AQA

Please write clearly in block capitals.

Centre number | 2 | 2 | 3 | 4 | 5 | Candidate number | 1 | 2 | 3 | 4 |

Surname Example

Forename(s) John

Candidate signature

I declare this is my own work.

GCSE
COMBINED SCIENCE: TRILOGY

H

Higher Tier
Chemistry Paper 1H

Time allowed: 1 hour 15 minutes

Materials

For this paper you must have:
- a ruler
- a scientific calculator
- the periodic table (enclosed).

Instructions
- Use black ink or black ball-point pen.
- Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

Information
- The maximum mark for this paper is 70.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

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0 1 This question is about the periodic table.

0 1 . 1 **Figure 1** shows part of Mendeleev's version of the periodic table.

Figure 1

H							
Li	Be	B	C	N	O	F	
Na	Mg	Al	Si	P	S	Cl	
K Cu	Ca Zn		Ti	V As	Cr Se	Mn Br	Fe Co Ni
Rb Ag	Sr Cd	Y In	Zr Sn	Nb Sb	Mo Te	I	Ru Rh Pd

Which group of elements had **not** been discovered when Mendeleev's version of the periodic table was published?

[1 mark]

The Nobel Gasses, Group 0

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Figure 2 represents different models of the atom.

Figure 2

A B C D

0 1 . 2 Which model represents the plum pudding model?

[1 mark]

Tick (✓) **one** box.

A ☐ B ☑ C ☐ D ☐

0 1 . 3 Which model resulted from Chadwick's experimental work?

[1 mark]

Tick (✓) **one** box.

A ☑ B ☐ C ☐ D ☐

Question 1 continues on the next page

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Potassium has different isotopes.

0 1 . 4 What is meant by 'isotopes'?

You should refer to subatomic particles.

[2 marks]

Isotopes are atoms that have the same number of protons in their nucleus as another atom but a different number of neutrons

0 1 . 5 **Table 1** shows the mass numbers and the percentage abundance of two isotopes of potassium.

Table 1

Mass number	Percentage abundance
39	93.1
41	6.9

Calculate the relative atomic mass (A_r) of potassium.

Give your answer to 1 decimal place.

[3 marks]

$$A_r = \frac{(39 \times 93.1) + (41 \times 6.9)}{100}$$

$$= 39.138$$

Relative atomic mass (1 decimal place) = 39.1

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 2 Acids react to produce salts.

Universal indicator is added to water and then nitric acid is added to the mixture.

0 2 . 1 Give the colour change when nitric acid is added to the mixture of universal indicator and water.

[1 mark]

Tick (✓) **one** box.

- [ ] Blue to red
- [ ] Green to purple
- [✓] Green to red
- [ ] Red to purple

0 2 . 2 What happens to the pH of water when nitric acid is added?

[1 mark]

Tick (✓) **one** box.

- [✓] Decreases
- [ ] Stays the same
- [ ] Increases

0 2 . 3 What is the state symbol for nitric acid?

[1 mark]

(aq)

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Zinc carbonate reacts with nitric acid.

The word equation for the reaction is:

zinc carbonate + nitric acid → zinc nitrate + water + carbon dioxide

white solid — colourless solution

0 2 . 4 Give **two** observations that would be made when zinc carbonate is added to nitric acid until the zinc carbonate is in excess.

[2 marks]

1 CO_2 gas would bubble through the solution

2 white solid would be found at the bottom

0 2 . 5 The formula of the zinc ion is Zn^{2+}

The formula of the nitrate ion is NO_3^-

What is the formula for zinc nitrate?

[1 mark]

Tick (✓) **one** box.

- $ZnNO_3$ ☐
- $Zn(NO_3)_2$ ☑
- Zn_2NO_3 ☐
- $Zn_2(NO_3)_2$ ☐

Question 2 continues on the next page

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0 2 . 6 Acids react with insoluble metal oxides to produce salts.

Plan a method to produce a pure, dry sample of the soluble salt copper chloride from an acid and a metal oxide.

[6 marks]

Warm hydrochloric acid should be poured into a suitable container. To this copper oxide should be added. At first this should all dissolve. Eventually the copper oxide will have been added to excess and no more will dissolve. This will leave solid copper oxide at the bottom of the container. The reaction mixture should then be filtered to remove the excess copper oxide. Once done, the remaining solution should be placed in an evaporating dish and gently heated. The water in the solution will evaporate off, leaving pure and dry crystals of copper chloride.

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ANSWER IN THE SPACES PROVIDED

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0 3 This question is about energy change.

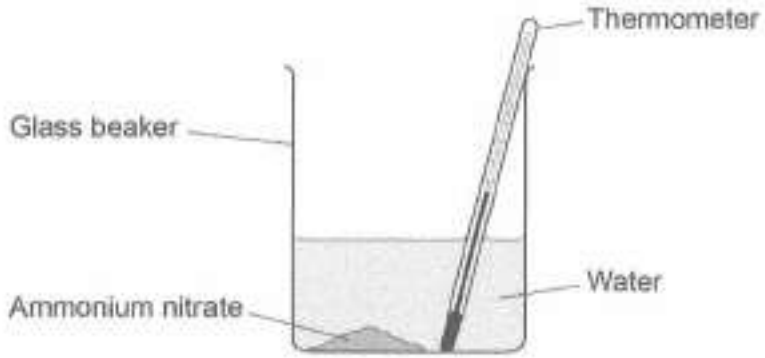
A student investigated the temperature change when 10 g of ammonium nitrate was added to 100 cm^3 of water.

This is the method used.

1. Measure the temperature of 100 cm^3 of water.
2. Add 10 g of ammonium nitrate.
3. Stir once.
4. Measure the temperature of the solution every minute for 7 minutes.

Figure 3 shows the apparatus.

Figure 3



0 3 . 1 What is the dependent variable in this investigation?

[1 mark]

Temperature

0 3 . 2 Give **three** improvements to the investigation to make the results more accurate.

[3 marks]

1 The experiment could be carried out in a Styrofoam cup to keep the heat in

2 A lid could be added to further reduce heat loss.

3 Repeat the experiment multiple times to get a mean value of each reading

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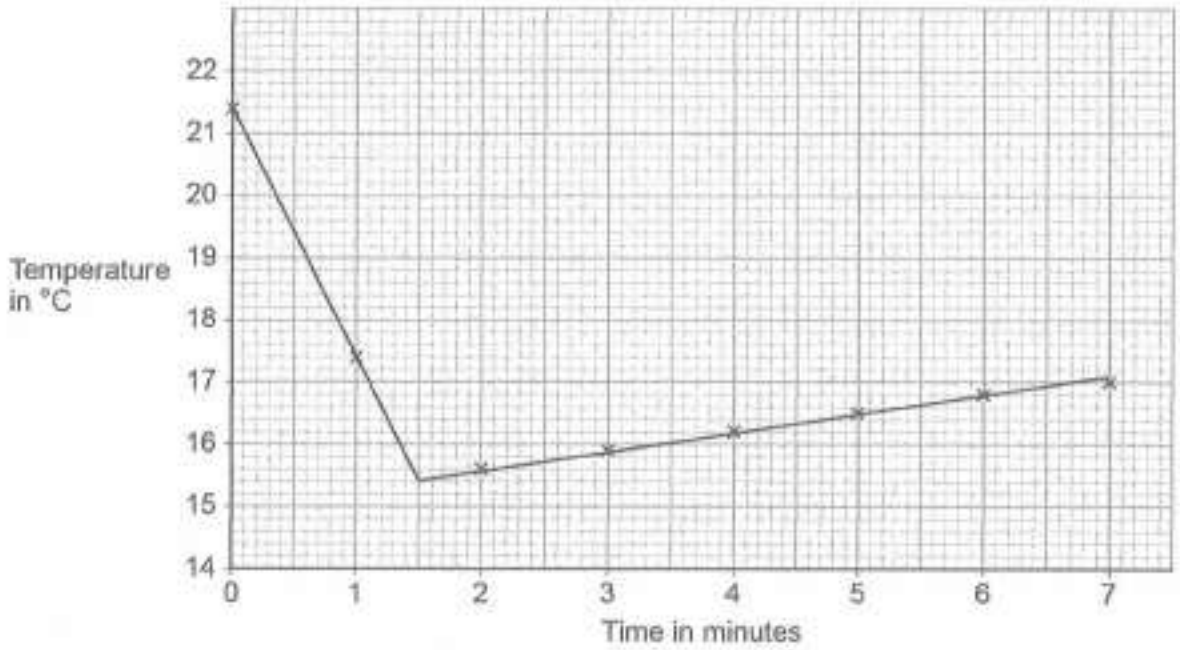
0 3 . 3 **Figure 4** shows the results.

Figure 4



Explain the results.

[4 marks]

From 0 to 1.5 minuets the temperature decreases. This is because dissolving amonium nitrate is an endothermic process. After 1.5 minuets the temperature increases again as energy transfers into the solution from the surroundings.

Question 3 continues on the next page

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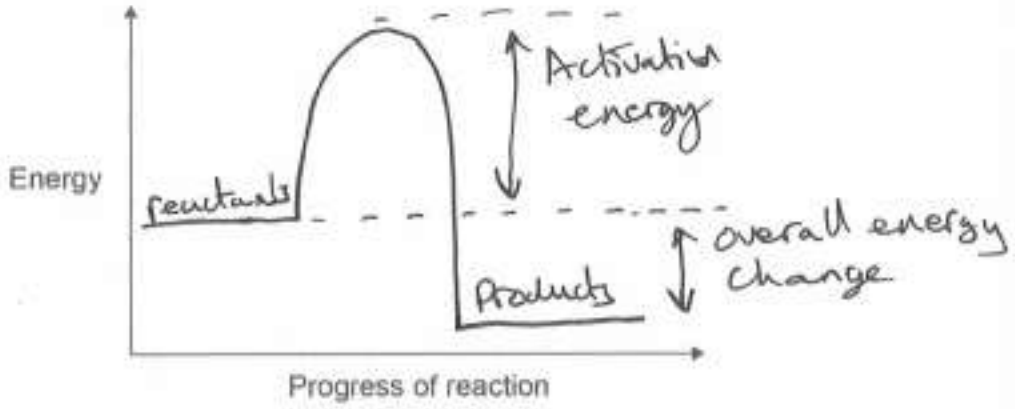
0 3 . 4 Draw a reaction profile for an exothermic reaction.

You should label:

- the energy level of the reactants and of the products
- the activation energy
- the overall energy change.

[4 marks]



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ANSWER IN THE SPACES PROVIDED

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Steel is an alloy of iron and carbon.

0 4 . 3 Explain why steel is harder than iron.

[3 marks]

Carbon atoms and Iron ions are different sizes. As steel is a mixture of Iron and Carbon, the layers of iron ions are distorted by the carbon. This means the layers can't slide over each other, giving steel it's strength

0 4 . 4 Iron is alloyed with carbon and other metals to make stainless steel.

A stainless steel fork contains 71.92% iron.

Table 2 shows the mass of each element in the fork.

Table 2

Element	Iron	Carbon	Chromium	Nickel
Mass of element in g	X	0.05	10.44	5.80

Calculate the mass of iron (X) in the fork.

[4 marks]

Mass other elements = 0.05 + 10.44 + 5.80
= 16.29 g

% mass = 100 − 71.92 = 28.08%

mass of fork = $\frac{16.92\ g}{28.08\%} \times 100$ = 58.01 g

Mass of Iron = 58.01 × 0.7192
= 41.72 g

X = 41.72 g

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0 5 . 3 Hydrogen gas and oxygen gas are produced when sodium sulfate solution is electrolysed.

Explain how oxygen gas is produced in the electrolysis of sodium sulfate solution.

[4 marks]

Water molecules are broken down at the electrode to form H^+ and OH^- ions. The OH^- ions are the attracted to the positive electrode. Here they are reduced to form oxygen Gas.

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Turn over for the next question

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0 6 . 2 The student repeated the experiment **without** a lid on the crucible.

Suggest why the mass of magnesium oxide produced would be different without a lid on the crucible.

[2 marks]

The mass of Magnesium oxide produced would be less as products would have escaped the open crucible

0 6 . 3 Copper reacts with oxygen to produce copper oxide.

63.5 g of copper produces 79.5 g of copper oxide.

Calculate the mass of copper oxide produced when 0.50 g of copper reacts with oxygen.

Give your answer to 3 significant figures.

[3 marks]

Increase in mass = (79.5 ÷ 63.5) × 0.5
Per Kilogram = 0.62598 g
= 0.626 g

Mass (3 significant figures) = 0.626 g

Question 6 continues on the next page

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0 6 . 4 Iron reacts with oxygen to produce an oxide of iron.

0.015 moles of iron reacts with 0.010 moles of oxygen gas (O_2).

Determine:

- the formula of the iron oxide produced
- the balanced symbol equation for the reaction.

[4 marks]

0.015 : 0.010 Fe_3O_4

3 : 2

Fe O_2

Formula of iron oxide = Fe_3O_4

Balanced symbol equation

$3Fe + 2O_2 \rightarrow Fe_3O_4$

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ANSWER IN THE SPACES PROVIDED

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0 7 Methane, ethane, propane and butane all react with oxygen to produce carbon dioxide and water.

0 7 . 1 Suggest why a mixture of methane and oxygen does **not** react at room temperature.

Answer in terms of particles.

[2 marks]

The methane and O_2 particles will collide at room temperature but will not have enough energy to react.

0 7 . 2 **Table 3** shows the energy released when methane, ethane and propane react with oxygen to produce carbon dioxide and water.

Table 3

	Compound reacted with oxygen		
	Methane	Ethane	Propane
Formula of compound	CH_4	C_2H_6	C_3H_8
Energy released in kJ/mol	680	1160	1640

+480 +480 +480

Predict the energy released when butane (C_4H_{10}) reacts with oxygen to produce carbon dioxide and water.

[1 mark]

1640 + 480 = 2120 kJ/mol

Energy released = 2120 kJ/mol

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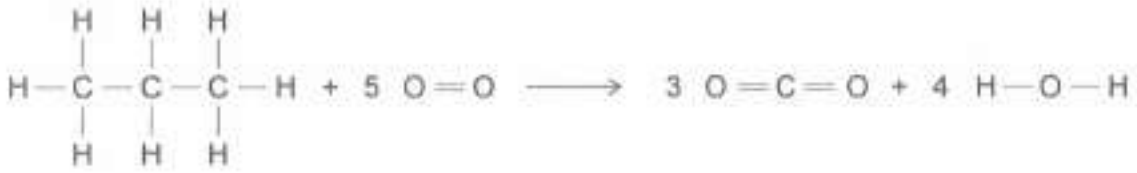
0 7 . 3 Propane reacts with oxygen to produce carbon dioxide and water.

The displayed formula equation for the reaction is:



The reaction is exothermic.

In the reaction, the energy released when forming new bonds is 1640 kJ/mol greater than the energy needed when breaking bonds.

Table 4 shows bond energies.

Table 4

Bond	H–C	C–C	O=O	C=O	O–H
Bond energy in kJ/mol	410	X	500	740	460

Calculate the C—C bond energy (**X**).

[5 marks]

Bonds Broken = 8(410) + 5(500) + 2x

Bonds formed = 6(740) + 8(460) = 8120 kJ mol^{-1}

Bonds Broken = 8120 − 1640
= 6480 kJ mol^{-1}

6480 = 8(410) + 5(500) + 2x

6480 = 3200 + 2500 + 2x

2x = 700

x = 350 kJ mol^{-1}

X = 350 kJ/mol

8

END OF QUESTIONS