Chemical Reactions – 2019 June

1. 0620/31/M/J/19/No.7

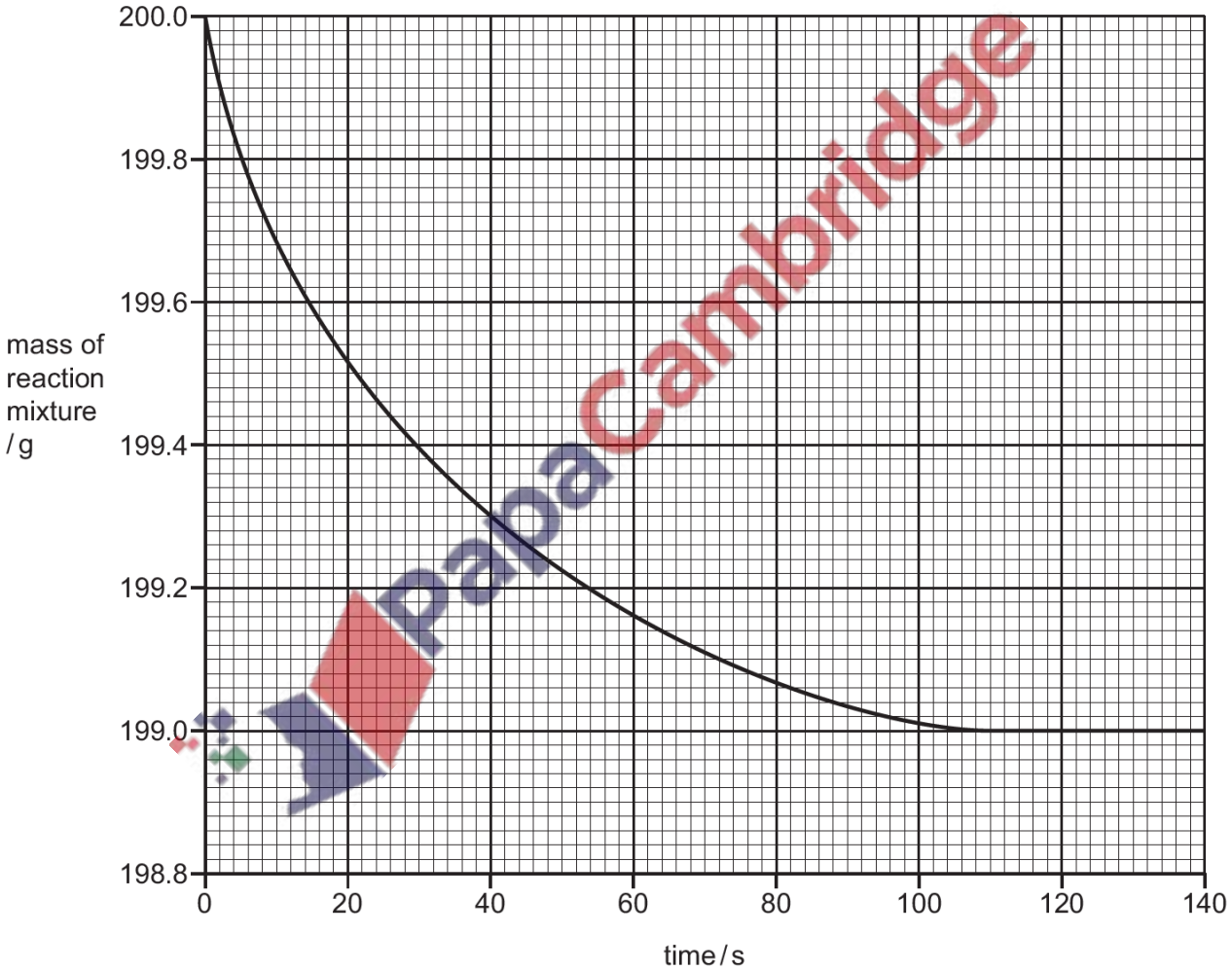
A student investigates the rate of reaction of small pieces of calcium carbonate with an excess of hydrochloric acid of concentration 1 mol / dm^3.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$$

(a) Name the salt formed when calcium carbonate reacts with hydrochloric acid.

..... [1]

(b) The graph shows how the mass of the reaction mixture changes with time.



(i) State why the reaction mixture decreases in mass.

..... [1]

(ii) Calculate the loss in mass during the first 40 seconds of the experiment.

..... g [1]

(iii) The experiment is repeated using hydrochloric acid of concentration 2 mol / dm^3.
All other conditions are kept the same.

Draw a line **on the grid** for the experiment using hydrochloric acid of concentration 2 mol / dm^3. [2]

(iv) In the experiment, when 2.00 g of calcium carbonate is used, the loss in mass of the reaction mixture is 0.88 g.
All other conditions are kept the same.

Calculate the loss in mass when 0.50 g of calcium carbonate is used.

loss in mass = ... g [1]

(v) The experiment is repeated using the same mass of different sized pieces of calcium carbonate.
All other conditions are kept the same.

The sizes of the pieces of calcium carbonate are:

- powder
- small pieces
- large pieces.

Complete the table by writing the sizes of the pieces of calcium carbonate in the first column.

size of pieces of calcium carbonate	initial rate of loss in mass in g / s
	0.005
	0.030
	0.100

[1]

[Total: 7]

2. 0620/32/M/J/19/No.7

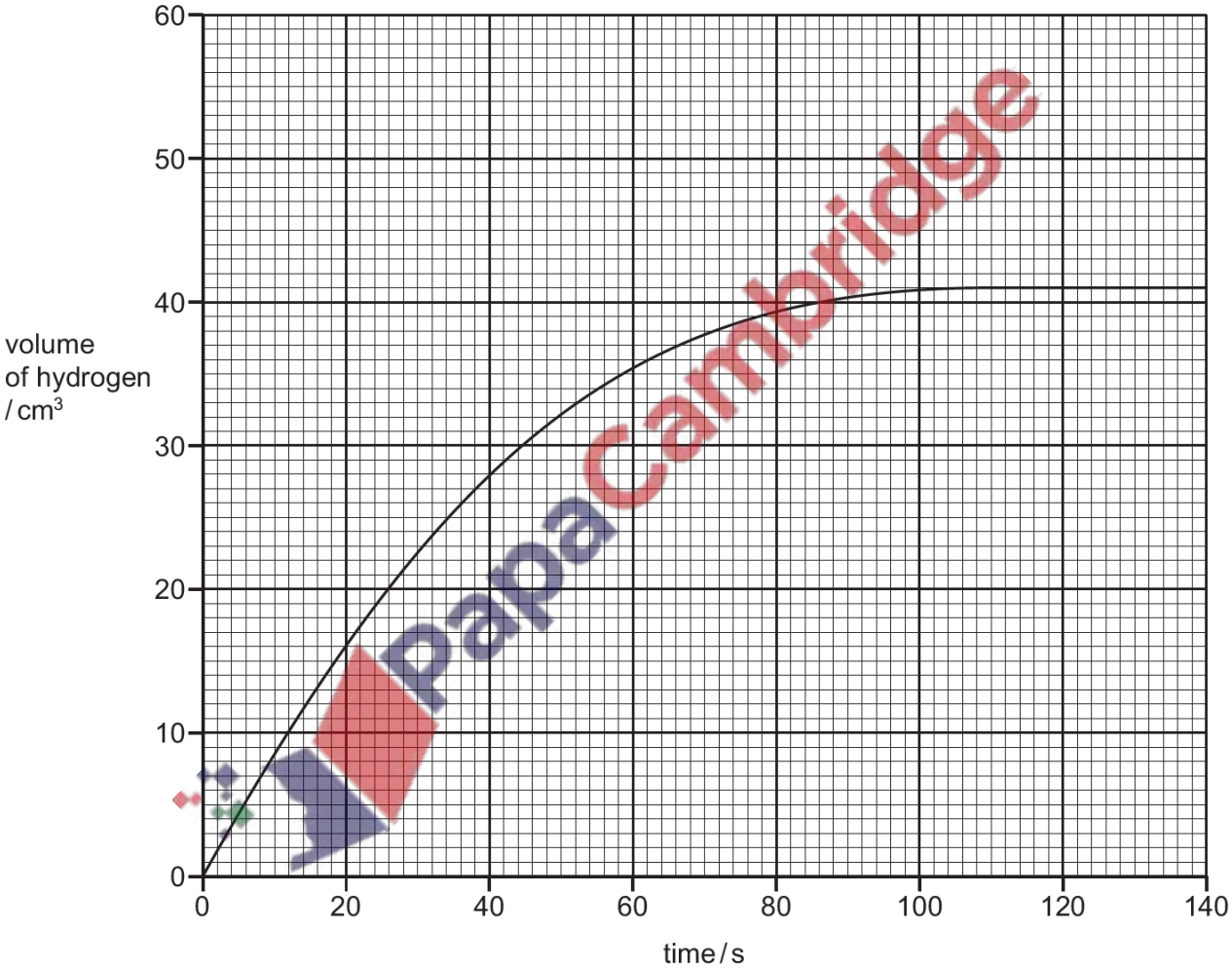
A student investigates the rate of reaction of magnesium ribbon with an excess of dilute hydrochloric acid.

$$Mg + 2HCl \rightarrow MgCl_2 + H_2$$

(a) Name the salt formed when magnesium reacts with dilute hydrochloric acid.

..... [1]

(b) The graph shows how the volume of hydrogen produced changes with time.



(i) Describe how the rate of reaction changes with time.
Use the graph to explain your answer.

.....

.....

..... [2]

(ii) How many seconds did it take to collect the first 25 cm^3 of hydrogen?

..... s [1]

(iii) The experiment is repeated at a higher temperature.
All other conditions are kept the same.

Draw a line **on the grid** for the experiment using a higher temperature. [2]

(iv) If 2.4 g of magnesium is used, 0.2 g of hydrogen is produced.

Calculate the mass of magnesium needed to produce 0.8 g of hydrogen using an excess of dilute hydrochloric acid.

mass of magnesium = ... g [1]

[Total: 7]

3. 0620/33/M/J/19/No.7

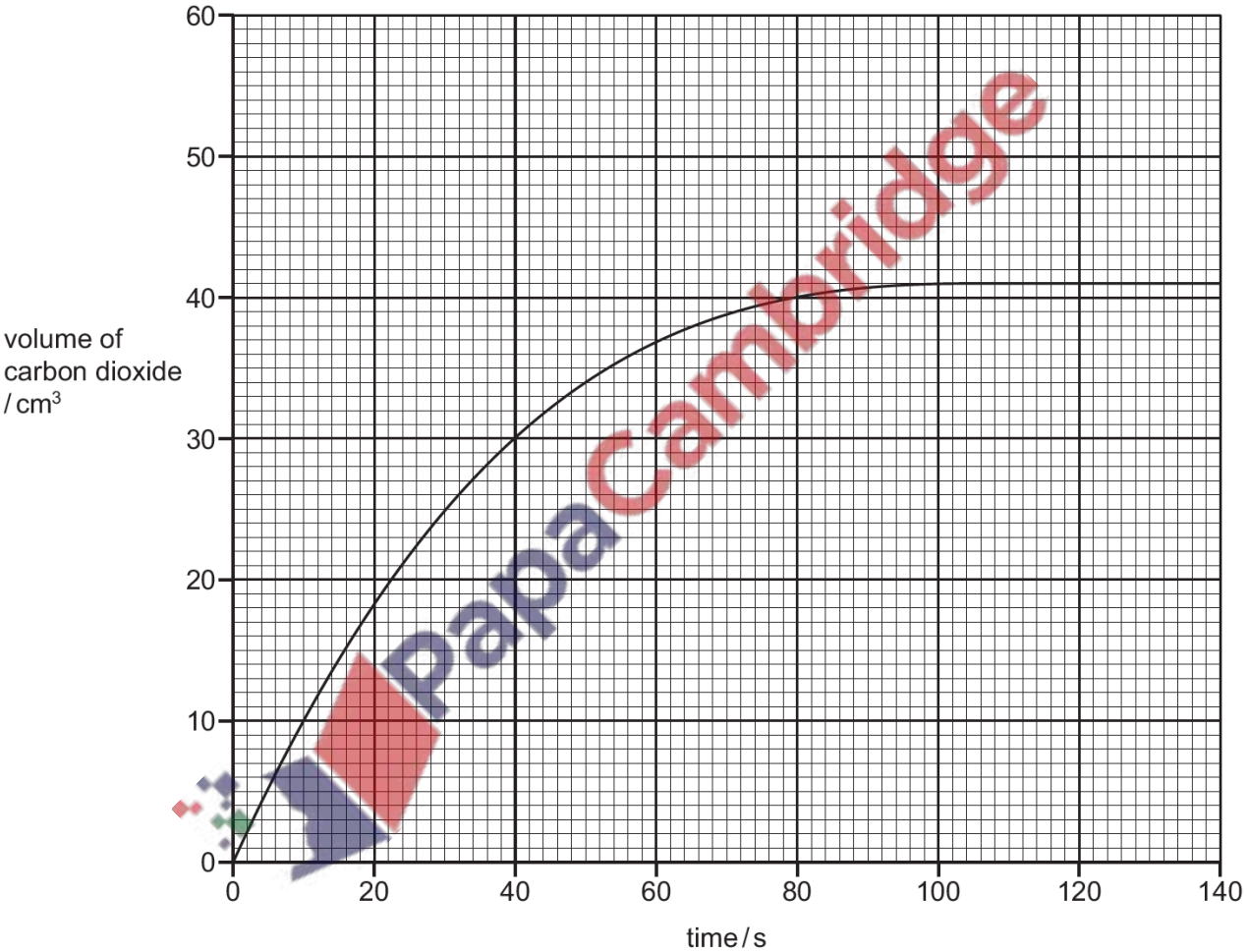
A student investigates the rate of reaction of large pieces of magnesium carbonate with an excess of dilute nitric acid.

$$MgCO_3 + 2HNO_3 \rightarrow Mg(NO_3)_2 + CO_2 + H_2O$$

(a) Name the salt formed when magnesium carbonate reacts with dilute nitric acid.

..... [1]

(b) The graph shows how the volume of carbon dioxide changes with time.



(i) After how many seconds did the reaction finish?

..... s [1]

(ii) From the graph, deduce the volume of carbon dioxide produced during the first 50 seconds of the experiment.

.....cm^3 [1]

(iii) The experiment is repeated using smaller pieces of the same mass of magnesium carbonate.
All other conditions are kept the same.

Draw a line **on the grid** for the experiment using smaller pieces of magnesium carbonate.
[2]

(iv) How does increasing the temperature affect the rate of this reaction?
All other conditions are kept the same.

..... [1]

(v) How does decreasing the concentration of nitric acid affect the rate of this reaction?
All other conditions are kept the same.

..... [1]

(c) Nitric acid contains nitrate ions.

Complete these sentences about the test for nitrate ions using words from the list.

aluminium	**ammonia**	**blue**	**chloride**	**copper**
green	**iron**	**nitrate**	**oxygen**	**red**

Aqueous sodium hydroxide and ..... foil are added to the solution being tested. The mixture is warmed gently. The ..... produced turns damp ..... litmus paper ..... .

[3]

[Total: 10]

4. 0620/32/F/M/19/No.4

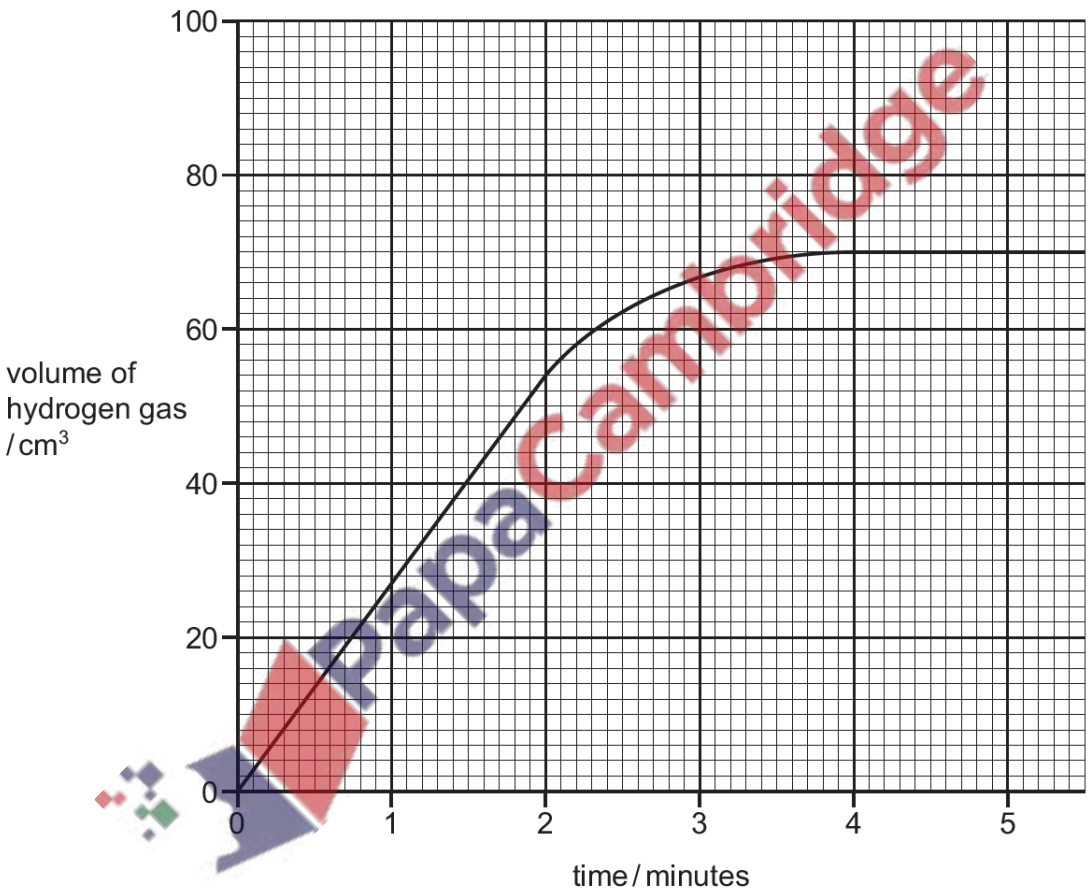
A student investigated the reaction between zinc and dilute hydrochloric acid by measuring the volume of hydrogen gas produced at one minute intervals.

$$Zn + 2HCl \rightarrow ZnCl_2 + H_2$$

(a) Give the name of the salt formed in this reaction.

..... [1]

(b) The graph shows the results using small pieces of zinc and dilute hydrochloric acid.



(i) Deduce the volume of hydrogen gas produced in the first **two** minutes of the reaction.

..... cm^3 [1]

(ii) Draw a letter **S on the graph** to show where the reaction is slowing down but has **not** stopped completely. [1]

(iii) Draw a line **on the grid** to show how the volume of hydrogen gas changes with time when the reaction is repeated with a catalyst.
All other conditions are kept the same. [2]

(iv) What effect do the following have on the rate of this reaction?

- Decreasing the temperature at which the reaction is done.
  All other conditions are kept the same.

.....

- Using zinc powder instead of small pieces of zinc.
  All other conditions are kept the same.

.....

[2]

(c) Describe a test for hydrogen.

test .....

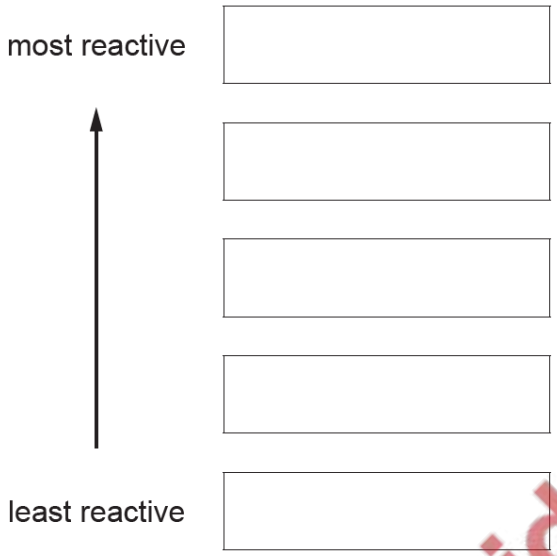
result .....

[2]

(d) The table gives some information about the rate of reaction of zinc and some other metals with cold water and with steam.

metal	rate of reaction	
	with cold water	with steam
iron	no reaction	hot iron reacts very slowly
magnesium	reacts very slowly	hot magnesium reacts rapidly
mercury	no reaction	no reaction
strontium	reacts rapidly	reacts rapidly
zinc	no reaction	hot zinc reacts slowly

Put the **five** metals in order of their reactivity.
Put the most reactive metal at the top.



[2]

(e) When 13.0 g of zinc reacts completely with sulfur, 19.4 g of zinc sulfide is formed.

Calculate the maximum mass of zinc sulfide formed when 3.25 g of zinc reacts completely with sulfur.

mass of zinc sulfide formed = ... g [1]

[Total: 12]