Controlling reactions – 2021/20 GCSE Gateway Chemistry A
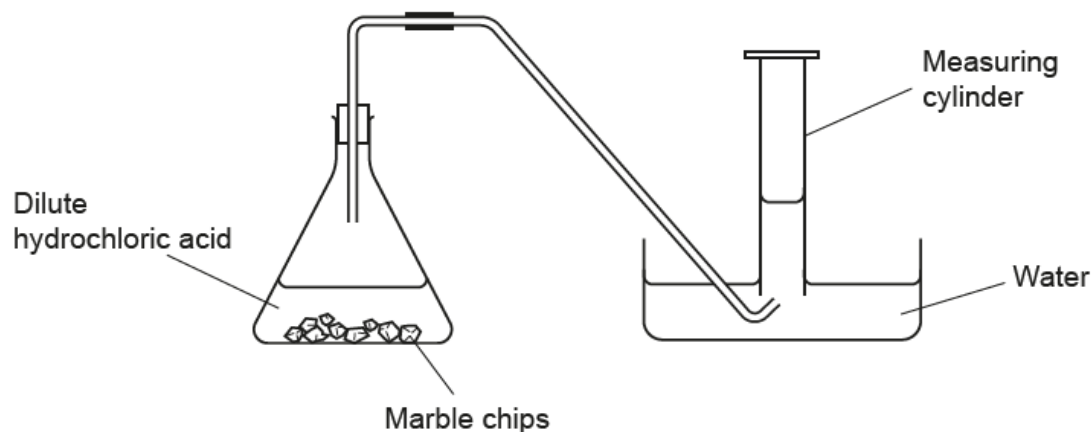
1. Nov/2021/Paper_J248/02/No.19

   A student investigates the rate of reaction between marble chips and dilute hydrochloric acid.

   The student measures the volume of carbon dioxide gas given off every 30 seconds.
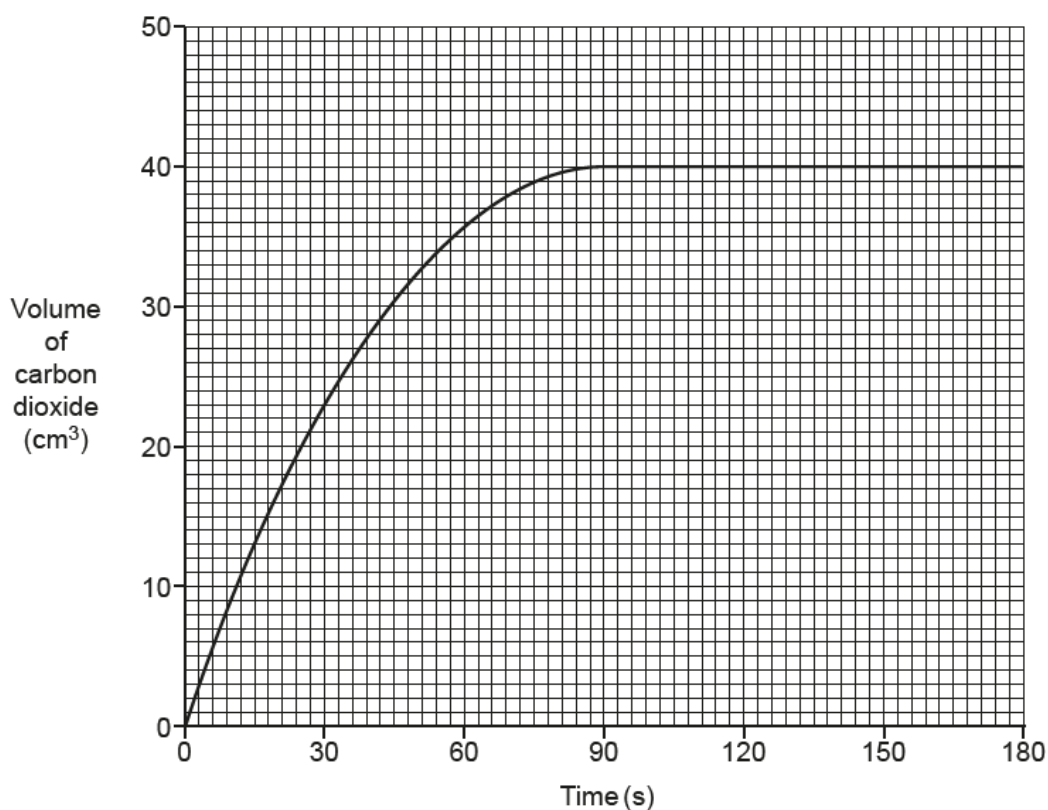
   Look at the apparatus they use.

   (a) Suggest a piece of apparatus that the student could use to measure the **volume** of carbon dioxide more accurately.

   .... [1]

   (b) Describe the test for carbon dioxide gas.

   ....

   .... [2]

(c) The graph shows the student's results.

(i) What is the time taken to make 23 cm^3 of carbon dioxide?

Time = ... s [1]

(ii) The student repeats the experiment. The only difference is they use **larger** marble chips.

Draw a line on the graph to show the results of this experiment. **[2]**

(d) The student made 0.073 g of carbon dioxide in their experiment.

They predicted that they should have made 0.088 g.

Calculate the **percentage yield**.

Give your answer to **2** significant figures.

Percentage yield = ... % **[3]**

(e) Another student investigates the effect of changing the temperature of the dilute hydrochloric acid on the rate of the reaction.

The table shows the student's results.

Experiment	Temperature (°C)	Time for reaction to finish (s)
1	20	107
2	30	61
3	40	35
4	50	17

Describe and explain the effect of changing the temperature on the **rate** of the reaction.

Use the student's results and the reacting particle model in your answer.

....

....

....

....

....

.... **[3]**

2. Nov/2020/Paper_J248/02/No.11

A student investigates the reaction between zinc and dilute sulfuric acid.

He measures the time taken to collect $50\,cm^3$ of hydrogen gas. This time is 65 seconds.

The student investigates four substances which are possible **catalysts** for the reaction.

Substance	Appearance of substance	Time to collect $50\,cm^3$ of hydrogen (g)	Other observations
A	red-brown powder	19	red-brown powder remains
B	blue solid	15	colourless solution formed
C	red-brown lumps	65	red-brown lumps remain
D	white solid	65	colourless solution formed

Which substance, **A**, **B**, **C** or **D**, is a catalyst for the reaction?

Your answer ☐

[1]

2. Nov/2020/Paper_J248/02/No.11

3. Nov/2020/Paper_J248/02/No.18

A student investigates the rate of reaction between dilute hydrochloric acid and magnesium carbonate.

She wants to find out how the concentration of the acid changes the rate of reaction.

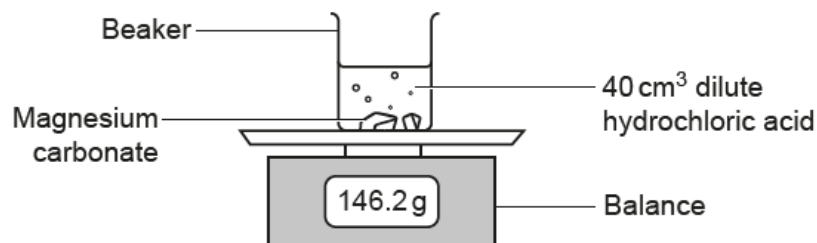**Fig. 18.1** shows the apparatus she uses.

Fig. 18.1

Carbon dioxide gas is given off in the reaction.

The student measures the loss in mass every 30 seconds for 5 minutes.

(a) Another student also investigates the rate of reaction between dilute hydrochloric acid and magnesium carbonate.

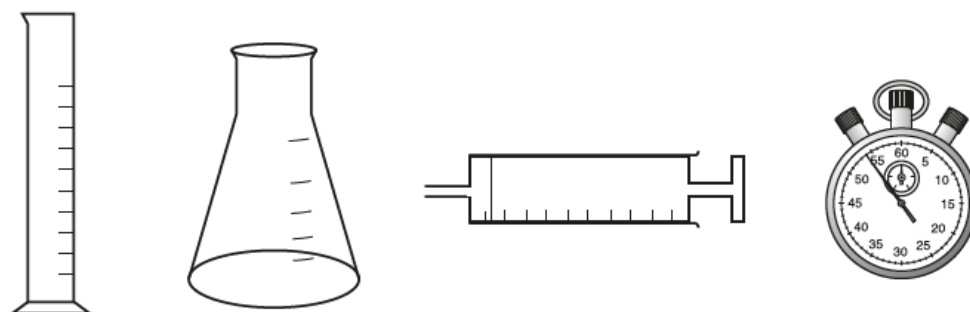Fig. 18.2 shows diagrams of some of the apparatus he uses.

Fig. 18.2

5

The student also wants to find out how the **concentration** of the acid changes the rate of reaction.

Describe the **method** he follows using the apparatus in **Fig. 18.2**.

Include a **labelled diagram** of the set-up of the apparatus he uses.

....

....

....

....

....

....

....

....

.... **[4]**

(b) The students now investigate the reaction between sodium thiosulfate and dilute hydrochloric acid.

They want to find out how **temperature** changes the rate of reaction.

Fig. 18.3 is a diagram of their experiment.

Add dilute hydrochloric acid and start timing

Sodium thiosulfate solution
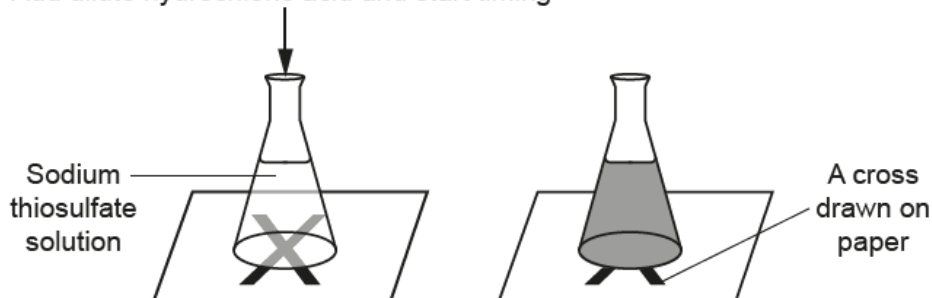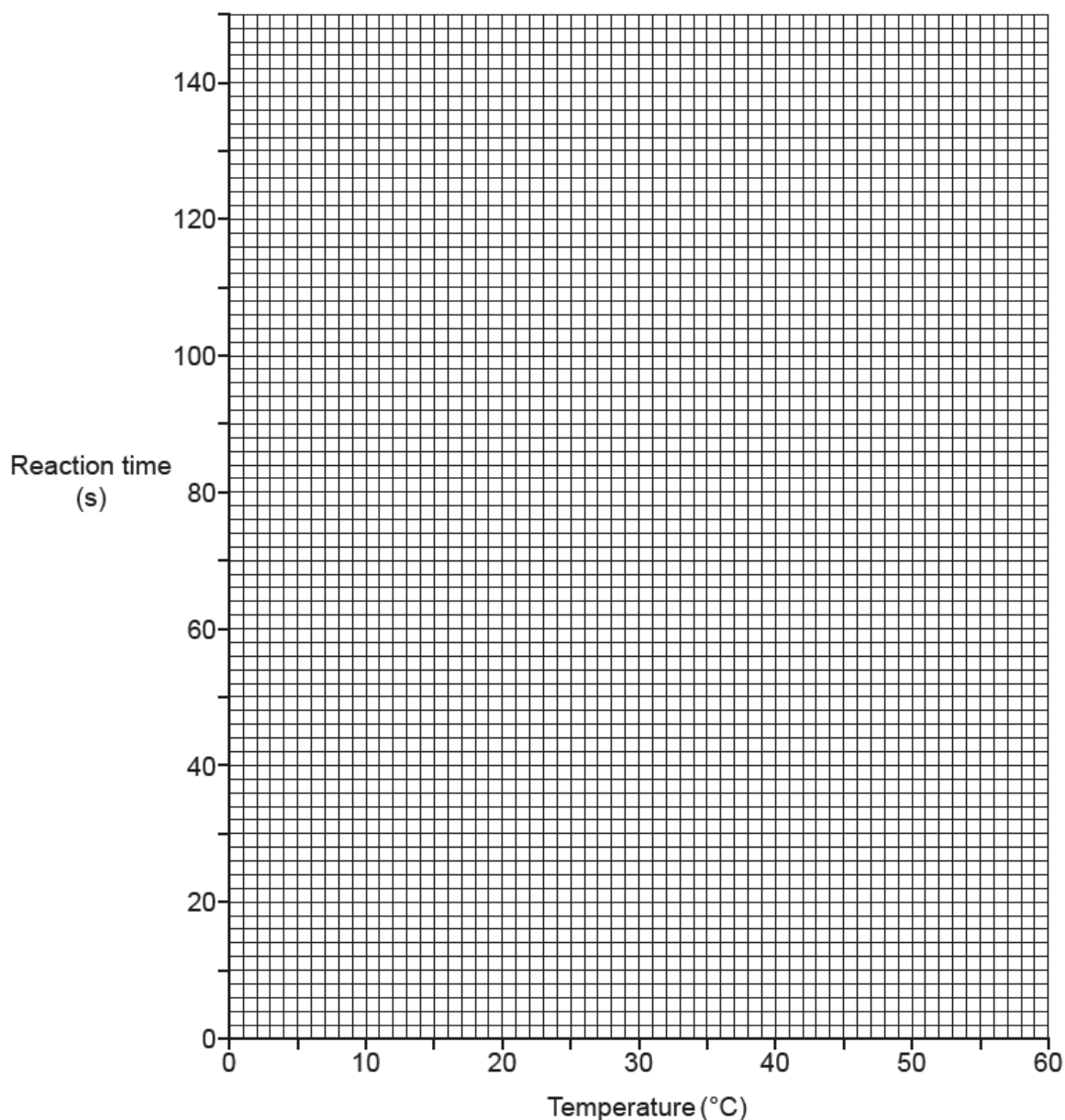
A cross drawn on paper

Fig. 18.3

A yellow solid is made during the reaction.

The students time how long it takes for the cross to disappear. This is the reaction time.

Look at their results.

Temperature (°C)	Reaction Time (s)
10	140
20	56
30	34
40	26
50	22

(i) Plot a graph of the results on the grid. Draw a line of best fit.

[3]

(ii) What is the reaction time at **25 °C**?

Reaction time = ... s [1]

(iii) What happens to the **rate of reaction** as the temperature increases?

.... [1]

(iv) Explain your answer to **(b)(iii)**. Include ideas about collisions between particles in your answer.

....

....

.... [2]

4. Nov/2021/Paper_J248/04/No.2

Lumps of zinc react with dilute sulfuric acid.

What change would **decrease** the rate of this reaction?

A   Further diluting the sulfuric acid with water.

B   Using a larger volume of sulfuric acid.

C   Using warmer sulfuric acid.

D   Using zinc powder instead of zinc lumps.

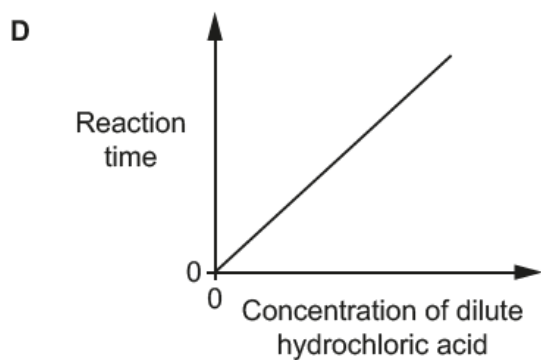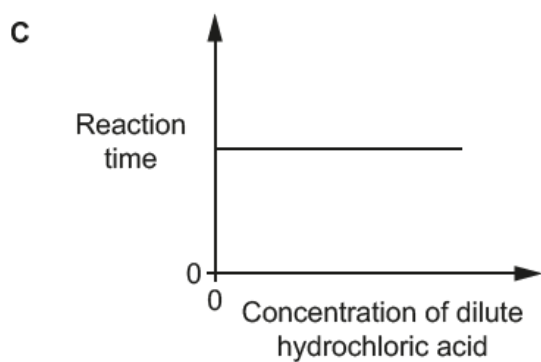Your answer   ☐   [1]

5. Nov/2021/Paper_J248/04/No.11

A student investigates the reaction between magnesium and dilute hydrochloric acid.

Which graph shows the effect of the **concentration** of the dilute hydrochloric acid on the reaction time?

A

Reaction time

0

0 Concentration of dilute hydrochloric acid

B

Reaction time

0

0 Concentration of dilute hydrochloric acid

C

Reaction time

0

0 Concentration of dilute hydrochloric acid

D

Reaction time

0

0 Concentration of dilute hydrochloric acid
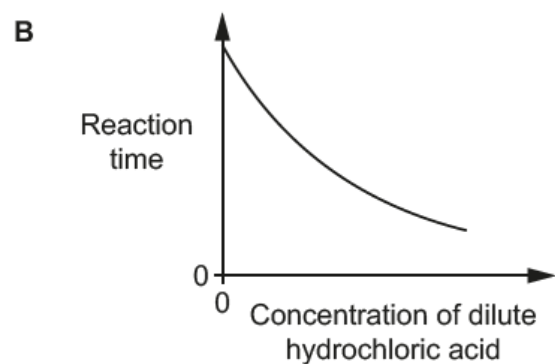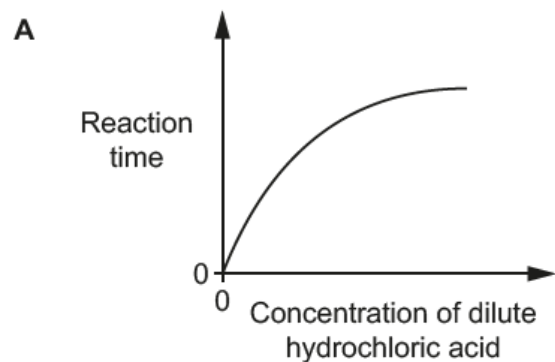
Your answer [ ]   **[1]**

6. Nov/2021/Paper_J248/04/No.18

A student investigates the rate of reaction between large marble chips and dilute hydrochloric acid.

The student measures the volume of carbon dioxide gas given off every 30 seconds.

Look at the apparatus they use.
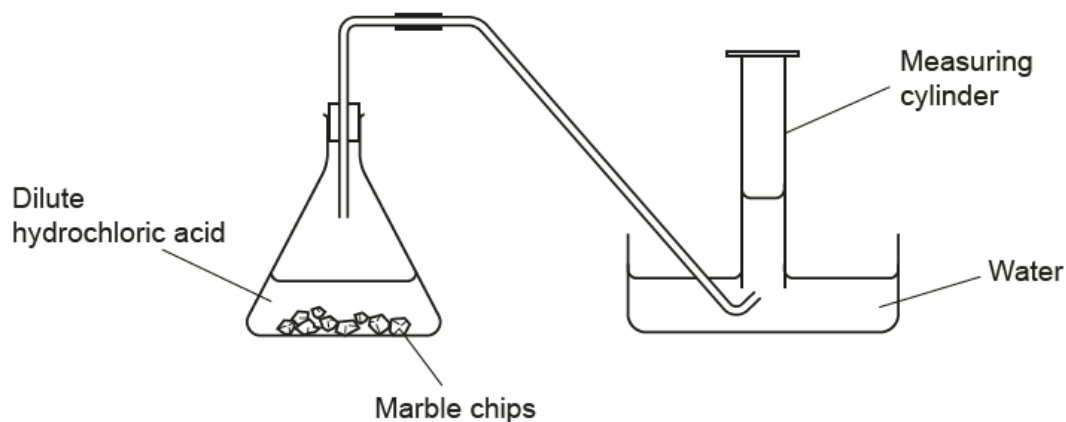
(a) State how the student can improve their experiment to measure the volume of carbon dioxide more accurately.

.... **[1]**

(b) The graph shows the student's results.
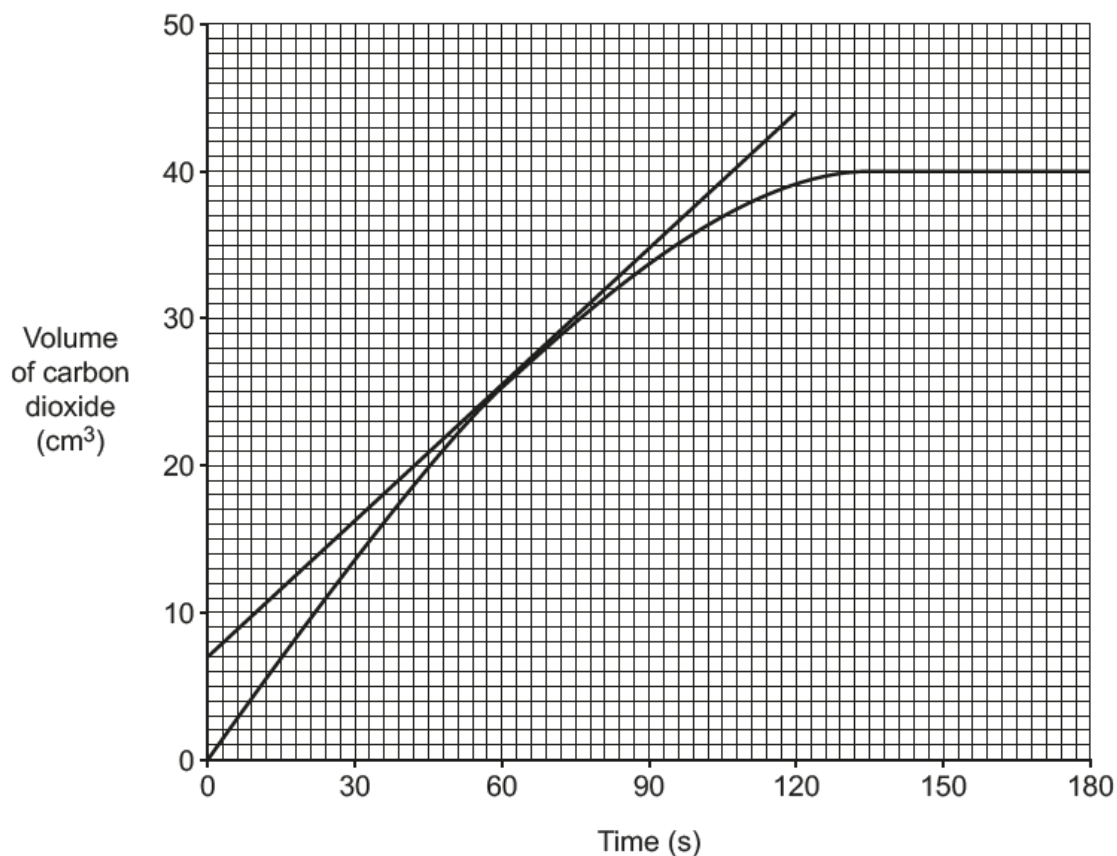
(i) The student has drawn a tangent to the line on the graph at 60 seconds.

Use the tangent to calculate the **rate of reaction** at 60 seconds.

Rate of reaction = ... cm^3/s **[2]**

(ii) The student repeats the experiment. The only difference is they use **smaller** marble chips.

Draw a line on the graph to show the results of this experiment. **[2]**

(c) The balanced equation for this reaction is:

$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$
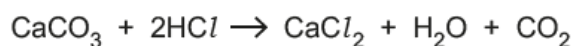
In their experiment the student reacted 0.5 mol of dilute hydrochloric acid, HCl, with 0.5 mol of marble chips, $CaCO_3$.

Use the equation to show that, in this experiment, the calcium carbonate is in excess.

....

.... **[1]**

(d)* Another student investigates the effect of changing the temperature of the dilute hydrochloric acid on the rate of the reaction.

The table shows the student's results.

Experiment	Concentration of acid (g/dm³)	Temperature (°C)	Time for reaction to finish (s)
1	10	20	300
2	10	40	80
3	40	40	20

Explain, using the student's results and the reacting particle model, the effect of changing the temperature and of changing the concentration on the **rate** of this reaction.

....

....

....

....

....

....

....

....

....

....

....

.... **[6]**

13

7. Nov/2020/Paper_J248/04/No.6

Enzymes are a type of catalyst.

Which of the following catalysts is an example of an enzyme?

A   Amylase – a catalyst found in human saliva.

B   Iron – a catalyst used in the Haber process.

C   Manganese(IV) oxide – a catalyst used in the decomposition of hydrogen peroxide.

D   Vanadium(V) oxide – a catalyst used in the Contact process.

Your answer ☐   **[1]**

8. Nov/2020/Paper_J248/04/No.13

Chemists often have a choice of reaction pathway when making a new product.

Which factor do chemists consider when choosing a reaction pathway?

A   Disposal of product

B   Price they can charge for the product

C   Rate of reaction

D   Usefulness of waste reactants

Your answer ☐   **[1]**

9. Nov/2020/Paper_J248/04/No.15

The rate of reaction of marble chips with dilute hydrochloric acid depends on the surface area of the marble chips.

Which surface area of the marble chips gives the **highest** rate of reaction?

A $0.673 \, mm^2$

B $1030 \, mm^2$

C $2.18 \times 10^3 \, mm^2$

D $4.98 \times 10^{-2} \, mm^2$

Your answer ☐   **[1]**
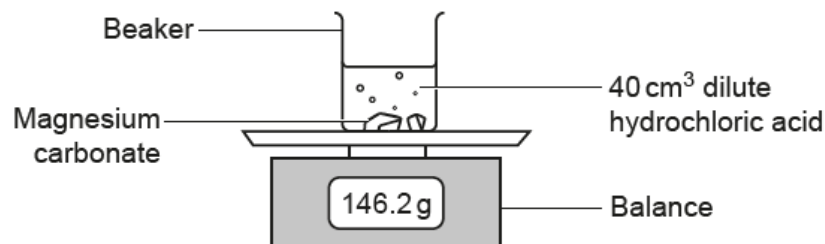
10. Nov/2020/Paper_J248/04/No.19

A student investigates the rate of reaction between dilute hydrochloric acid and magnesium carbonate.

She wants to find out how the concentration of the acid changes the rate of reaction.

Look at the apparatus she uses.

Carbon dioxide gas is given off in the reaction.

The student measures the loss in mass every 30 seconds for 5 minutes.

(a) Another student also investigates the rate of reaction between dilute hydrochloric acid and magnesium carbonate.

He also wants to find out how the **concentration** of the acid changes the rate of reaction. He uses a **different** method.

Describe the **method** he uses.

Include a **labelled diagram** of the set-up of the apparatus he uses.
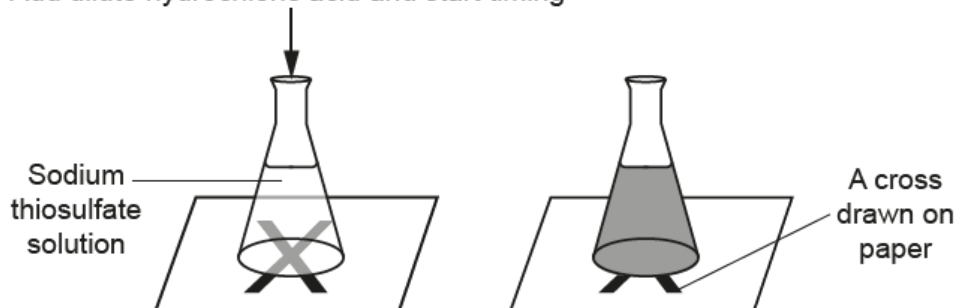
....

....

....

....

....

....

.... **[5]**

(b) The students now investigate the reaction between sodium thiosulfate and dilute hydrochloric acid.

They want to find out how **temperature** changes the rate of reaction.

Look at the diagram of their experiment.

Add dilute hydrochloric acid and start timing

A yellow solid is made during the reaction.

The students time how long it takes for the cross to disappear. This is the reaction time.

Look at their results.

Temperature (°C)	Reaction time (s)	Rate of reaction (s^{-1})
10	140	7×10^{-3}
20	56	2×10^{-2}
30	34	3×10^{-2}
40	26	4×10^{-2}
50	22	5×10^{-2}

(i) Plot a graph of the results on the grid. Draw a line of best fit.

rate of reaction
× 10^{-2}
(s^{-1})
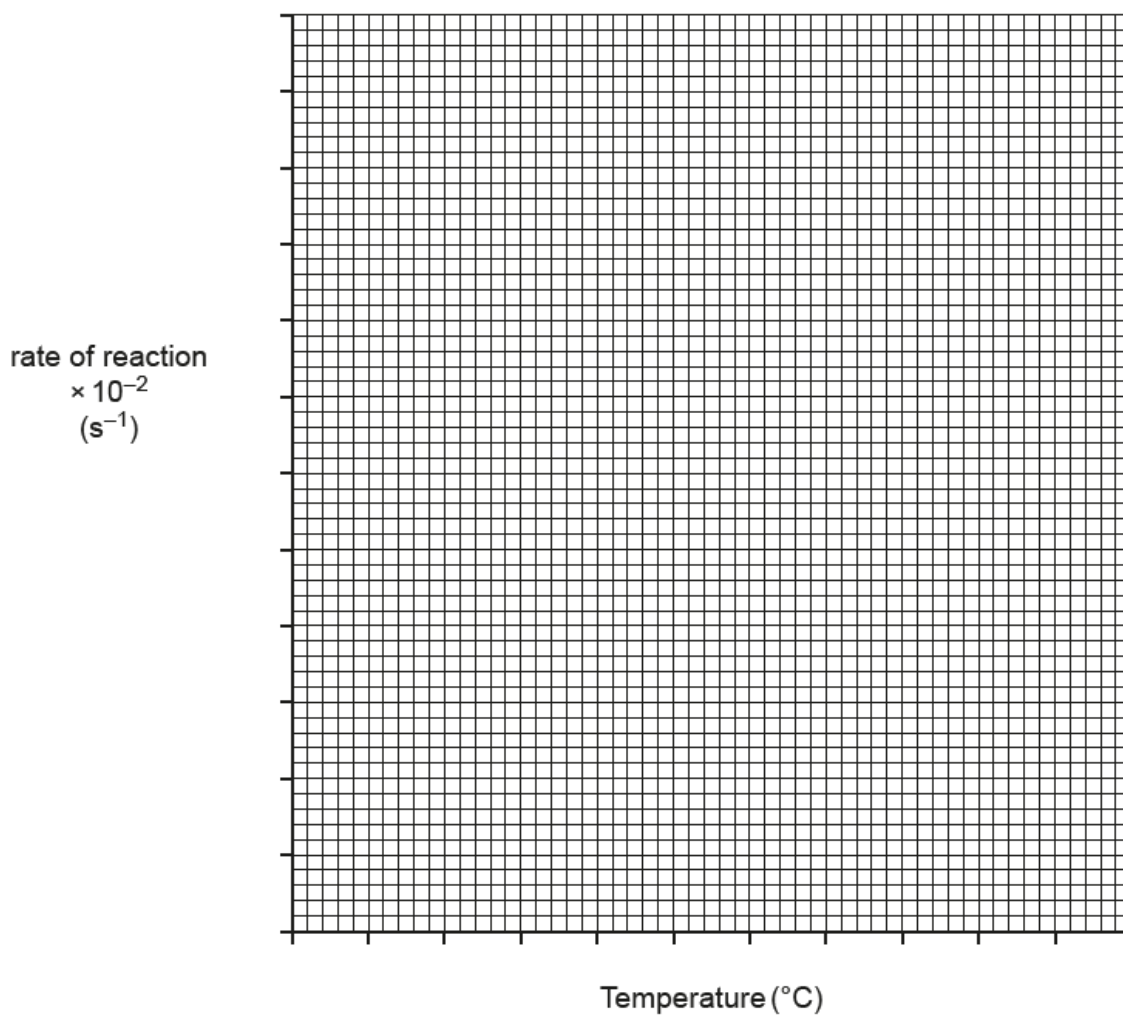
Temperature (°C)

[4]

(ii) What happens to the **rate of reaction** as the temperature increases?

.... [1]

(iii) Explain your answer to **(b)(ii)**.

Use ideas about collisions between particles in your answer.

....

....

....

.... [3]

18