

## 5: Reaction rates – Topic questions

## Paper 3

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
3	2016	June	31
7	2016	June	31
7	2016	June	32

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at [www.cambridgeinternational.org/support](http://www.cambridgeinternational.org/support)

- 3 (a) The reactions between metals and acids are redox reactions.



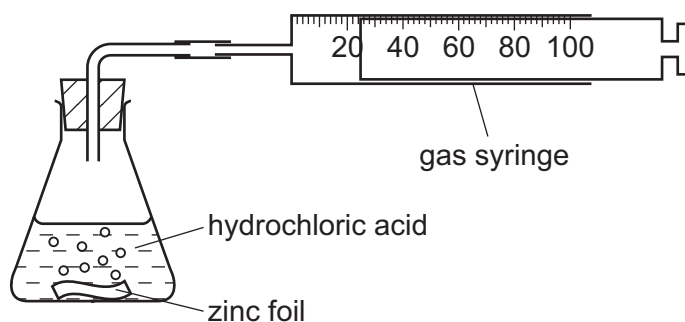
- (i) Which change in the above reaction is oxidation, Zn to  $\text{Zn}^{2+}$  or  $2\text{H}^+$  to  $\text{H}_2$ ? Give a reason for your choice.

.....  
..... [2]

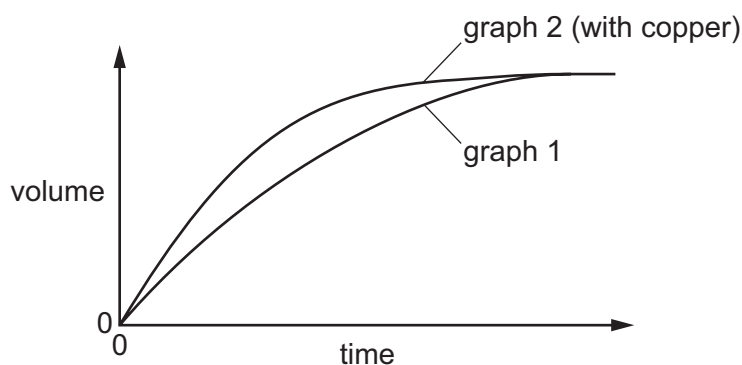
- (ii) Which reactant in the above reaction is the oxidising agent? Give a reason for your choice.

.....  
..... [2]

- (b) The rate of reaction between a metal and an acid can be investigated using the apparatus shown below.



A piece of zinc foil was added to  $50\text{ cm}^3$  of hydrochloric acid, of concentration  $2.0\text{ mol/dm}^3$ . The acid was in excess. The hydrogen evolved was collected in the gas syringe and its volume measured every minute. The results were plotted and labelled as graph 1.



The experiment was repeated to show that the reaction between zinc metal and hydrochloric acid is catalysed by copper. A small volume of aqueous copper(II) chloride was added to the acid before the zinc was added. The results of this experiment were plotted on the same grid and labelled as graph 2.

- (i) Explain why the reaction mixture in the second experiment contains copper metal. Include an equation in your explanation.

.....  
..... [2]

- (ii) Explain how graph 2 shows that copper catalyses the reaction.

.....  
.....  
..... [3]

- (c) If the first experiment was repeated using ethanoic acid,  $\text{CH}_3\text{COOH}$ , instead of hydrochloric acid, how and why would the graph be different from graph 1?

.....  
.....  
.....  
..... [4]

- (d) Calculate the maximum mass of zinc which will react with  $50\text{ cm}^3$  of hydrochloric acid, of concentration  $2.0\text{ mol/dm}^3$ .

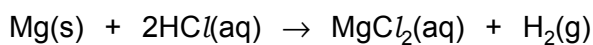


Show your working.

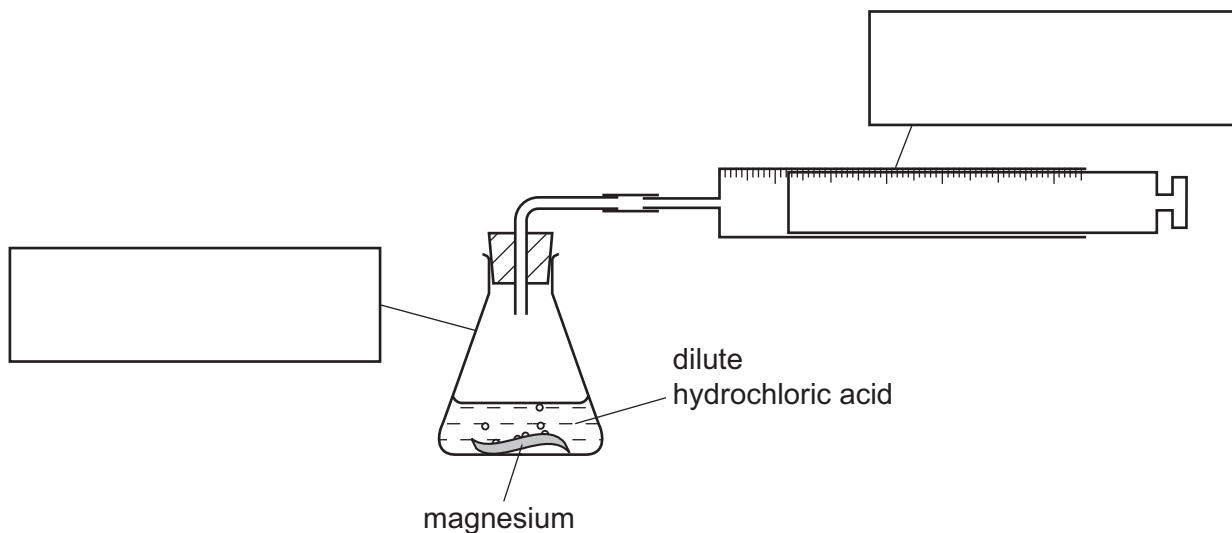
[3]

[Total: 16]

- 7 When magnesium reacts with hydrochloric acid, the products are aqueous magnesium chloride and hydrogen.



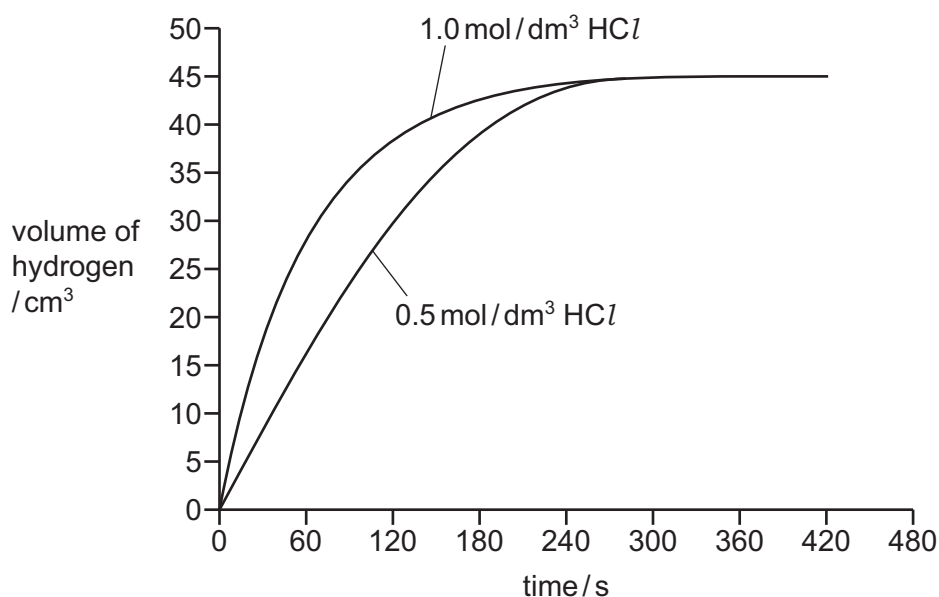
A student used the apparatus shown to follow the progress of this reaction.



- (a) Complete the diagram by putting the correct labels in the boxes.

[2]

- (b) The student conducted two experiments using the same mass of magnesium in each experiment and two different concentrations of hydrochloric acid. The hydrochloric acid was in excess. All other conditions were kept constant. The student measured the volume of hydrogen produced over a period of time. The graph shows the results.



- (i) Which concentration of hydrochloric acid gave the faster initial rate of reaction?

Use the graph to explain your answer.

.....

..... [1]

- (ii) Draw a curve **on the graph on page 16** to show how the volume of hydrogen would change if a third experiment was carried out using  $1.5 \text{ mol/dm}^3$  hydrochloric acid and the same mass of magnesium.

[2]

- (c) Give **one** use of hydrogen.

..... [1]

- (d) Explosions have occasionally been reported where tiny particles of metal dust escape into the air.

Explain why metal dust can form an explosive mixture with air.

.....

..... [1]

[Total: 7]

- 7** Calcium carbonate reacts with dilute hydrochloric acid.

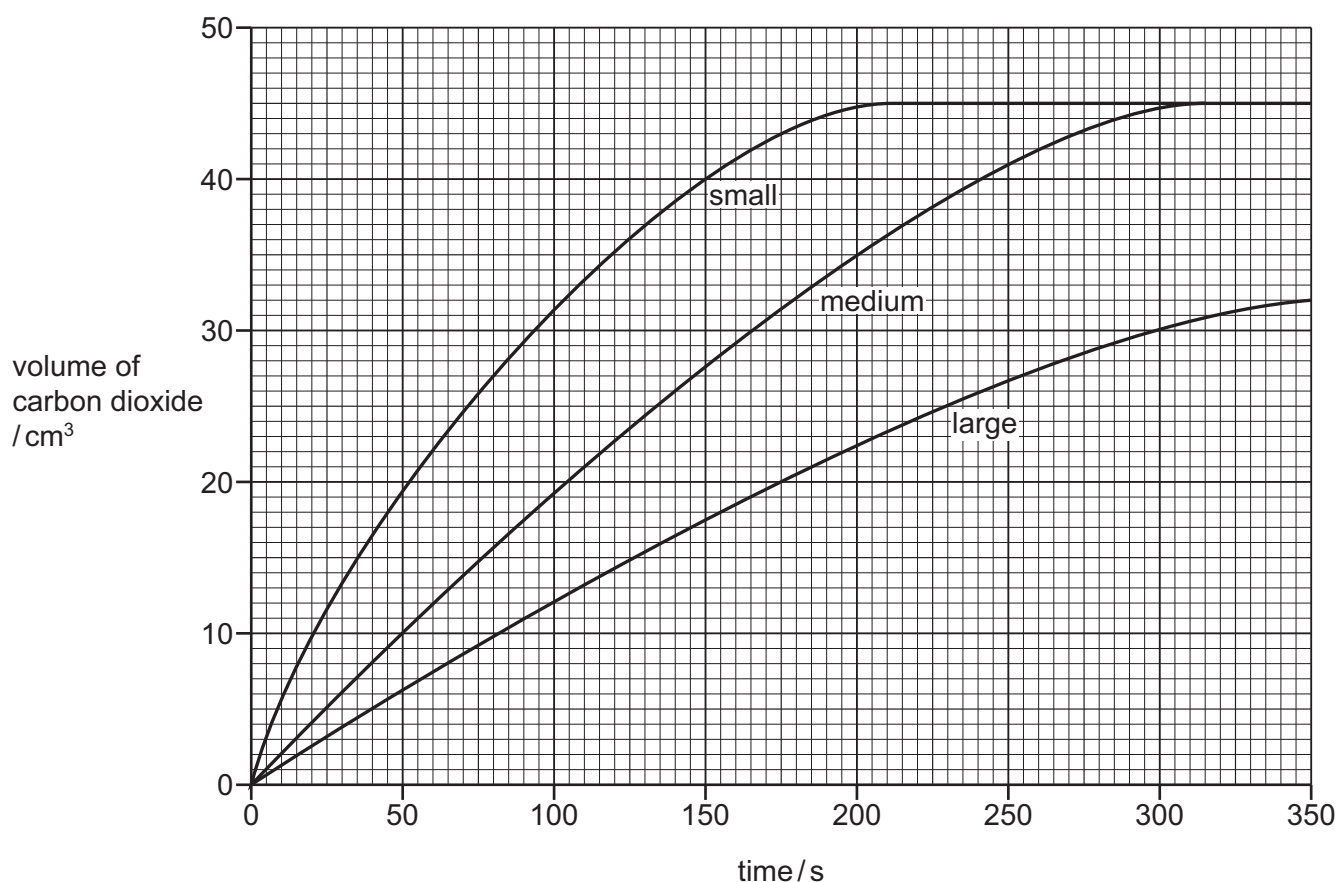


A student investigated this reaction by measuring the volume of carbon dioxide released every minute at constant temperature.

- (a)** Draw a diagram of the apparatus that the student could use to investigate this reaction.

[2]

- (b) The graph shows the results of this reaction using three samples of calcium carbonate of the same mass: large pieces, medium-sized pieces and small pieces.



- (i) Which sample, large, medium or small pieces, gave the fastest initial rate of reaction?

Use the graph to explain your answer.

.....

..... [2]

- (ii) The experiment was repeated using powdered calcium carbonate of the same mass. Draw a line **on the grid above** to show how the volume of carbon dioxide changes with time for this experiment. [2]

- (iii) At what time was the reaction just complete when small pieces of calcium carbonate were used?

..... [1]

(c) When calcium carbonate is heated strongly, calcium oxide is formed.

(i) Give **one** use of calcium oxide.

..... [1]

(ii) What type of oxide is calcium oxide?

Explain your answer.

.....  
..... [2]

[Total: 10]



Question	Answer	Marks
3 (a) (i)	Zn to Zn <sup>2+</sup> ; because electron loss;	2
3 (a) (ii)	(2)H <sup>+</sup> or 'hydrogen ion(s)'; it accepts electrons or takes electrons (from zinc atoms);	2
3 (b) (i)	zinc displaces copper or zinc more reactive than copper; $\text{Zn} + \text{CuCl}_2 \rightarrow \text{ZnCl}_2 + \text{Cu}$ <b>OR</b> $\text{Zn} + \text{Cu}^{2+} \rightarrow \text{Cu} + \text{Zn}^{2+}$ ;	2
3 (b) (ii)	steeper(line) or higher gradient; (means an) increased rate; but the same (final) volume;	3
3 (c)	M1 less steep (line) or lower gradient; M2 (because of) decreased rate; M3 ethanoic is a weak(er) acid; M4 only partially ionised or dissociated <b>OR</b> lower concentration of hydrogen ions;	4
3 (d)	M1 moles of HCl = 0.1 (mol); M2 moles of Zn = 0.05 (mol); mass of zinc = 3.25 g;	3
		Total: 16

*Continues on next page ...*

Question	Answer	Marks
7 (a)	flask; (gas) syringe;	2 1 1
7 (b) (i)	1.0 (mol/dm <sup>3</sup> ) because the initial gradient is steeper / initial slope is steeper;	1
7 (b) (ii)	steeper gradient than curve for 1.0 mol/dm <sup>3</sup> ; same final volume	2 1 1
7 (c)	any suitable use, e.g. fuel / reducing agent / making margarine / making ammonia / Haber process / fuel cells;	1
7 (d)	dust has a (very) high surface area;	1
		Total: 7
7 (a)	(gas) syringe leading to flask / beaker / test tube <b>OR</b> flask and tube leading to upturned measuring cylinder over trough of water; closed apparatus with no air gaps;	2 1 1
7 (b) (i)	small pieces; line / curve / graph steepest;	2 1 1
7 (b) (ii)	line to the left of the small pieces starting at (0, 0); finishing at 45 cm <sup>3</sup> and before the other lines;	2 1 1
7 (b) (iii)	any value between 205 s and 215 s (inclusive);	1
7 (c) (i)	neutralising (acidic) soils / neutralising (acidic) waste / steelmaking / self-heating cans / making concrete / making glass / water treatment / making plaster / making paper / flue-gas desulfurisation / neutralising acids / making limewater;	1
7 (c) (ii)	basic oxide; because it is a metal oxide / because it would react with acid / neutralizes acids / calcium is on the left of the Periodic Table'	2 1 1
		Total: 10