Name: _____

Class: _____

Date: _____

Rates & Equilibrium part 4 AQA Triple Chemistry

Time: **34 minutes**

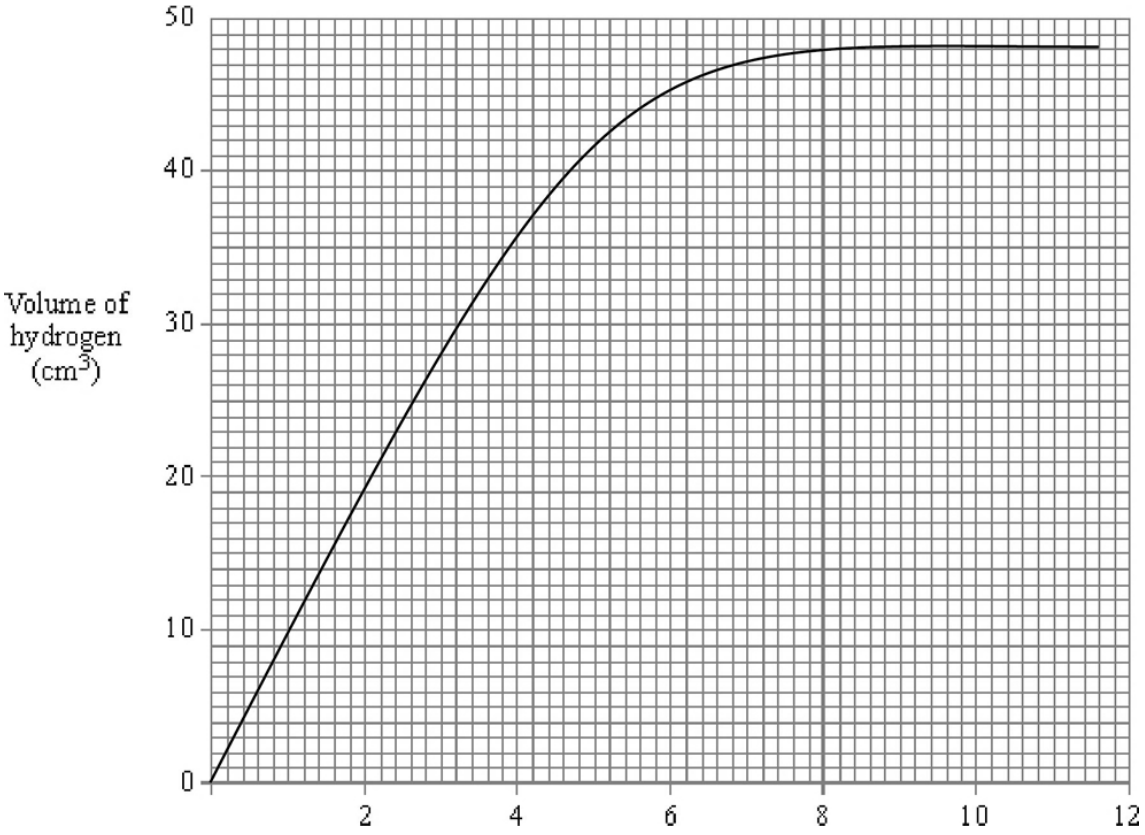
Marks: **34 marks**

Comments:

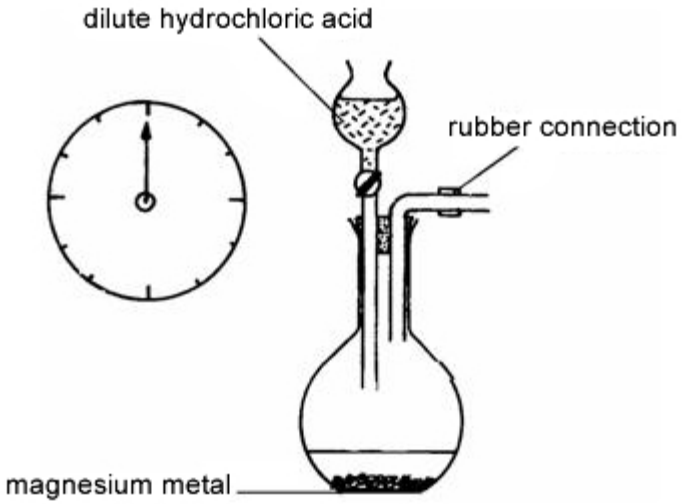
1. A student does an experiment to examine the rate of reaction between magnesium and dilute hydrochloric acid.
She adds 25 cm^3 of the acid to a weighed amount of the metal.
The reaction produces hydrogen gas.

Magnesium + hydrochloric acid ⟶ magnesium + hydrogen chloride

She collects the gas and measures the volume collected at one minute intervals.
All the metal reacted but there was some acid left unreacted.
Her results are shown on the graph.



(a) The diagram shows part of the apparatus she used for the experiment.
Complete the diagram to show how the student could collect the hydrogen produced and measure the volume after each minute.



(2)

(b) (i) When is the rate of reaction at its fastest?

_____

(1)

(ii) State **one** way in which she could increase the rate of reaction.

_____

(1)

(c) (i) What is the total volume of hydrogen collected in the experiment?

_____ cm^3

(1)

(ii) State **one** way in which she could increase the final volume of hydrogen collected.

_____

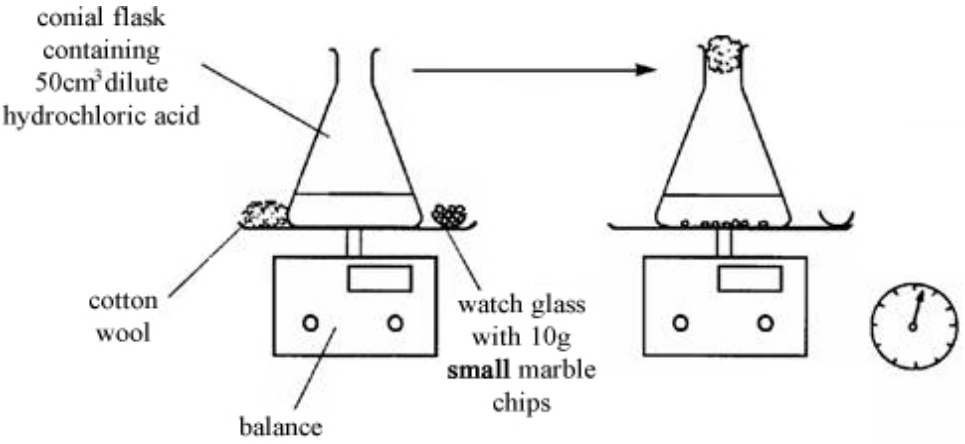
(1)

(Total 6 marks)

2. Marble chips (calcium carbonate) react with dilute hydrochloric acid.

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

A student wanted to find out if the size of the marble chips made a difference to how fast the reaction took place.



(a) What readings should she take?

_____

_____

_____

(2)

(b) She repeated the experiment but this time used the same mass (10g) of **large** marble chips. In both experiments there was some marble left in the flask when the reaction stopped.

These are the results of the two experiments.

TIME (minutes)	0	2	4	6	8	10	12
Loss in mass (g), using small chips	0.00	0.40	0.72	0.91	1.04	1.04	1.04
Loss in mass (g), using large chips	0.00	0.28	0.52	0.70	0.84	0.94	1.04

(i) Explain the loss in mass in the two experiments.

_____

_____

_____

_____

(1)

(ii) What difference does the size of the chips make?

_____

_____

(1)

(c) A chemical reaction occurs when reacting particles collide with sufficient energy. The reaction between marble and hydrochloric acid is faster if the acid is at a higher temperature. Explain why.

_____

_____

_____

_____

(3)

(Total 7 marks)

3. (a) Ammonium sulphate is made by the reaction:

$$2NH_3(aq) + H_2SO_4(aq) \rightarrow (NH_4)_2SO_4(aq)$$

(i) Complete the **three** answers in the table.

Question	Answer
How many hydrogens are there in the formula of ammonium sulphate?	_____
What is the name of the substance with the formula NH_3?	_____
What is the name of the substance with the formula H_2SO_4?	_____

(3)

(ii) What is the main use for ammonium sulphate?

_____

(1)

(iii) A similar reaction is used to make ammonium nitrate. What is the name of the acid which must be used?

_____

(1)

(b) NH_3 is made by the reversible reaction:

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

(i) Explain what the term *reversible reaction* means.

_____

_____

_____

(2)

(ii) What is the name of the raw material which is the source of nitrogen (N_2)?

_____

(1)

(iii) Nitrogen is an element. Explain what the term *element* means.

_____

_____

_____

(2)

(Total 10 marks)

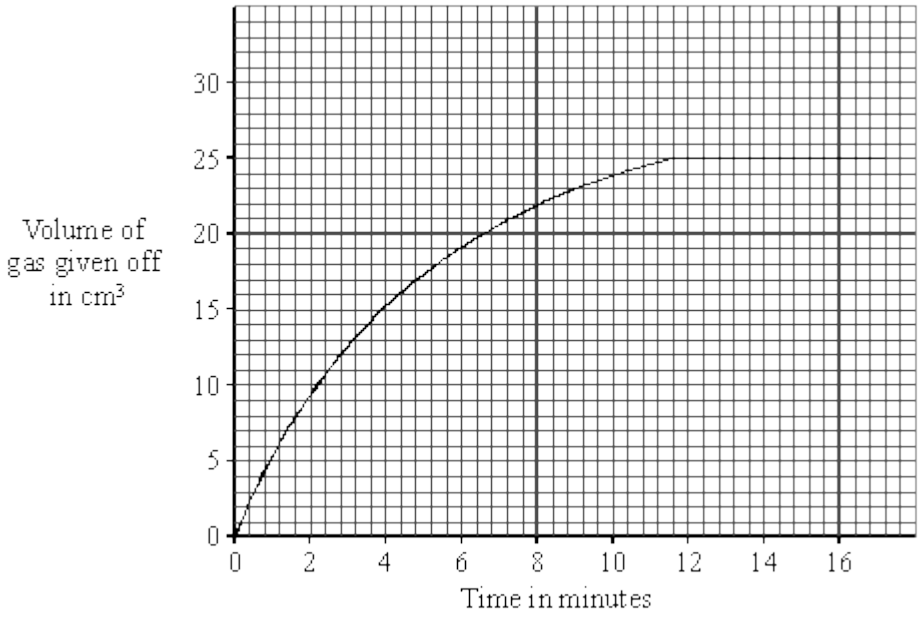
4. Zinc powder normally reacts slowly with hydrochloric acid.

(a) Balance the symbol equation for the reaction.

$Zn + HCl \rightarrow ZnC1_2 + H_2$

(1)

The graph shows the results from a reaction of 1.0 g of zinc powder with 20 cm^3 of dilute hydrochloric acid. It gives off a gas and forms zinc chloride, $ZnCl_2$. Some unreacted zinc is left at the end.



(b) Copper powder is a good catalyst for the reaction of zinc with hydrochloric acid.

(i) A mixture of 10 cm^3 of the same dilute hydrochloric acid and 1.0 g of copper powder was added to 1.0 g of zinc powder. What is the maximum volume of gas which could be given off?

_____ cm^3

(1)

(ii) Draw a graph, on the axes above, for an experiment where 20 cm^3 of the same dilute hydrochloric acid was added to 1.0 g of copper powder mixed with 1.0 g of zinc powder.

(2)

(iii) Give **two** other ways the reaction described in part (i) could be made to go faster.

1. _____

2. _____

(2)

(c) Copper powder can be formed by adding copper sulphate solution to the mixture of zinc powder and acid.

(i) Why does zinc react with copper sulphate solution to produce copper?

_____

_____

(1)

(ii) Write the word equation for the reaction.

_____

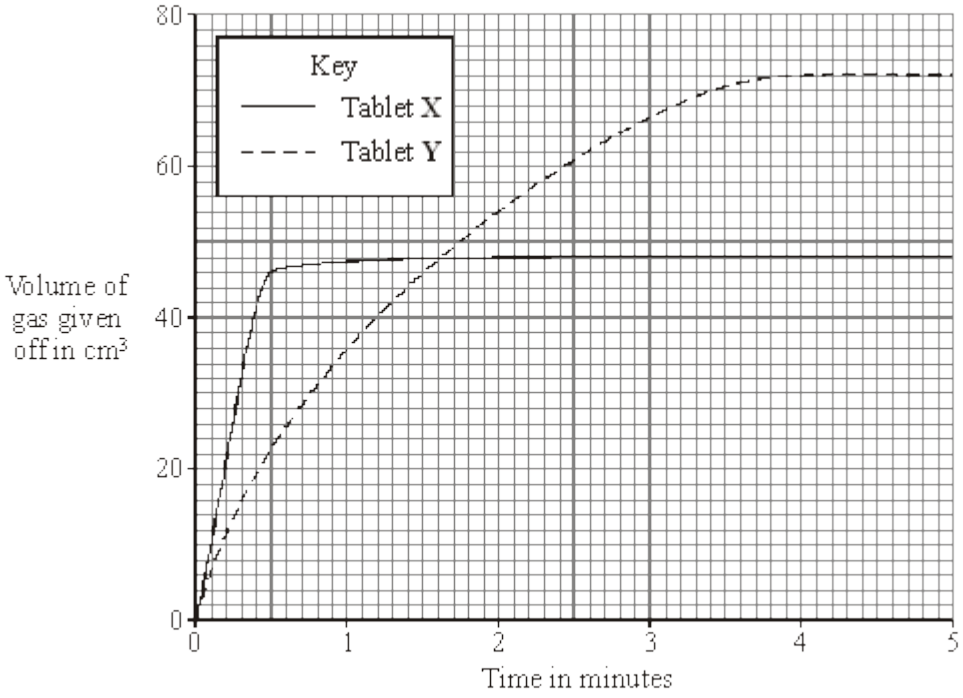
(1)

(Total 8 marks)

5. Many indigestion tablets contain calcium carbonate as their only active ingredient. Calcium carbonate neutralises some of the hydrochloric acid in the stomach.

Two different indigestion tablets, **X** and **Y**, were separately reacted with excess hydrochloric acid. The volume of gas given off in each reaction was measured every minute.

The results are shown in the graph.



(i) Which tablet, **X** or **Y**, contained most calcium carbonate? _____

Explain the reason for your answer.

_____

_____

(1)

(ii) Which tablet, **X** or **Y**, reacted faster with hydrochloric acid?_____

Explain the reason for your answer.

_____

_____

(1)

(iii) Explain the shape of the graph for tablet **X** between 3 and 5 minutes.

_____

_____

_____

_____

(1)

(Total 3 marks)

1.

(a) (must be possible for the gas to enter and displace the water) **or** other suitable apparatus

- apparatus to collect the gas correctly assembled
  for 1 mark
- **calibrated** collection vessel (award even if diagram is wrong)
  for 1 mark

2

(b) (i) at the start / in the first 1/2 minutes (or any time within this range)
for 1 mark

1

(ii) increase the temperature / use smaller pieces of metal /
use more metal / increase the surface area of the metal /
add a catalyst / shake the flask / increase the concentration /
strength of the acid
for 1 mark

1

(c) (i) 48
for 1 mark

1

(ii) increase the amount of magnesium used
for 1 mark
(do not allow increase the amount of acid used)

1

[6]

2.

(a) *ideas that*

- ref to read the balance / read the mass / weight
- ref to read the stop clock / read the time
- 'readings' taken at the beginning and end / at regular intervals
  for 1 mark each

2

(b) (i)
- loss of carbon dioxide (from the flask) }

(ii)
- smaller chips give faster reaction / reaction } **mark as a whole**
  finishes quicker /dissolved faster *[or reverse]* }
- smaller chips have a larger surface area }

any 2 for 1 mark each
[Allow converse answers]

2

(c) *ideas that*

- heating increases the speed / energy / vibration of the (acid) particles / marble particles
- (acid) particles collide (with marble chips / (particles)) more frequently / more likely to collide
- reacting particles collide with greater energy / collide faster
- so particles more likely to react *[do not accept* 'react faster' *]*

[Accept 'atoms', 'molecules' or 'ions' instead of 'particles' *in this question]*

any three for 1 mark each

3

[7]

3. (a) (i) 8

ammonia

do not credit ammonium

sulphuric acid

do not credit just sulphuric; credit sulfuric acid

do not credit hydrogen sulphate

3

(ii) (as a) fertiliser

1

(iii) nitric (acid)

accept HNO_3 if correct in every detail

1

(b) (i) chemical change (in which)

or *under suitable conditions*

1

product(s) can be converted to reactant(s)

or *direction of reaction can be reversed*

or *equilibrium can be achieved*

do not credit reaction can be reversed

1

(ii) air

or *(the) atmosphere*

1

(iii) made of atoms

1

which are all the same

credit the idea that the particles (in an element) are all the same even if the name of the particles (the first mark) is incorrect

or *which have the same number of protons*

or *which have the same atomic number / proton number*

it cannot be broken down into anything simpler (2) marks

1

[10]

4. (a) $Zn + \mathbf{2}HC1 \rightarrow ZnC1_2 + H_2$

1

(b) (i) 12.5

1

(ii) steeper curve same volume of gas evolved

do not credit two intersects of straight lines

accept a sharp bend

2

(iii) any **two** from:

stir it

accept mix it better

heat it

accept warm it

use a more finely divided catalyst

accept use a better catalyst or more finely divided zinc

do not credit use acid of a higher

2

(c) (i) any **one** from

zinc is more reactive than copper

accept zinc is above copper in the reactivity series

zinc displaces copper

accept it is higher than copper in the reactivity series

1

(ii) zinc + copper sulphate → copper + zinc sulphate

ignore the presence of acid ***or*** *water*

accept a balanced equation

1

[8]

5. (i) (Y)
more gas / carbon dioxide given off

1

(ii) (X)
curve / slope steeper

accept rises more rapidly / only took 30 seconds

1

(iii) (flat)
since calcium carbonate /
substrate all used up

accept the reaction has stopped /
no more gas is being produced *1*

1

[3]