

Name:

Date:

C5 - Test 1  
ENERGY CHANGES  
Beginner

**GCSE**

CHEMISTRY

AQA - Combined Science

Mark

Grade

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### Materials

For this paper you must have:

- Ruler
- Pencil and Rubber
- Scientific calculator, which you are expected to use when appropriate

### Instructions

- Answer all questions
- Answer questions in the space provided
- All working must be shown

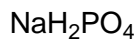
### Information

- The marks for the questions are shown in brackets

1.

A student investigated some instant soup.

(a) Instant soup contains a food additive which has the formula:



Give the names of all the elements in this compound.

The periodic table on the Data Sheet may help you to answer this question.

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(2)

(b) The student investigated the reaction which takes place when soup powder is added to cold water.

The student thought that the reaction might be *exothermic*.

(i) What is meant by the term *exothermic* reaction?

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(2)

(ii) Describe an experiment that the student could do to prove that this reaction is exothermic.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

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(4)

(Total 8 marks)

2.

During a thunderstorm lightning strikes the Eiffel Tower.



By M. G. Loppé [Public domain], via Wikimedia Commons

In lightning the temperature can reach 30 000 °C. This causes nitrogen and oxygen in the air to react, producing nitrogen oxide. This reaction has a high *activation energy* and is *endothermic*.

(a) Nitrogen and oxygen in the air do not react easily.

What makes nitrogen and oxygen react during thunderstorms?

\_\_\_\_\_

(1)

(b) Complete the word equation for the reaction of nitrogen with oxygen.

nitrogen + \_\_\_\_\_ → \_\_\_\_\_

(1)

(c) In an *endothermic* reaction, energy is taken in from the surroundings.

Draw a ring around the correct answer to complete the sentence.

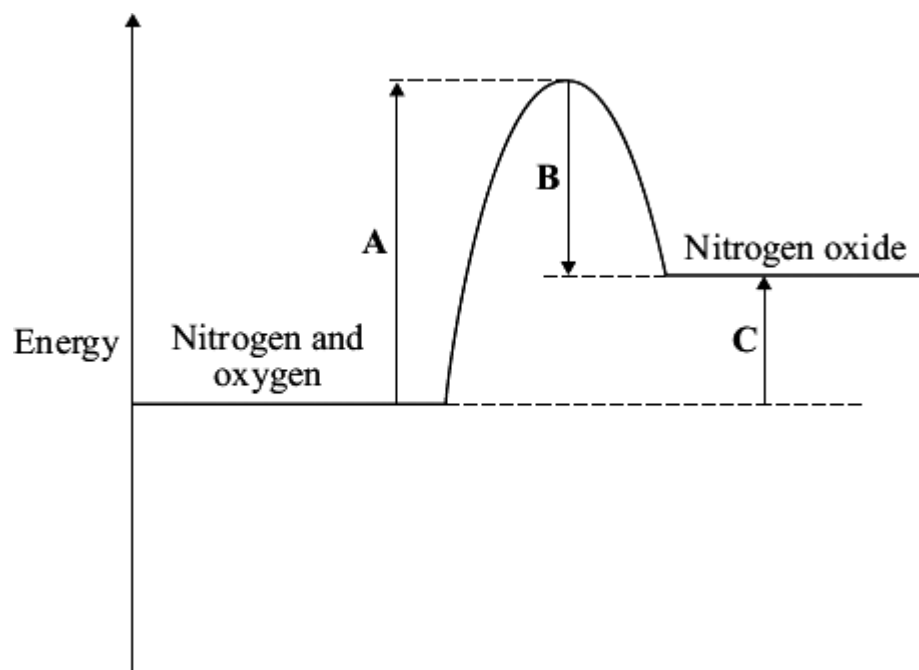
In an *endothermic* reaction, the energy needed to break existing bonds is

less than
more than
the same as

the energy released from forming new bonds.

(1)

(d) The energy level diagram for this reaction is shown.



Use the energy level diagram to help you to answer these questions.

(i) Which energy change, **A**, **B** or **C**, represents the *activation energy*?

(1)

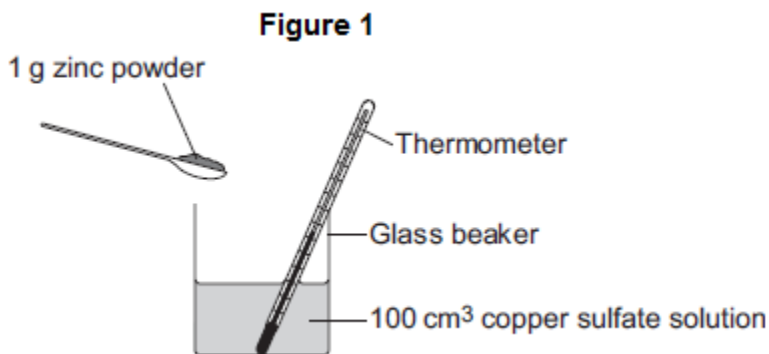
(ii) Which energy change, **A**, **B** or **C**, shows that this reaction is *endothermic*?

(1)

(Total 5 marks)

3.

A student investigates the energy released when zinc powder reacts with copper sulfate solution. The student uses the apparatus shown in **Figure 1**.



The student:

- measures 100 cm<sup>3</sup> copper sulfate solution into a beaker
- measures the temperature of the copper sulfate solution
- puts 1 g zinc powder into the beaker
- stirs the mixture with a thermometer
- measures the highest temperature.

The student's results were:

Starting temperature = 21 °C

Highest temperature = 32 °C

- (a) (i) Calculate the change in temperature.

\_\_\_\_\_

Change in temperature = \_\_\_\_\_ °C

(1)

- (ii) Calculate the energy released in the reaction.

Use the equation

$$\begin{array}{ccccccc} \text{energy released} & = & \text{volume of solution} & \times & 4.2 & \times & \text{temperature change} \\ \text{in J} & & \text{in cm}^3 & & & & \text{in } ^\circ\text{C} \end{array}$$

\_\_\_\_\_

\_\_\_\_\_

Energy released = \_\_\_\_\_ J

(2)

(b) The reaction of zinc with copper sulfate is exothermic.

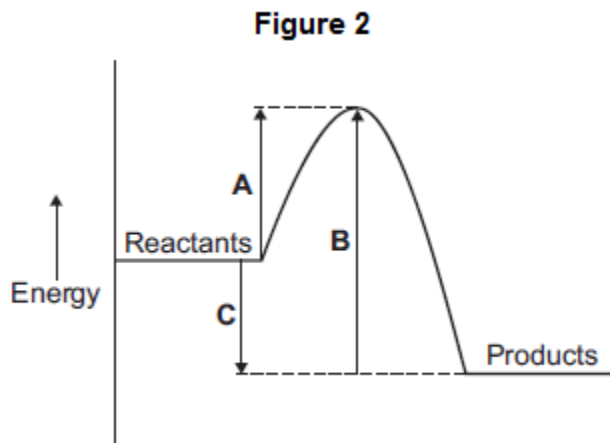
How can you tell from the student's results that the reaction is exothermic?

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(1)

(c) The energy diagram for the reaction is shown in **Figure 2**.



(i) How can you tell from the energy diagram that the reaction is exothermic?

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(1)

(ii) Which arrow shows the activation energy in **Figure 2**?

Tick (✓) **one** box.

**A**

**B**

**C**

(1)

(Total 6 marks)

4.

Some students investigated the reactivity of four unknown metals, **W**, **X**, **Y** and **Z**.

The letters are not the symbols of these elements.

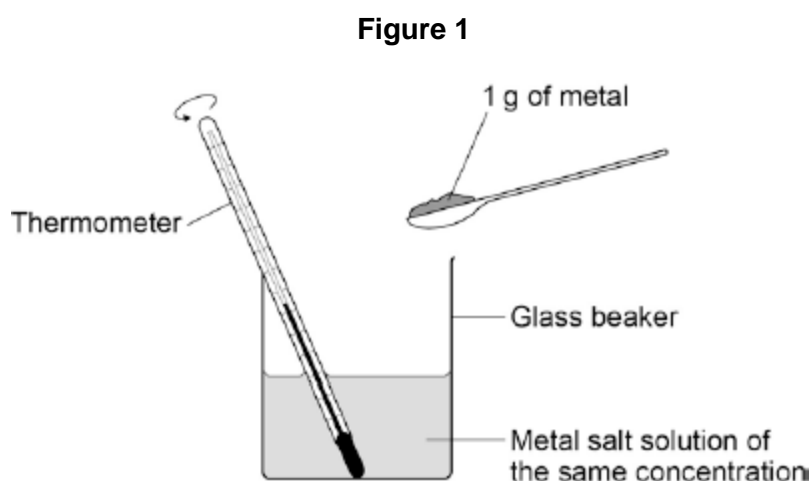
The students used metal salt solutions of copper nitrate, magnesium sulfate and zinc chloride.

This is the method used.

1. Pour a solution of a metal salt into a glass beaker.
2. Measure the temperature of the solution.
3. Add 1 g of metal to the solution.
4. Measure the temperature of the solution.
5. Calculate the temperature increase.

The students did the experiment using each salt solution with each metal.

**Figure 1** shows the apparatus the students used.



The table below shows the students' results.

Solution	Temperature increase in °C			
	Metal W	Metal X	Metal Y	Metal Z
Copper nitrate	46	10	29	No change
Magnesium sulfate	No change	No change	No change	No change
Zinc chloride	15	No change	No change	No change

(a) Which metal is **least** reactive?

Tick **one** box.

Metal W

Metal X

Metal Y

Metal Z

(1)

(b) How do the results show that magnesium is **more** reactive than the metals **W**, **X**, **Y** and **Z**?

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(1)

(c) How do the results show that the reaction between metal **Y** and copper nitrate solution is exothermic?

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(1)

(d) One student said that the investigation was not valid (a fair test).

Write a plan for the investigation that includes improvements to the method and apparatus.

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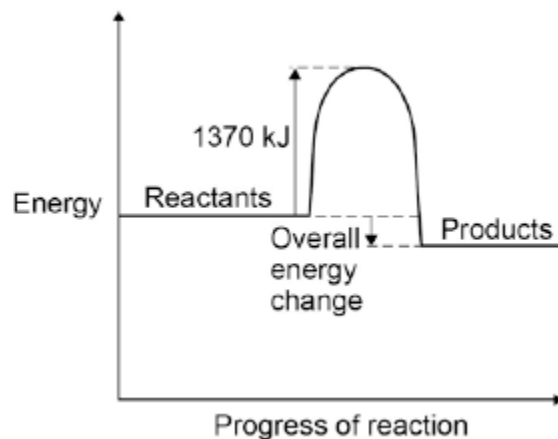
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(4)



(e) **Figure 2** shows the reaction profile of an exothermic reaction.

**Figure 2**



What does the energy value of 1370 kJ represent?

Tick **one** box.

Activation energy

Products energy

Reactants energy

Released energy

**(1)**

(f) The overall energy change is 386 kJ.

What percentage of 1370 kJ is this?

Give your answer to two significant figures.

Percentage = \_\_\_\_\_ %

**(2)**

**(Total 10 marks)**