

Rate of Reaction

Question Paper 1

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Chemistry
Exam Board	AQA
Topic	5.6 Rate + Extent Chemical Change
Sub-Topic	Rate of Reaction
Difficulty Level	Bronze Level
Booklet	Question Paper 1

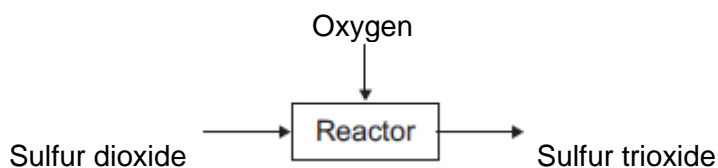
Time Allowed: 59 minutes

Score: /59

Percentage: /100

Grade Boundaries:

Q1.(a) The figure below represents the reaction of sulfur dioxide with oxygen.



(i) Complete the word equation for the reaction of sulfur dioxide with oxygen.

sulfur dioxide + →

(1)

(ii) Draw a ring around the correct answer to complete the sentence.

Sulfur dioxide (SO₂) is

a compound.

an element.

a mixture.

(1)

(b) The reactants are gases.

When the pressure of the gases is increased, the reaction gets faster.

Complete the sentence.

When the pressure of the gases is increased,

the frequency of the collisions

(1)

(c) The particles need energy to react.

Complete the sentence.

The minimum amount of energy that particles need to react is called

the energy.

(1)

- (d) Give **one** way of increasing the rate of the reaction other than changing the pressure.

.....

.....

(1)
(Total 5 marks)

Q2. Thermosoftening polymers can be used to make plastic bottles and food packaging.

- (a) Why are thermosoftening polymers **not** suitable for storing very hot food?

.....

.....

(1)

- (b) The reaction to produce the polymers uses a catalyst.

Why are catalysts used in chemical reactions?

.....

.....

(1)

- (c) Compounds from food packaging must not get into food.

Gas chromatography can be used to separate compounds in food.

The output from the gas chromatography column can be linked to an instrument which can identify the compounds.

- (i) Name the instrument used to identify the compounds.

.....

.....

(1)

- (ii) Give **one** reason why instrumental methods of analysis are used to identify the compounds.

.....
.....

(1)

- (d) Poly(ethene) is a thermosoftening polymer.

Poly(ethene) can be made with different properties. The properties depend on the conditions used when poly(ethene) is made.

Suggest **two** conditions which could be changed when poly(ethene) is made.

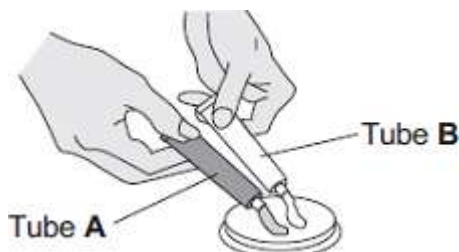
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(2)

(Total 6 marks)

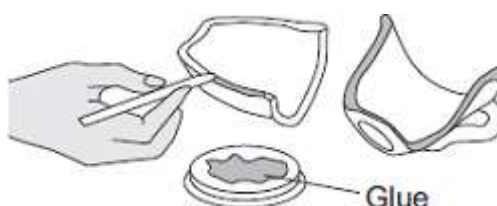
Q3.The following steps show how to use a type of glue.

Step 1 Measure out equal amounts of the liquids from tubes **A** and **B**.

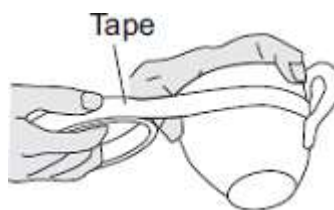


Step 2 Mix the liquids to make the glue.

Put a thin layer of the glue onto each of the surfaces to be joined.



Step 3 Put the pieces together and hold them with tape.



Step 4 Leave the glue to set.

- (a) When liquids **A** and **B** are mixed a chemical reaction takes place.

This reaction is *exothermic*.

What does *exothermic* mean?

.....

.....

.....

.....

(2)

- (b) The time taken for the glue to set at different temperatures is given in the table below.

Temperature in°C	Time taken for the glue to set
20	3 days
60	6 hours
90	1 hour

- (i) Use the correct answer from the box to complete each sentence.

decreases	increases	stays the same
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When the temperature is increased the time taken for the glue to set

.....

When the temperature is increased the rate of the setting reaction

.....

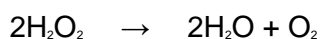
(2)

- (ii) Tick (✓) **two** reasons why an increase in temperature affects the rate of reaction.

Reason	Tick (✓)
It gives the particles more energy	
It increases the concentration of the particles	
It increases the surface area of the particles	
It makes the particles move faster	

(2)
(Total 6 marks)

- Q4.** (a) The symbol equation for the decomposition of hydrogen peroxide is:

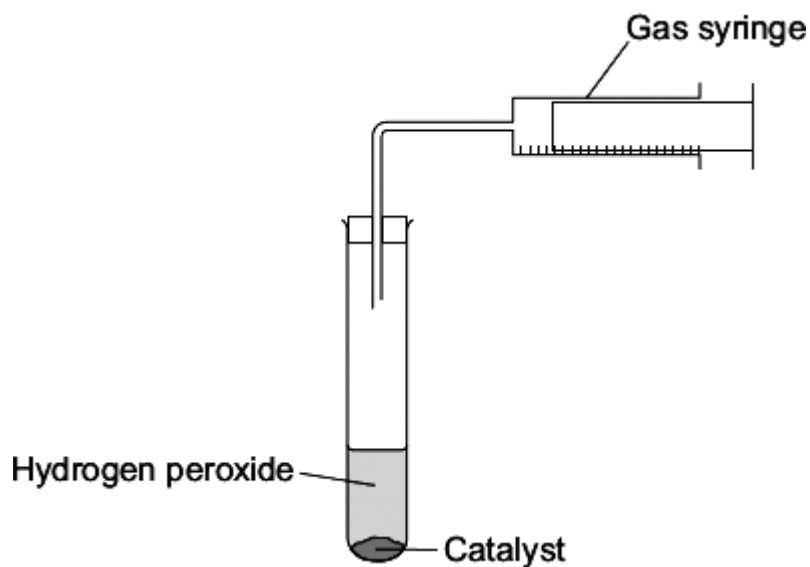


Complete the word equation for the decomposition of hydrogen peroxide.

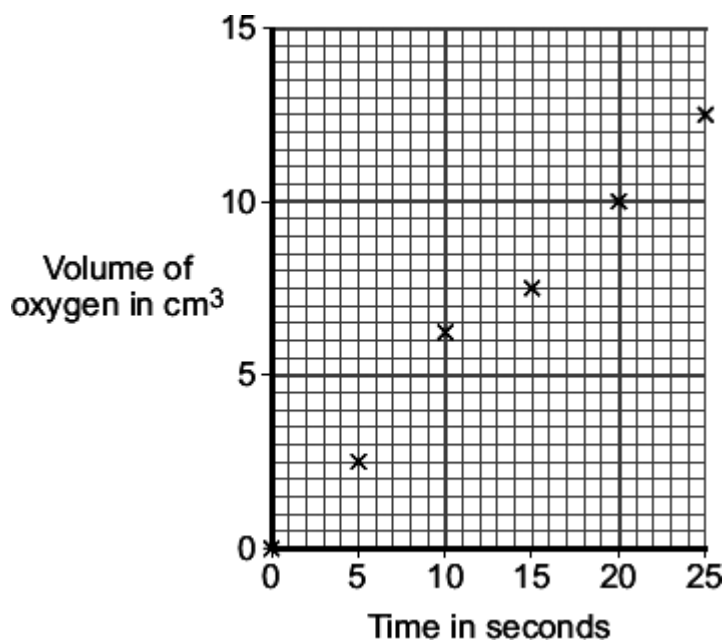
Hydrogen peroxide → +

(1)

- (b) A student did an experiment to see how quickly hydrogen peroxide decomposes. The student used the apparatus shown below to measure the volume of oxygen.



- (i) Draw a straight line of best fit to complete the graph.



(1)

- (ii) Draw a circle around the anomalous point on the graph.

(1)

- (iii) What is the volume of oxygen given off after 15 seconds?

..... cm³

(1)

- (iv) How did the volume of oxygen change between 0 and 25 seconds?

.....

(1)

- (c) The student wanted to make the reaction faster.

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

- (i) To make the reaction faster, the temperature should be

higher.
lower.
the same.

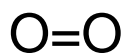
(1)

- (ii) To make the reaction faster, the hydrogen peroxide should be

more dilute.
more concentrated.
the same.

(1)

- (d) The diagram represents the bonding in oxygen.



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

- (i) When two oxygen atoms bond, the atoms

share
transfer electrons.
delocalise

(1)

(ii) The oxygen atoms are joined by

ionic

metallic

bonds.

covalent

(1)

(iii) Oxygen is made of

simple molecules.

a giant lattice.

macromolecules.

(1)

- (e) When hydrogen peroxide decomposes water is produced.
Which **two** statements in the table explain why water is a liquid at room temperature?

Tick (✓) the **two** statements.

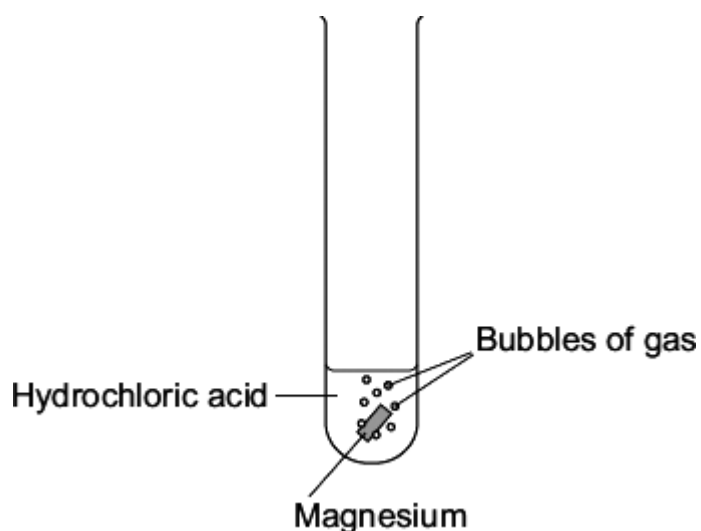
Statement	Tick (✓)
Water has a boiling point of 100 °C.	
Water is made of ions.	
Water has a melting point lower than room temperature.	
Water has a giant covalent structure.	

(2)

(Total 12 marks)

Q5. A student investigated the reaction of magnesium with hydrochloric acid.

(a) A piece of magnesium was dropped into the hydrochloric acid.



Bubbles of gas were produced and the magnesium disappeared.

The reaction is exothermic.

(i) What measurements would the student make to show that the reaction is exothermic?

.....

.....

.....

.....

(2)

(ii) How would these measurements show that the reaction is exothermic?

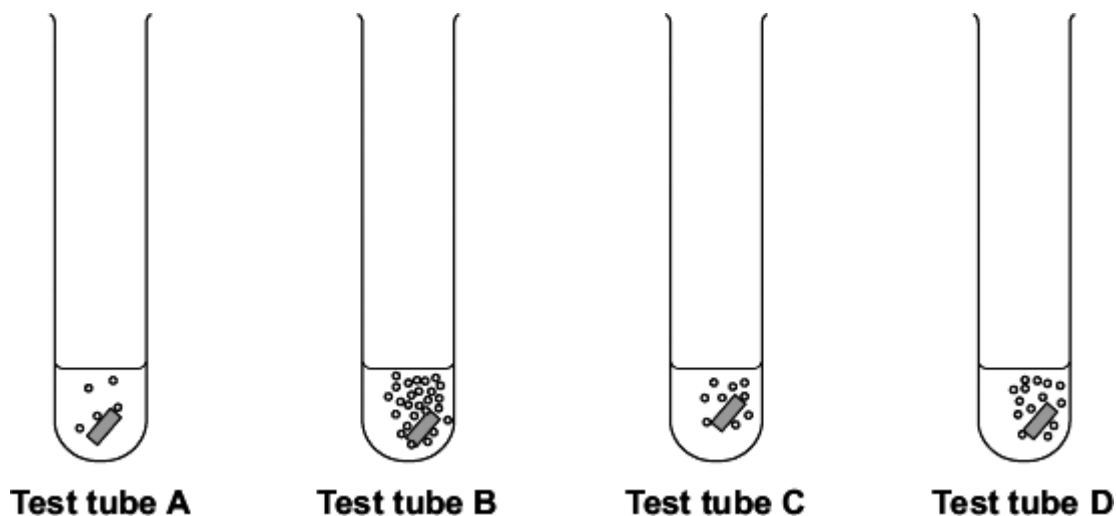
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(1)

The student investigated how changing the concentration of the hydrochloric

acid affects this reaction.

Each test tube contained a different concentration of hydrochloric acid.
The diagrams show the results of this experiment.



- (b) Suggest **one** control variable in this investigation.

.....
.....

(1)

- (c) (i) Which test tube, **A**, **B**, **C** or **D**, contained the greatest concentration of hydrochloric acid?

Test tube

(1)

- (ii) Why did you choose this test tube?

.....
.....

(1)

- (d) The student predicted that if the temperature of the acid was increased the reaction would take place faster.

Tick (✓) **two** statements in the table which explain why.

Statement	Tick (✓)
The particles move faster	
The particles collide with less energy	
The particles collide more often	
The particles are bigger	

(2)
(Total 8 marks)

Q6. The picture shows a lump of phosphate rock.



Rob Lavinsky, iRocks.com – CC-BY-SA-3.0 [CC-BY-SA-3.0], via Wikimedia Commons

Phosphoric acid is made by reacting phosphate rock with sulfuric acid.

Only **three** of the methods shown below will **increase** the rate of this reaction.

Put a **tick (✓)** next to each of the **three** methods that will **increase** the rate of this reaction.

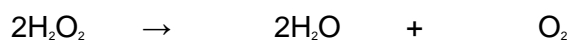
Method	Tick (✓)
Use a more concentrated solution of sulfuric acid	

Use larger lumps of phosphate rock	
Cool the mixture of phosphate rock and sulfuric acid	
Grind the phosphate rock into a powder before adding the acid	
Increase the temperature of the sulfuric acid	
Dilute the sulfuric acid solution with water	

(3)
(Total 3 marks)

Q7. Hydrogen peroxide decomposes slowly to give water and oxygen.

The reaction is *exothermic*.



(a) In an *exothermic* reaction, energy is given out.

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

In an *exothermic* reaction, the temperature

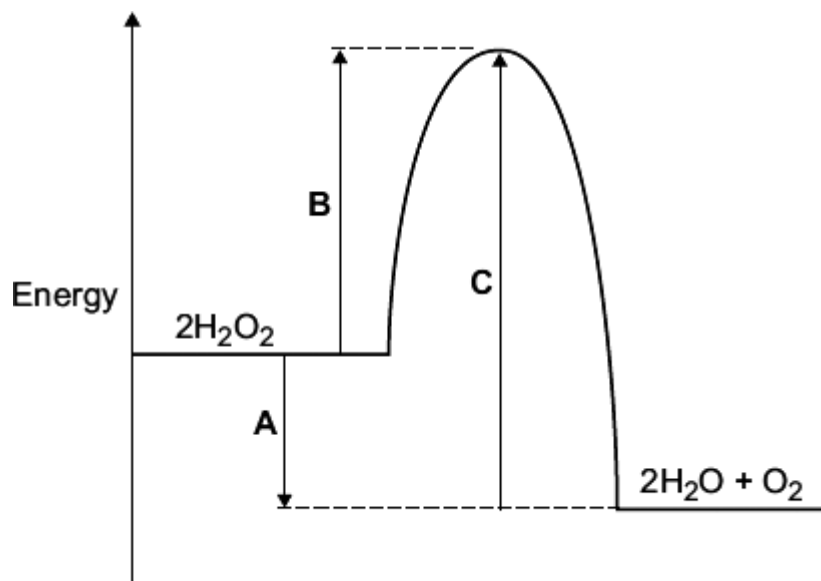
goes down.

goes up.

stays the same.

(1)

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



The energy changes, **A**, **B** and **C**, are shown on the diagram.

Use the diagram to help you answer these questions.

(i)

Which energy change, **A**, **B** or **C**, is the activation energy?

(1)

(ii)

Which energy

<p>gy chan ge, A, B or C, show s that this reacti on is exot herm ic?</p>		
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(1)

- (iii) Hydrogen peroxide decomposes quickly when a small amount of manganese(IV) oxide is added.

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

Hydrogen peroxide decomposes quickly because

manganese(IV) oxide is

a catalyst.
an element.
a solid.

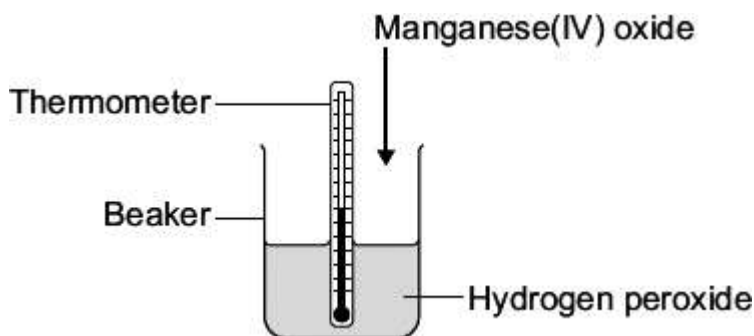
The manganese(IV) oxide has lowered the

activation energy.
boiling point.
temperature.

(2)

- (c) A student did an experiment to find the amount of energy produced when hydrogen peroxide solution is decomposed using manganese(IV) oxide.

The apparatus the student used is shown in the diagram.



The student first measured the temperature of the hydrogen peroxide. Then the student added the manganese(IV) oxide, stirred the mixture and recorded the highest temperature.

- (i) Suggest why the student stirred the mixture before recording the highest temperature.

.....
.....

(1)

- (ii) The biggest error in this experiment is heat loss.

Suggest how the student could change the apparatus so that less heat is lost.

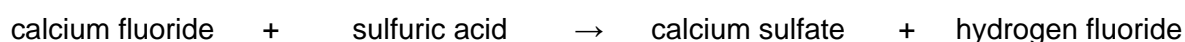
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.....

(1)

(Total 7 marks)

Q8. Hydrogen fluoride is used to make hydrofluoric acid.

- (a) A company makes hydrogen fluoride by reacting solid calcium fluoride with sulfuric acid. The reaction takes place in a rotating kiln.



The company want this reaction to take place quickly.

- (i) Rotating the kiln makes the reaction take place faster.

Suggest why.

.....

.....

(1)

(ii) Draw a ring around the correct word in each box.

To make the reaction take place **faster**:

the temperature should be

higher
lower

 so that the particles have

less
more

 energy

the solid calcium fluoride should be

powder
lumps

 to give a

small
big

 surface area

the sulfuric acid solution should be

dilute
concentrated

 to give

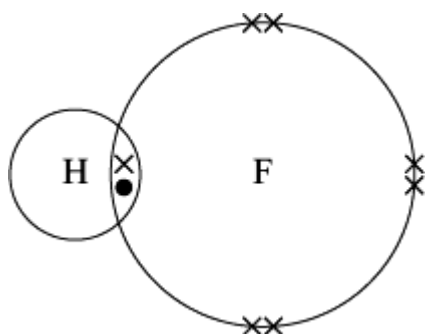
less
more

 collisions

between the particles each second.

(3)

(b) The diagram represents a molecule of hydrogen fluoride.



The hydrogen and fluorine atoms are joined by a covalent bond.

Use the correct word from the box to complete the sentence.

electrons	neutrons	protons
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In a covalent bond the atoms share

.....

(1)

- (c) Hydrogen fluoride is dissolved in water to make an acidic solution of hydrofluoric acid.

Draw a ring around the symbol of the ion that makes the solution acidic.

H⁺

OH⁻

F⁻

(1)
(Total 6 marks)

Q9. The picture shows three glowsticks.



Photograph supplied by iStockphoto/Thinkstock

Glow sticks contain several chemicals. When a glow stick is bent the chemicals mix. A chemical reaction takes place which causes light to be given out.

A student investigated three glow sticks. One was placed in water at 5 °C, one in water at

40 °C and one in water at 70 °C.

The results are shown in the table.

Temperature in °C	Effect on glow stick	
	Brightness of light	Time it gave out light, in hours
5	dim	7
40	bright	3
70	very bright	1

- (a) How did increasing the temperature affect the brightness of the glow stick?

.....

(1)

- (b) How did increasing the temperature affect the time it gave out light?

.....

(1)

- (c) The student was asked why an **increase** in temperature changes the rate of the chemical reaction. The student listed five ideas. Only **three** of them are correct.

Put ticks (✓) next to the **three** correct ideas.

Ideas	Ticks (✓)
The particles will collide more often.	
The particles will be more concentrated.	
The particles will move faster.	
The particles will have more energy.	
The particles will get bigger.	

(3)

- (d) Suggest **one** way the student could improve this investigation.

.....

.....

(1)
(Total 6 marks)