OXFORD

INTERNATIONAL AQA EXAMINATIONS

Topic Test: OxfordAQA International GCSE Combined Science Chemistry 9204

The rate and extent of chemical change

Name: _____

Class: _____

Date: _____

Time: **47 minutes**

Marks: **47 marks**

Comments:

1 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.

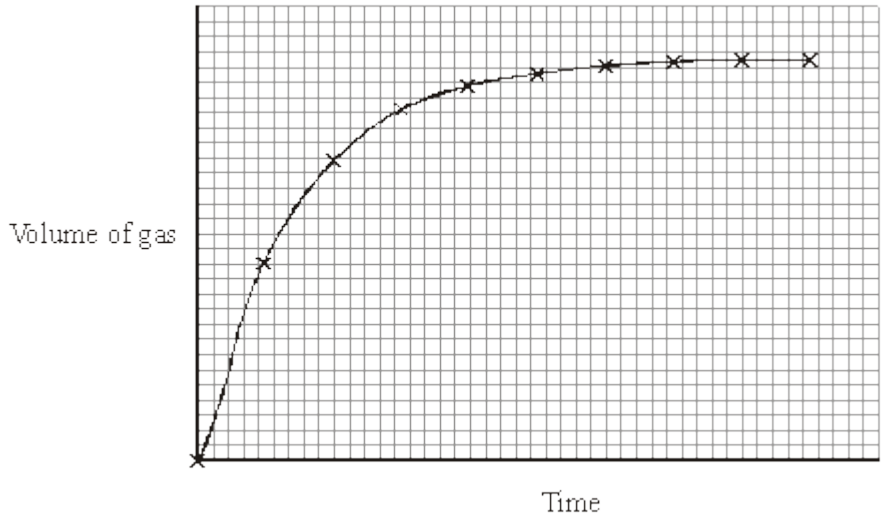
Method	**Tick (✓)**
Use a more concentrated solution of sulfuric acid	
Use larger lumps of phosphate rock	
Cool the mixture of phosphate rock and sulfuric acid	
Grind the phosphate rock into a powder before adding the acid	
Increase the temperature of the sulfuric acid	
Dilute the sulfuric acid solution with water	

(3)

(Total 3 marks)

2 Pieces of zinc react with dilute acid to form hydrogen gas.

The graph shows how the volume of hydrogen gas produced changes with time.



(a) Describe, as fully as you can, how the volume of gas produced changes with time.

_____

_____

_____

_____

(2)

(b) A student wants to make the reaction take place faster.

Some suggestions are given in the table.

Put ticks (✓) next to the **two** suggestions that would make the reaction take place faster.

Suggestions	(✓)
Use bigger pieces of zinc.	
Use a more concentrated acid.	
Use zinc powder.	
Decrease the temperature of the acid.	

(2)

(Total 4 marks)

3 Hydrogen peroxide slowly decomposes into water and oxygen.

hydrogen peroxide → water + oxygen

The reaction can be speeded up by adding manganese dioxide.

(a) (i) What do we call a substance that speeds up a chemical reaction without being changed itself?

_____

(1)

(ii) Give **two** other ways of increasing the rate of this reaction.

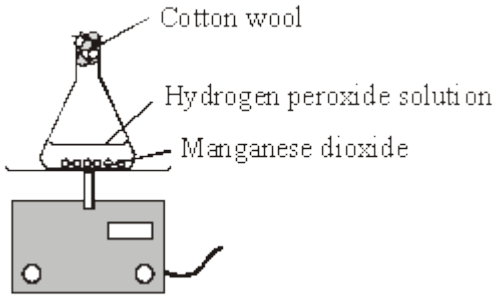
1. _____

2. _____

(2)

(b) The diagram shows how the rate of this reaction can be measured.

As the hydrogen peroxide decomposes, the mass of the flask and its contents decreases.



Why does this decrease in mass take place?

_____

_____

(1)

(Total 4 marks)

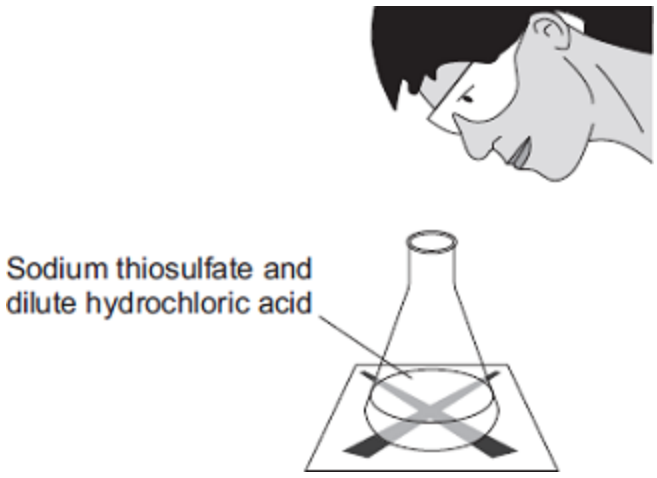
4 A student investigated the rate of reaction between sodium thiosulfate and dilute hydrochloric acid.

The student placed a conical flask over a cross on a piece of paper.

The student mixed the solutions in the flask.

The solution slowly went cloudy.

The student timed how long it took until the cross could not be seen.



The equation for the reaction is:

$Na_2S_2O_3(aq)$	+	2 HCl(aq)	→	2 NaCl(aq)	+	H2O(l)	+	SO2(g)	+	S(s)
sodium thiosulfate	+	hydrochloric acid	→	sodium chloride	+	water	+	sulfur dioxide	+	sulfur

(a) Explain why the solution goes cloudy.

_____

_____

_____

_____

(2)

(b) The student repeated the experiment with different concentrations of sodium thiosulfate.

Concentration of sodium thiosulfate in moles per dm^3	Time taken until the cross could not be seen in seconds			
	Trial 1	**Trial 2**	**Trial 3**	**Mean**
0.040	71	67	69	69
0.060	42	45	45	44
0.080	31	41	33	

(i) Calculate the mean time for 0.080 moles per dm^3 of sodium thiosulfate.

Mean = _____ seconds

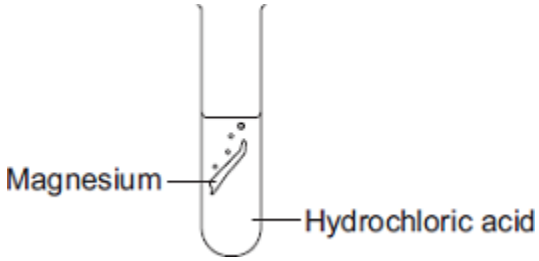
(2)

(ii) Describe and explain, in terms of particles and collisions, the effect that increasing the concentration of sodium thiosulfate has on the rate of the reaction.

(3)

(Total 7 marks)

5 A student investigated the reaction between magnesium and hydrochloric acid.



The equation for the reaction is:

Mg(s) magnesium	+	2 HCl(aq) hydrochloric acid	⟶	$MgCl_2$(aq) magnesium chloride	+	H_2(g) hydrogen

(a) Give **two** observations the student could make during the reaction.

1. _____

_____

2. _____

_____

(2)

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

The student investigated how the rate of this reaction changed when the concentration of hydrochloric acid was changed.

Write a plan the student could use.

In your plan you should:

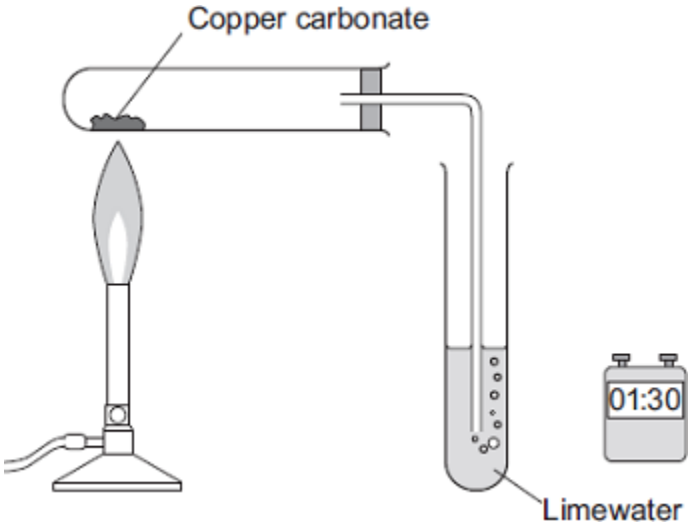
- describe how you would carry out the investigation and make it a fair test
- describe the measurements you would make.

(6)

(Total 8 marks)

6 Carbon dioxide is produced when copper carbonate is heated.

A student investigated heating copper carbonate.
The student used the apparatus to measure how long it took for carbon dioxide to be produced.
The student also noted what happened during each minute for three minutes.



(a) The student used changes to the limewater to measure how long it took for carbon dioxide to be produced.

Describe how.

_____

_____

_____

_____

(2)

(b) The student wrote down her observations.

Time interval in minutes	Observations
Between 0 and 1	A slow release of gas bubbles. The limewater did not change. The solid in the test tube was green.
Between 1 and 2	A fast release of gas bubbles. The limewater changed at 1 minute 10 seconds.
Between 2 and 3	No release of gas bubbles. The solid in the test tube was black.

(i) Suggest the reason for the student's observations between 0 and 1 minute.

(2)

(ii) Explain the student's observations between 1 and 2 minutes.

(2)

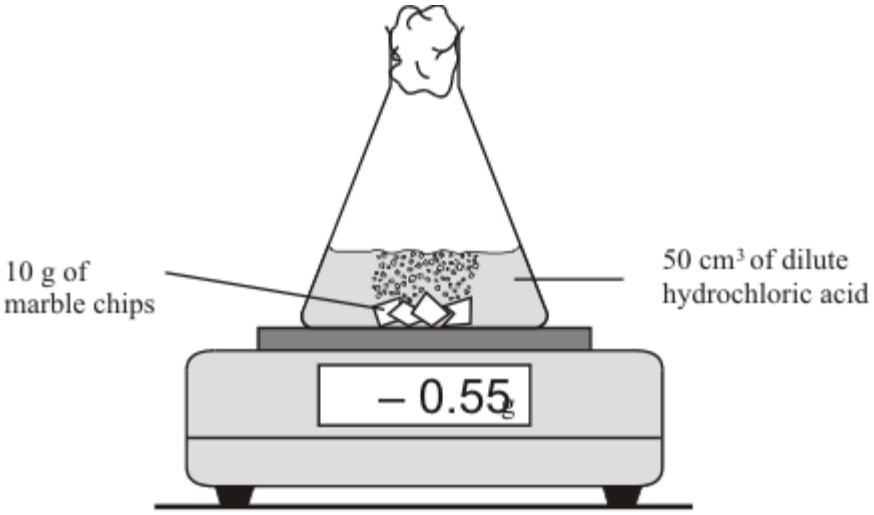
(iii) Explain the student's observations between 2 and 3 minutes.

(2)

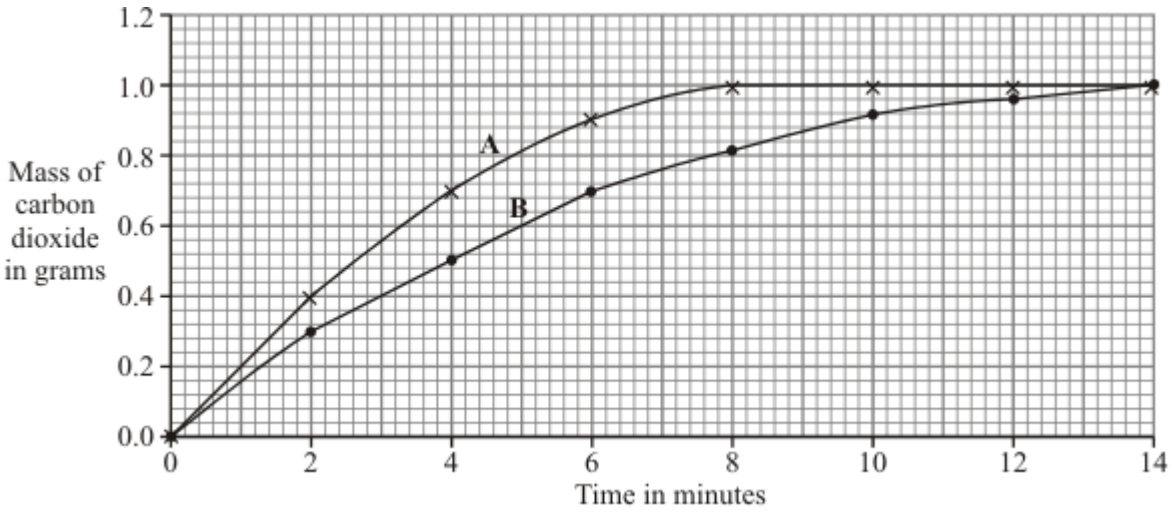
7 Marble is a rock that contains mainly calcium carbonate. This reacts with hydrochloric acid.

calcium carbonate + hydrochloric acid → calcium chloride + water + carbon dioxide

The rate of this reaction was followed by measuring the mass of carbon dioxide formed.



Two 10 g samples of marble, **A** and **B**, were each reacted with 50 cm^3 of dilute hydrochloric acid, at different temperatures. The mass of carbon dioxide formed in each reaction was recorded and plotted to produce the graph below.



Each reaction stopped when no more carbon dioxide was formed.
In both experiments some marble was left unreacted when the reaction stopped.

(a) Explain how you can tell which sample, **A** or **B**, reacted faster with the dilute hydrochloric acid.

_____

_____

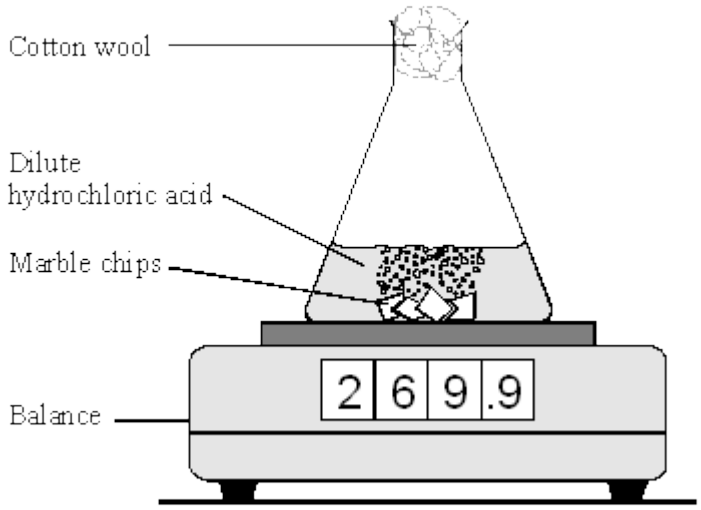
(2)

(b) The faster rate of reaction was caused by using a higher temperature. Explain, in terms of particles, why a higher temperature causes a faster rate of reaction.

(3)

(Total 5 marks)

8 The apparatus shown in the diagram was used to investigate the rate of reaction of excess marble chips with dilute hydrochloric acid, HCl. Marble is calcium carbonate, formula $CaCO_3$. The salt formed is calcium chloride, $CaCl_2$.



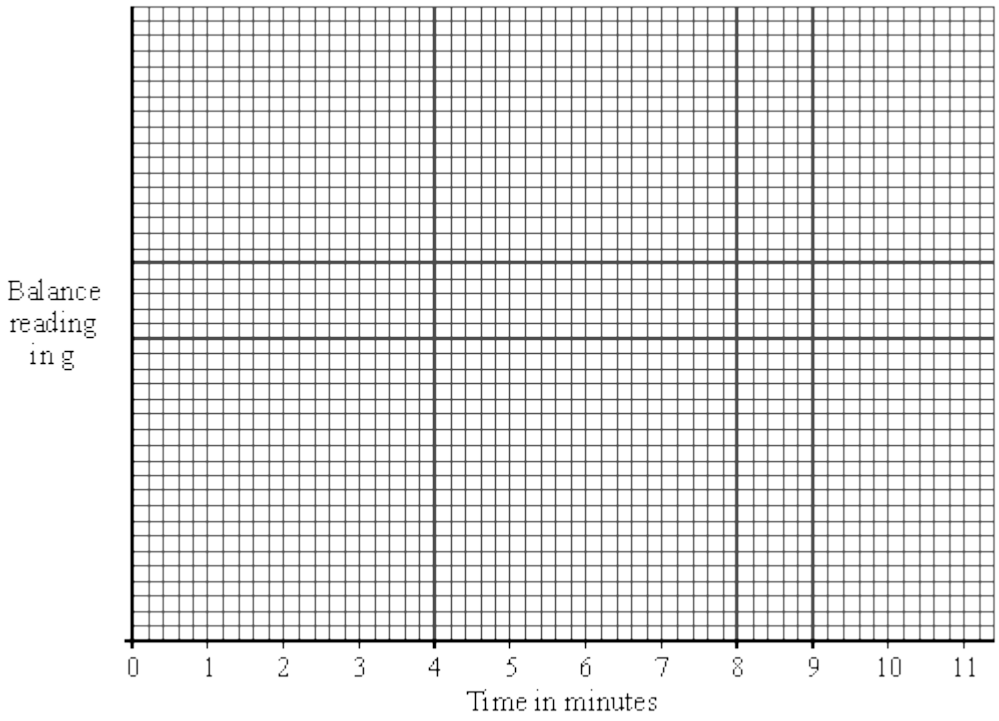
(a) Write a balanced equation for the reaction.

(2)

The following results were obtained from the experiment.

Time in minutes	Reading on balance in g
0.5	269.6
1.0	269.3
2.0	269.0
3.0	268.8
5.0	268.7
9.0	268.6

(b) (i) Plot the results and draw a graph on the axes below.



(3)

(ii) Continue the graph you have drawn to show the expected reading after11 minutes.

(1)

(iii) On the axes above, sketch a graph of the result which would be obtained if in a similar experiment the same mass of powdered marble was used instead of marble chips.

(2)

(Total 8 marks)

1 use a more concentrated solution of sulfuric acid

1

grind the phosphate rock into a powder before adding the acid

1

increase the temperature of the sulfuric acid

1

[3]

2 (a) any **two** from:

- increases
  owtte allow 'goes up'
- until reaches maximum / levels off
  owtte
- quickly at first
  owtte
- then more slowly / rate decreases
  allow reaction finished
  ignore rate increases

2

(b) use a more concentrated acid
list principle applies

use zinc powder

2

[4]

3 (a) (i) catalyst / enzyme

1

(ii) any **two** from
do not accept increase volume of peroxide

- heat
- stir / shake
- increase concentration of peroxide / catalyst

2

(b) oxygen lost
do not allow incorrect gas

1

[4]

4 (a) because sulfur / S forms

1

which is insoluble / a solid / a precipitate

1

(b) (i) 32

*correct answer with or without working gains **2** marks*

*accept evidence of 31 + 33 / 2 for **1** mark*

*allow 35 for **1** mark*

2

(ii) reaction rate increases

*if incorrect reference to energy = max **2***

1

because of more particles (per unit volume)

allow because particles are closer together

1

and because there is an increase in frequency of collisions

*accept because particles are more likely to collide **or** higher chance of collision*

ignore more (successful) collisions

1

[7]

5 (a) any **two** from:

- effervescence / bubbles / fizzing

  allow gas / hydrogen is given off
  allow volume of gas

  allow magnesium floats

- magnesium disappears / dissolves

  allow change in mass of magnesium

- heat given off / exothermic

  allow temperature change
  *do **not** accept temperature decreases*

- change in pH

  *do **not** accept pH decreases*

2

(b) 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.

0 marks
No relevant content.

Level 1 (1-2 marks)
A simple plan without reference to changing any variable but should include an attempt at measuring rate **or** an attempt at fair testing

Level 2 (3-4 marks)
A plan including change of concentration / 'volume' of acid **and** should include an attempt at measuring rate **and / or** an attempt at fair testing

Level 3 (5-6 marks)
A workable plan including change of concentration **and** measurement of rate **and** fair testing

Examples of chemistry points made in the response could include:

Plan:

- add magnesium to acid
- time reaction / 'count bubbles' / measure volume of gas
- change concentration / 'volume' of acid

Control Variables:

- amount / mass / length / same 'size' of magnesium
- volume / amount of acid

6

[8]

6 (a) time from when the heating is started until

1

the limewater turns cloudy / milky

1

(b) (i) the temperature was not high enough

accept the copper carbonate had not started to decompose / react

accept it takes time to heat up the copper carbonate

1

the bubbles of gas were air

accept no carbon dioxide produced

1

(ii) the copper carbonate was decomposing / reacting

accept the temperature was high enough to cause decomposition / a reaction

1

so carbon dioxide was produced

allow correct word / symbol equation

1

(iii) copper oxide was produced

allow correct word / symbol equation

1

because the copper carbonate had completely decomposed / reacted

ignore all of the carbon dioxide had been given off

1

[8]

7 (a) **A** faster because: the graph line steeper / the reaction had stopped earlier

*accept sample **B** slower because: the graph line was less steep / the reaction stopped later*

A because CO_2 given off faster / fizzes more for 1 mark

***B** because CO_2 given off slower / fizzes less for 1 mark*

2

(b) increases the speed / energy of the (hydrochloric acid) particles

1

collide more frequently

1

collide more energetically / successfully

accept more successful collisions = 2 marks

1

[5]

8 (a) $CaCO_3 + \mathbf{2}HC1 \rightarrow CaC1_2 + \mathbf{CO_2 + H_2O}$

*one mark for CO_2 and H_2O **or** H_2CO_3*

one mark for balancing the equation

2

(b) (i) linear suitable scale for y axis

± *one small square*

1

accurate plots

deduct one mark for each error plot

1

smooth curve through the points **or** a line of best fit

this mark requires a neat smooth curve

1

(ii) curve becomes almost horizontal at **or** above 268.5

do not credit a straight line reaching 268.5 at 11 mins

accept a plot at 268.6

1

(iii) steeper initial part to curve

1

becoming nearly horizontal between 268.6 and 268.4 g

1

[8]