



New Document 1

Name: _____

Class: _____

Date: _____

Time: **22 minutes**

Marks: **22 marks**

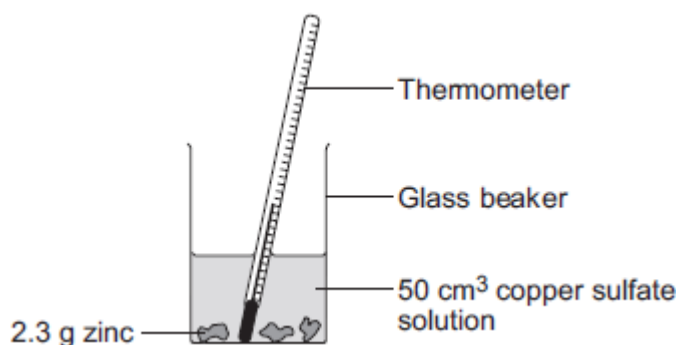
Comments:

Q1.

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.

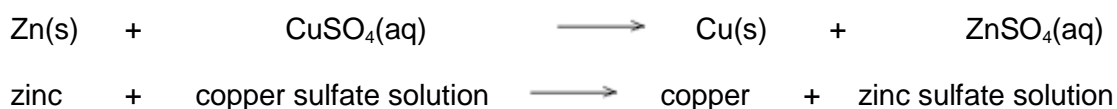
The student used the apparatus shown below.



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

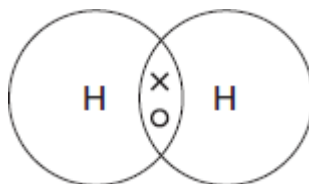
Describe **and** explain the trends shown in the student's results.

(6)
(Total 9 marks)

Q2.

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 ?

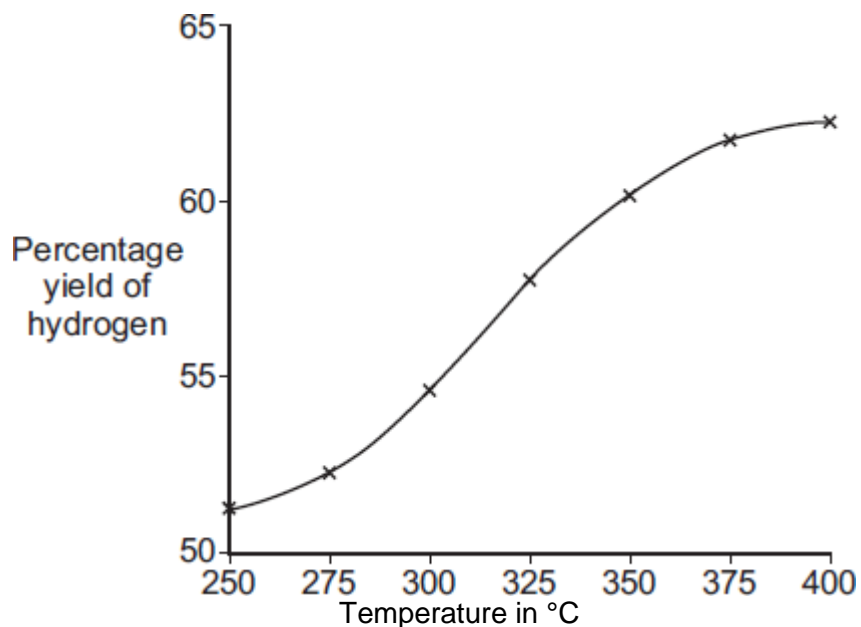
(1)

(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)

Mark schemes

Q1.

(a) any **one** from:

- solution becomes colourless or colour fades
- zinc becomes bronze / copper coloured
allow copper (forms) or a solid (forms)
- zinc gets smaller
allow zinc dissolves
- bubbles or fizzing.
ignore precipitate

1

(b) improvement:
use a plastic / polystyrene cup or add a lid
accept use lagging / insulation

1

reason - must be linked
reduce / stop heat loss

OR

improvement:

use a digital thermometer
allow use a data logger

reason - must be linked

more accurate or easy to read or stores data
allow more precise or more sensitive
ignore more reliable
ignore improvements to method, eg take more readings

1

(c) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking Guidance and apply a 'best-fit' approach to the marking.

0 marks

No relevant content

Level 1 (1–2 marks)

There is a statement about the results.

Level 2 (3–4 marks)

There are statements about the results. These statements may be linked or may include data.

Level 3 (5–6 marks)

There are statements about the results with at least one link and an attempt at an explanation.

Examples of chemistry points made in the response:

Description:

Statements

Concentration of copper sulfate increases

Temperature change increases

There is an anomalous result

The temperature change levels off

Reaction is exothermic

Linked Statements

Temperature change increases as concentration of copper sulfate increases

The temperature change increases, and then remains constant

After experiment 7 the temperature change remains constant

Statements including data

The trend changes at experiment 7

Experiment 3 is anomalous

Attempted Explanation

Temperature change increases because rate increases

Temperature change levels off because the reaction is complete

Explanation

As more copper sulfate reacts, more heat energy is given off

Once copper sulfate is in excess, no further heat energy produced

6

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Q2.

(a) (i) covalent

1

(ii) increases the rate of reaction

1

(b) (i) the reaction is reversible

1

(ii) at lower pressure the molecules will be further apart

1

so there will be fewer collisions per unit time
accept frequency of collisions lower

1

(iii) as the temperature increases, the yield of the reaction increases

1

(iv) 2 molecules / volumes become 4 **or** more molecules / volumes of product than reactant

1

- (c) Marks awarded for this answer will be determined by the Quality of Communication (QoC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a 'best-fit' approach to the marking.

0 marks

No relevant content

Level 1 (1 – 2 marks)

Candidate has written about some basic points from the table but has not added any extra knowledge. Candidate may have included advantages **or** disadvantages.

Level 2 (3 – 4 marks)

Candidate has attempted an evaluation using points from the table and their own knowledge. Candidate has included advantages **and** disadvantages.

Level 3 (5 – 6 marks)

Candidate has given an evaluation that includes both advantages and disadvantages. Candidate has clearly linked points from the table with their own knowledge and uses appropriate scientific terminology.

examples of the points made in the response

Advantages of using hydrogen:

- its combustion only produces water
- combustion of hydrogen does not produce carbon dioxide **or** does not contribute to climate change
- petrol requires much more oxygen to burn so partial combustion is possible producing carbon monoxide
- combustion of hydrogen does not produce any particulates **or** does not contribute to global dimming
- petrol comes from a non-renewable source **or** there are renewable ways of producing hydrogen, eg electrolysis of water.

Disadvantages of using hydrogen:

- hydrogen has to be stored at high pressure **or** risk of explosion or larger volume needed for storage.
- much less energy produced from the combustion of hydrogen **or** need to refuel more often
- most methods of producing hydrogen need fossil fuels.

6

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