

Exothermic and Endothermic Reactions

Question Paper 1

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Chemistry
Exam Board	AQA
Topic	5.5 Energy Changes
Sub-Topic	Exothermic and Endothermic Reactions
Difficulty Level	Silver Level
Booklet	Question Paper 1

Time Allowed: 60 minutes

Score: /58

Percentage: /100

Grade Boundaries:

Q1. The rate of chemical reactions can be changed by changing the conditions.

- (a) Methane burns in oxygen to produce carbon dioxide and water.

The activation energy for the reaction is 2648 kJ / mol.

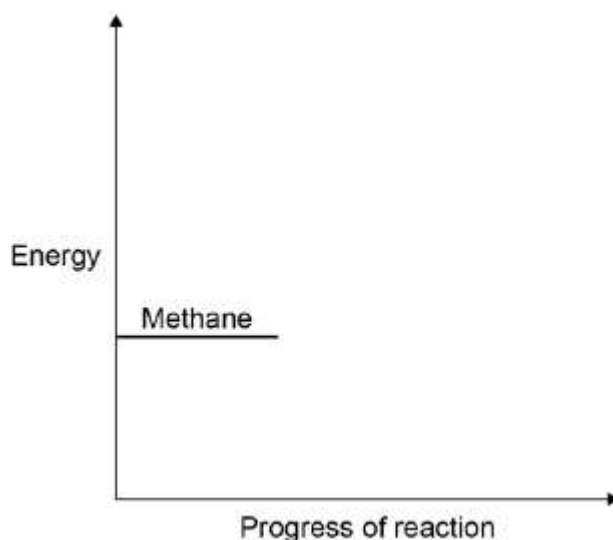
The reaction gives out 818 kJ / mol of energy.

The figure below shows the reaction profile for this reaction.

Complete the reaction profile.

Draw arrows to represent:

- the activation energy
- the energy given out.



(4)

- (b) What percentage of the activation energy is the energy given out?

.....

(1)

- (c) Calcium carbonate decomposes when it is heated:

The decomposition of calcium carbonate is an endothermic reaction.

How would the reaction profile for decomposition of calcium carbonate be different from the reaction profile of methane burning in oxygen?

.....

(1)

- (d) Catalysts are used in chemical reactions in industry.

Give **two** properties of catalysts.

For each property, explain why it makes the catalyst useful in industry.

.....
.....
.....
.....
.....
.....
.....
.....
.....

(4)

- (e) Enzymes are biological catalysts.

What type of molecule is an enzyme?

Tick **one** box.

Carbohydrate

☐

Hydrocarbon

☐

Lipid

☐

Protein

☐

(1)

- (f) If enzymes are denatured they stop working.

Give **two** ways an enzyme can be denatured.

1

2

(2)

- (g) An enzyme called lactase catalyses the reaction that breaks down lactose to smaller molecules.

One model used to explain how enzymes affect reactions is called the lock and key model.

Use the lock and key model to explain why lactase cannot be used to speed up **all** chemical reactions.

.....
.....
.....
.....
.....
.....

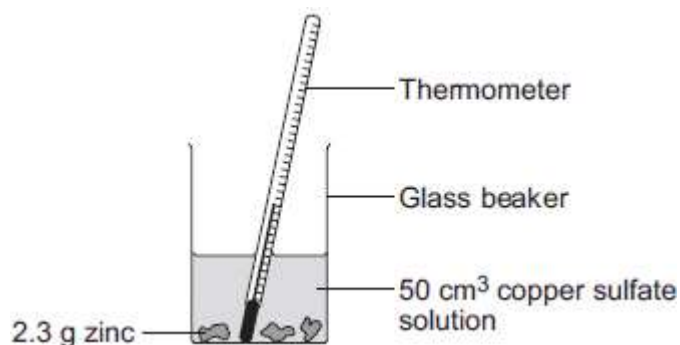
(3)

(Total 16 marks)

Q2.A student investigated the temperature change when zinc reacts with copper sulfate solution.

The student used a different concentration of copper sulfate solution for each experiment.

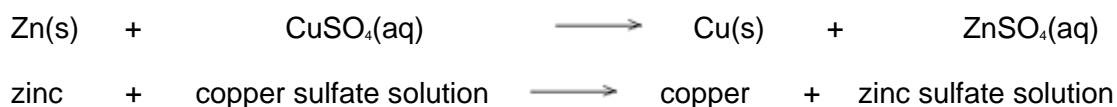
The student used the apparatus shown below.



The student:

- measured 50 cm³ copper sulfate solution into a glass beaker
- measured the temperature of the copper sulfate solution
- added 2.3 g zinc
- measured the highest temperature
- repeated the experiment using copper sulfate solution with different concentrations.

The equation for the reaction is:



- (a) The thermometer reading changes during the reaction.

Give **one** other change the student could **see** during the reaction.

.....

(1)

- (b) Suggest **one** improvement the student could make to the apparatus.

Give a reason why this improves the investigation.

Improvement

 Reason

(2)

- (c) In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

The student's results are shown in the table.

Table

Experiment number	Concentration of copper sulfate in moles per dm ³	Increase in temperature in °C
1	0.1	5
2	0.2	10
3	0.3	12
4	0.4	20
5	0.5	25
6	0.6	30
7	0.7	35
8	0.8	35
9	0.9	35
10	1.0	35

Describe **and** explain the trends shown in the student's results.

.....

.....

.....

.....

.....

.....

.....

.....

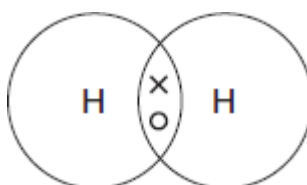
.....

.....

(6)
(Total 9 marks)

Q3.Hydrogen gas is produced by the reaction of methane and steam.

- (a) The diagram represents a molecule of hydrogen.



- (i) What type of bond joins the atoms of hydrogen?

Tick (✓) **one** box.

Covalent

☐

Metallic

☐

Ionic

☐

(1)

- (ii) A catalyst is used in the reaction.

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

A catalyst

increases the rate of reaction.

increases the temperature.

increases the yield of a reaction.

(1)

- (b) The equation for the reaction of methane and steam is:



- (i) What is meant by the symbol \rightleftharpoons ?

.....

(1)

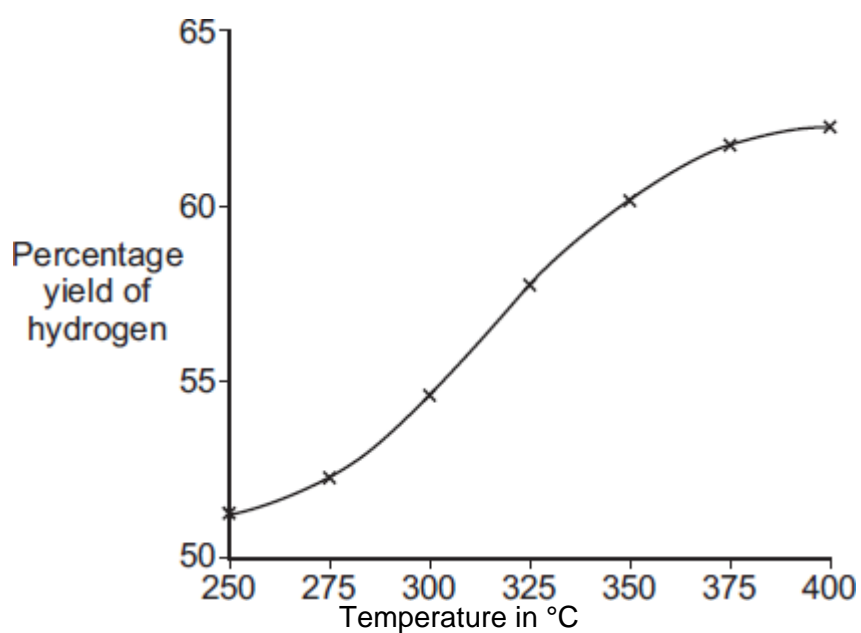
- (ii) Lowering the pressure reduces the rate of reaction.

Explain why, in terms of particles.

.....
.....
.....
.....

(2)

- (iii) The graph shows the yield of hydrogen at different temperatures.



The forward reaction is endothermic.

How does the graph show that the forward reaction is endothermic?

.....

(1)

(iv) Why is a higher yield produced if the reaction is repeated at a lower pressure?

.....

(1)

(c) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Car engines are being developed that use hydrogen gas as a fuel instead of petrol.

The table compares the two fuels.

	Hydrogen	Petrol
Energy	5700 kJ per litre	34 000 kJ per litre
State	Gas	Liquid
Equation for combustion	$2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$	$2\text{C}_8\text{H}_{18} + 25\text{O}_2 \rightarrow 16\text{CO}_2 + 18\text{H}_2\text{O}$
How the fuel is obtained	Most hydrogen is produced from coal, oil or natural gas. Hydrogen can be produced by the electrolysis of water or the solar decomposition of water.	Fractional distillation of crude oil.

Use the information in the table and your knowledge of fuels to evaluate the use of hydrogen instead of petrol as a fuel.

You should describe the advantages and disadvantages of using hydrogen instead of petrol.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Extra space

.....

.....

.....

.....

.....

(6)
(Total 13 marks)

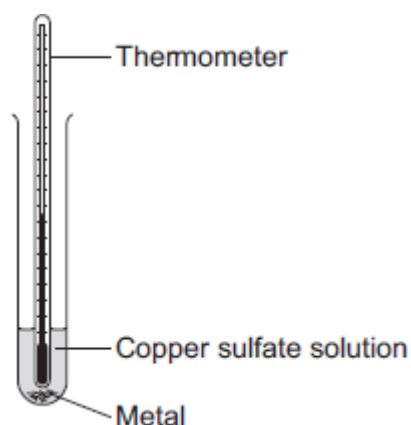
Q4.A student investigated displacement reactions of metals.

The student added different metals to copper sulfate solution and measured the temperature change.

The more reactive the metal is compared with copper, the bigger the temperature change.

The apparatus the student used is shown in **Figure 1**.

Figure 1



- (a) State **three** variables that the student must control to make his investigation a fair test.

1

2

3

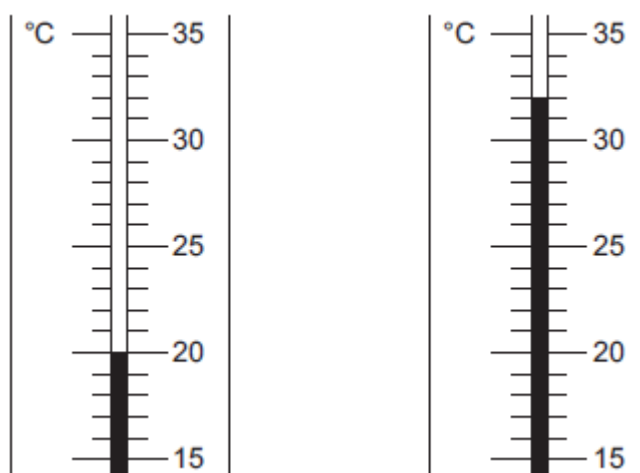
(3)

- (b) **Figure 2** shows the thermometer in one experiment before and after the student added a metal to the copper sulfate solution.

Figure 2

Before adding metal

After adding metal



Use **Figure 2** to complete **Table 1**.

Table 1

Temperature before adding metal in °C
Temperature after adding metal in °C
Change in temperature in °C

(3)

- (c) The student repeated the experiment three times with each metal.

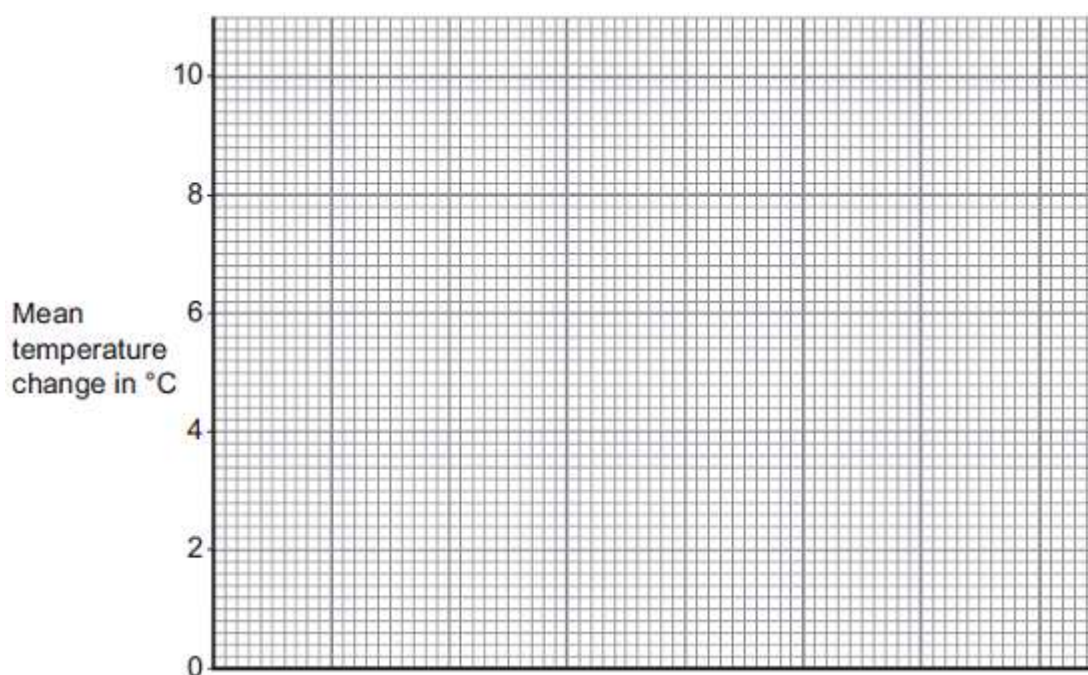
Table 2 shows the mean temperature change for each metal.

Table 2

Metal	Mean temperature change in °C
Cobalt	4.5
Gold	0.0
Magnesium	10.0
Nickel	3.0
Silver	0.0
Tin	1.5

- (i) On **Figure 3**, draw a bar chart to show the results.

Figure 3



(3)

- (ii) Why is a line graph **not** a suitable way of showing the results?

.....
.....

(1)

- (iii) Use the results to work out which metal is the most reactive.

Give a reason for your answer.

Most reactive metal

Reason

.....

(2)

- (iv) Explain why there was no temperature change when silver metal was added to the copper sulfate solution.

.....
.....

.....
.....

(2)

- (v) It is **not** possible to put all six metals in order of reactivity using these results.

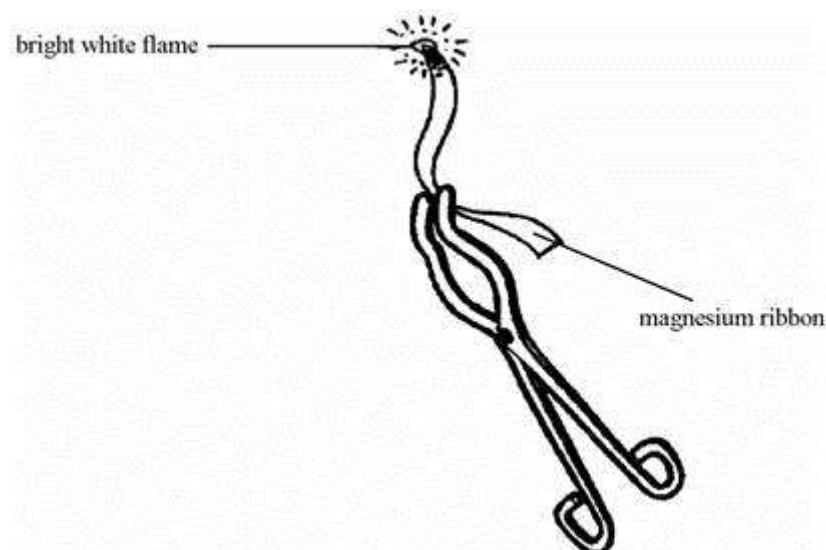
Suggest how you could change the experiment to be able to put all six metals into order of reactivity.

.....
.....
.....
.....
.....

(2)

(Total 16 marks)

- Q5.** The diagram shows some magnesium ribbon burning.



- (a) Choose words from the list to complete the sentences below.

electrical heat light kinetic
an endothermic an exothermic a neutralisation a reduction

When magnesium burns, it transfers

and energy to the surroundings.

We say that it is reaction.

(3)

(b) Complete the word equation for the reaction.

magnesium + _____ \longrightarrow magnesium oxide

(1)

(Total 4 marks)