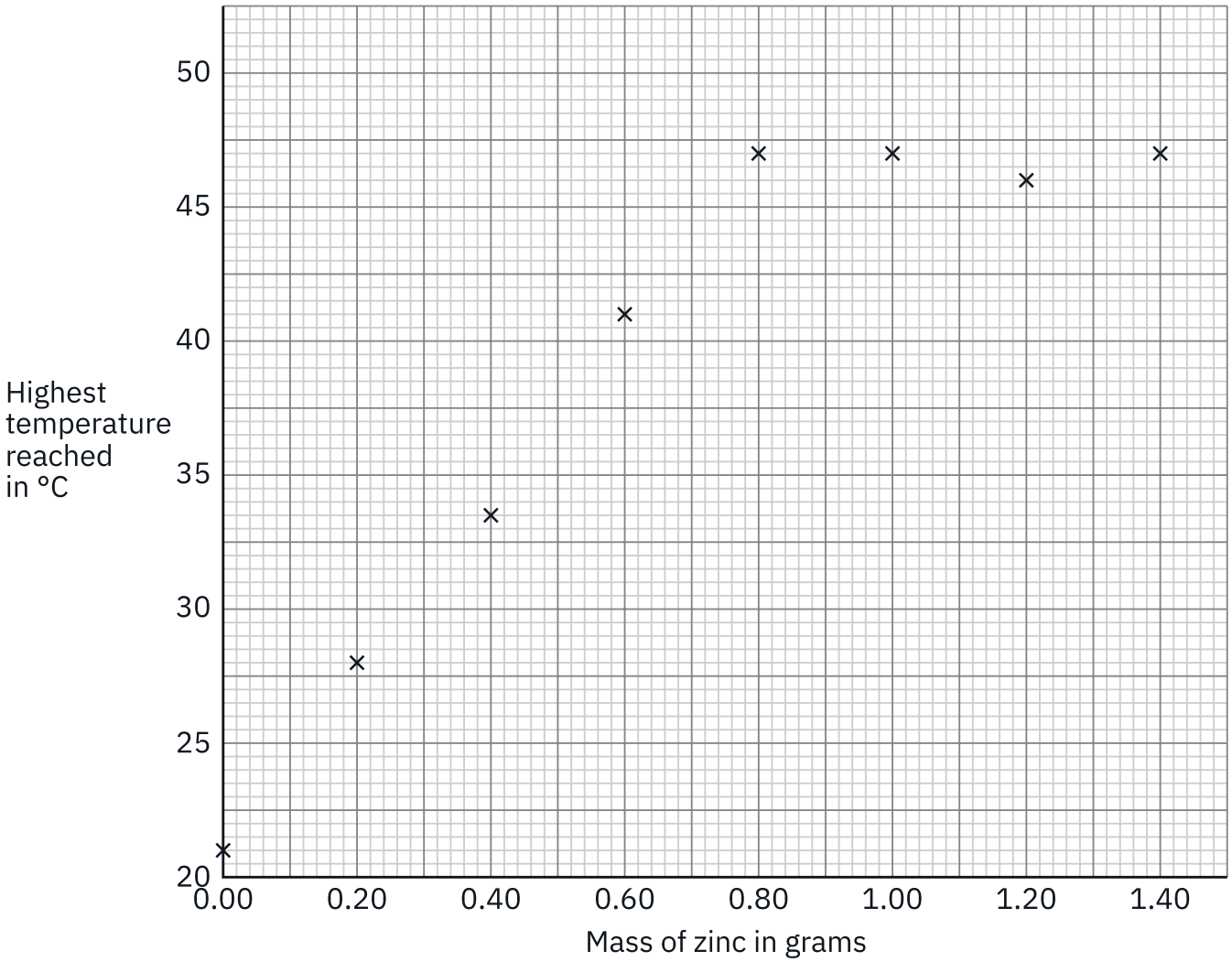
4. Stir the reaction mixture.

5. Record the highest temperature reached.

6. Repeat steps 1 to 5 with different masses of zinc powder.

Figure 3 shows the results.

Figure 3



04.1 Draw **two** lines of best fit on Figure 3.

The lines should cross.

[2 marks]

Draw your answer on the figure above.

04.2 Explain the results shown in Figure 3.

Do **not** refer to anomalous points.

Use data from Figure 3.

[4 marks]

04.3 Explain why using a polystyrene cup gives more accurate results than using a glass beaker.

[2 marks]

04.4 Complete the ionic equation for the reaction between zinc and copper sulfate solution.

Include state symbols.

$Zn(s) + Cu^{2+}(aq) \rightarrow$ _____(_____) + _____(_____)

[2 marks]

04.5 A different student repeated steps 1 to 5 of the method four times using 0.50 g of zinc powder.

Table 2 shows the results.

Table 2

	Trial 1	Trial 2	Trial 3	Trial 4
Highest temperature reached in °C	37.6	37.2	37.8	37.4

Calculate the mean highest temperature reached.

Include the uncertainty in your answer.

Mean highest temperature reached = _____ ± _____ °C

[3 marks]

04.6 The results show random errors.

The student did not make any measuring errors.

Suggest **one** reason for the random errors in this experiment.

[1 mark]

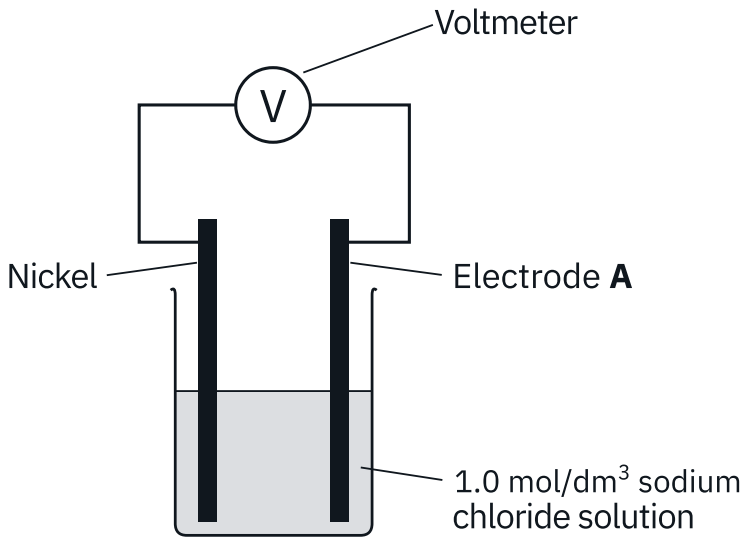
Q3 · June 2024 · Paper 1 Higher · Q6 · [11 marks]

This question also needs Chemical changes and Quantitative chemistry.

A student investigated the voltage produced by different pairs of metal electrodes in a chemical cell.

Figure 6 shows the apparatus.

Figure 6



This is the method used.

1. Place a nickel electrode and an electrode made from a different metal (electrode A)

in 1.0 mol/dm^3 sodium chloride solution.

2. Measure the voltage produced.

3. Repeat using different metals for electrode A.

Table 3 shows the results.

Table 3

Electrode A	**Symbol of metal**	**Voltage in volts**
Copper	Cu	–0.59
Magnesium	Mg	2.12
Nickel	Ni	0.00
Silver	Ag	–1.05
Zinc	Zn	0.51

06.1 Write the symbols of the five metals in Table 3 in order of reactivity.

Justify your answer.

Most reactive _____ _____ _____ _____ _____ Least reactive

Justification

[3 marks]

06.2 The voltage produced by a chemical cell depends on the concentration of the electrolyte solution.

Plan an experiment to investigate how the voltage produced by a chemical cell varies with the **concentration** of the electrolyte solution.

The following substances are available:

- the metal electrodes in Table 3
- 1.0 mol/dm^3 sodium chloride solution
- pure water.

[6 marks]

06.3 Describe how a hydrogen fuel cell produces a potential difference.

[2 marks]

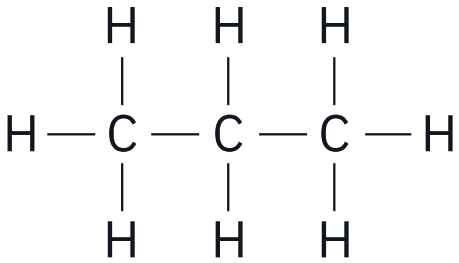
Q4 · June 2024 · Paper 1 Higher · Q8 · [9 marks]

This question also needs Bonding, structure, and the properties of matter.

This question is about propane (C_3H_8).

Figure 7 shows the displayed structural formula of propane.

Figure 7



08.1 Explain why propane has a low boiling point.

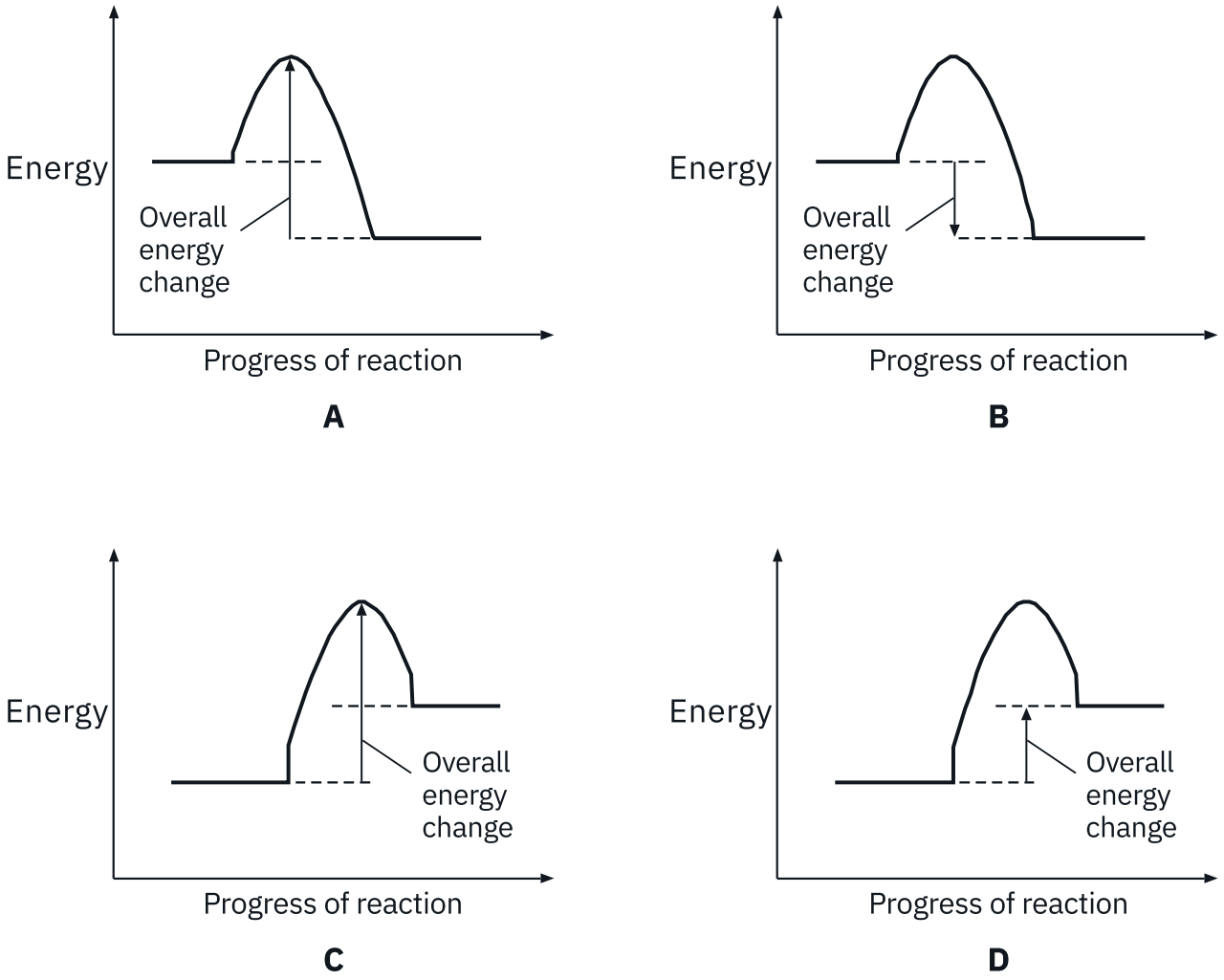
[3 marks]

08.2 Propane reacts with oxygen to produce carbon dioxide and water.

The reaction is exothermic.

Figure 8 shows four reaction profiles.

Figure 8



Which is the correct reaction profile and labels for the reaction between propane and oxygen?

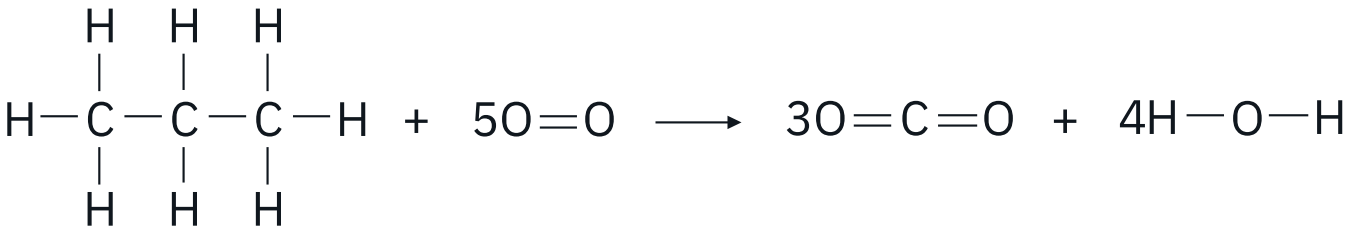
Tick (✓) **one** box.

A	☐
B	☐
C	☐
D	☐

[1 mark]

08.3 Figure 9 shows the displayed formula equation for the reaction between propane and oxygen.

Figure 9



The overall energy change of this exothermic reaction is 2219 kJ/mol.

Table 4 shows the bond energies of the bonds in the reaction.

Table 4

	C–C	C–H	O=O	C=O	O–H
Energy in kJ/mol	347	X	498	805	464

Calculate the bond energy of the C — H bond (X).

Bond energy of the C — H bond (X) = _____ kJ/mol

[5 marks]

Q5 · June 2025 · Paper 1 Higher · Q7 · [11 marks]

This question also needs Bonding, structure, and the properties of matter.

Hydrazine (N_2H_4) is a compound of nitrogen and hydrogen.

07.1 Scientists are researching the use of hydrazine in fuel cells.

Table 2 gives some information about the use of hydrogen and hydrazine in fuel cells.

Table 2

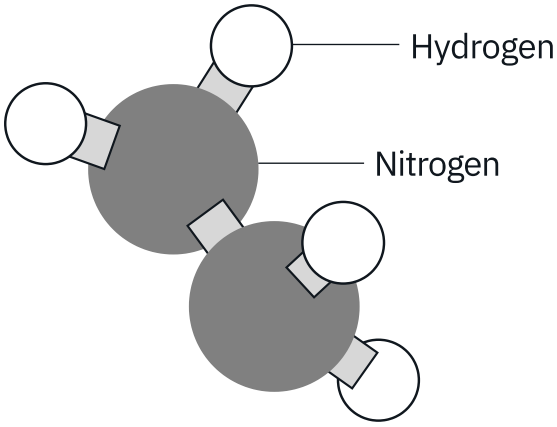
	Hydrogen	**Hydrazine**
State at room temperature	Gas	Liquid
Hazards	Explosive	Toxic
Equation for fuel cell reaction	$2H_2 + O_2 \rightarrow 2H_2O$	$N_2H_4 + O_2 \rightarrow N_2 + 2H_2O$
Voltage produced in volts	1.23	1.61
Catalyst needed for reaction	Platinum	None

Evaluate the use of hydrazine instead of hydrogen in a fuel cell.

[4 marks]

07.2 Figure 6 shows a model of the hydrazine molecule.

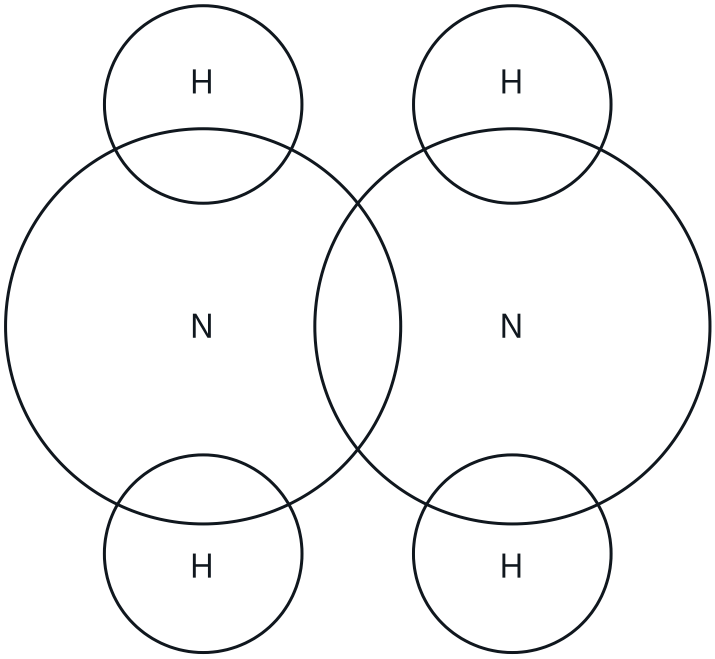
Figure 6



Complete the dot and cross diagram for hydrazine in Figure 7.

Show the outer shell electrons only.

Figure 7



[2 marks]

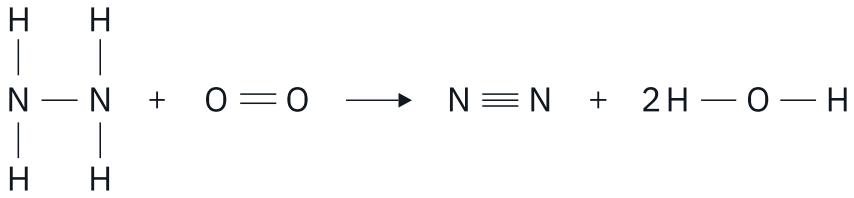
Draw your answer on the figure above.

07.3 Give **one** advantage of the ball and stick model in Figure 6 compared to the dot and cross diagram.

[1 mark]

07.4 Figure 8 shows the displayed formula equation for the reaction of hydrazine with oxygen.

Figure 8



The reaction is exothermic.

The energy released forming new bonds is 581 kJ/mol greater than the energy needed to break existing bonds.

Table 3 shows some bond energies.

Table 3

Bond	N–N	N–H	O=O	N≡N	O–H
Bond energy in kJ/mol	X	391	498	945	464

Calculate the bond energy (X) of the N–N bond.

X = _____ kJ/mol

[4 marks]

Source: AQA GCSE Chemistry past papers. Reproduced for revision at whiteboardchemistry.com.

Mark scheme:
whiteboardchemistry.com/revision/gcse-chemistry/exam-questions/pdf/c5-energy-changes-higher-mark-scheme.pdf