General

[MRSM07-11] Which of the following reactions occurs at the highest rate?

A Photosynthesis
B Rusting of iron
C Combustion of hydrogen in oxygen
D Combustion of magnesium in oxygen

[SPM09-01] Which process has the highest rate of reaction?

A rusting
B Respiration
C Combustion
D Photosynthesis

[SBPtrial11-08] Which of the following is a fast reaction?

A Precipitation reaction
B Photosynthesis
C Fermentation
D Rusting

[SPM11-24] The following chemical equation represents the reaction between calcium carbonate, $CaC0_3$ and hydrochloric acid, HC1.

$$CaC0_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + C0_2(g) + H_20(l)$$

Which changes can be used to determine the rate of reaction?

I Mass of calcium carbonate per unit time
II Volume of carbon dioxide released per unit time
III Colour of the solution per unit time
IV Mass of precipitate produced per unit time

A I and II
B I and III
C II and IV
D III and IV

[SPM03-18] Which of the following can be used to determine the rate of a reaction?

I Release of gas per unit time
II Change of colour intensity per unit time
III Formation of precipitate per unit time
IV Increase in the mass of reactant per unit time

A I and II only
B III and IV only
C I, II and III only
D II, III and IV only

[SPM07-12] The reaction between zinc, Zn and hydrochloric acid, HCl is represented by the following equation:

$$Zn_{(s)} + 2HCl_{2(aq)} \text{ -- > } ZnCl_{2(aq)} + H_{2(g)}$$

A student wants to determine the rate of the reaction in a school laboratory.
Which of the following methods is the most suitable?

A Determine the change in temperature of the solution with time
B Determine the change in the concentration of zinc chloride with time
C Determine the volume of hydrogen gas given off with time
D Determine the change in the concentration of hydrochloric acid with time

[SBPTrial09-09] The following equation shows the reaction between calcium carbonate, $CaCO_3$ and hydrochloric acid, HCl:

$$CaCO_{3(aq)} + 2HCl_{(aq)} \rightarrow CaCl_{2(aq)} + CO_{2\,(g)} + H_2O_{(l)}$$

Which of the following is the suitable method to determine the rate of reaction?

A Change in the temperature of the solution with time
B Change in the volume of carbon dioxide gas with time
C Change in the mass of water with time
D Change in the concentration of hydrochloric acid with time

[SPM07-33] Diagram 11 shows the apparatus set-up for an experiment to determine the rate of reaction.

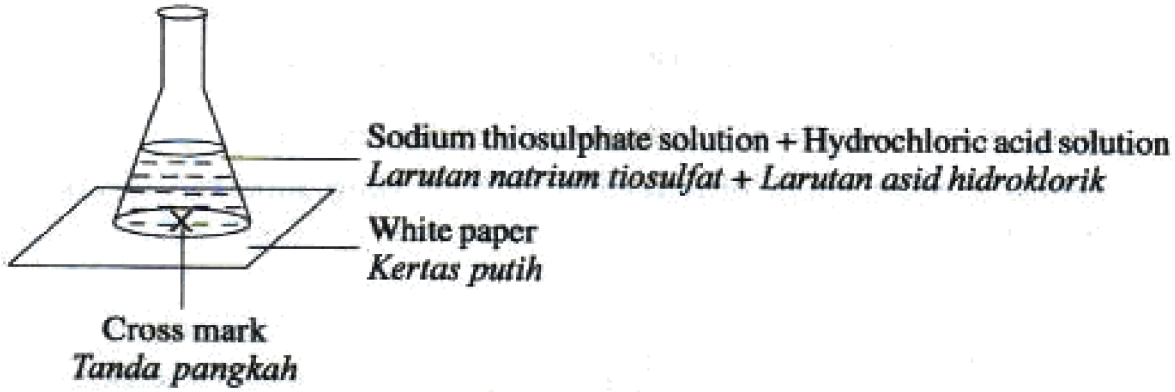


Diagram 11

Which of the following techniques is the most suitable to determine the rate of reaction?

A Record the times as soon as precipitate is formed
B Record the times taken to obtain the maximum temperature
C Record the times as soon as the cross mark cannot be seen
D Record the times taken for the change of the pH value until a fixed pH value is obtained

[SBPmidYearF5-01] A student wants to study the relationship between the concentration of hydrochloric acid and time of reaction by reacting the acid with magnesium ribbon. What should be the responding variable?

A Concentration of acid
B Time taken for reaction
C Amount of magnesium ribbon
D Length of magnesium ribbon

[SPM07-42] Which of the following is the correct match of a low rate of reaction and high rate of reaction?

	Low rate of reaction	High rate of reaction
A	Neutralisation between hydrochloric acid and sodium hydroxide solution	Iron rusting
B	Double decomposition between lead (II) nitrate solution and potassium iodide solution	Neutralisation between hydrochloric acid and sodium hydroxide solution
C	Iron rusting	Fermentation of glucose solution
D	Fermentation of glucose solution	Double decomposition between lead (II) nitrate solution and potassium iodide solution

Calculation

[SPM11-39] Table 4 shows the total volume of oxygen gas, 0_2, collected in the decomposition reaction of hydrogen peroxide, H_20_2.

Time(s)	0	30	60	90	120	150	180	210	240
Volume of 0_2(cm^3)	0.00	18.00	27.50	35.00	41.50	46.50	50.00	50.00	50.00

Table 4

What is the overall average rate of reaction?

A 0.152 cm^3s^{-1}
B 0.208 cm^3s^{-1}
C 0.278 cm^3s^{-1}
D 0.310 cm^3s^{-1}

[SBPtrial10-21] Table 2 shows the total volume of gas collected at regular intervals in a reaction.

Time/s	0	30	60	90	120	150	180	210	240
Volume of gas /cm^3	0	3.5	5.0	6.1	6.9	7.6	8.1	8.1	8.1

Table 2

What is the average rate of reaction?

A 0.034 $cm^3\ s^{-1}$
B 0.039 $cm^3\ s^{-1}$
C 0.045 $cm^3\ s^{-1}$
D 0.054 $cm^3\ s^{-1}$

[SPM10-31] Table 6 shows the total volume of hydrogen gas, collected at regular intervals for the reaction between zinc and dilute hydrochloric acid.

Time (min)	Total volume of hydrogen gas (cm^3)
0.0	0.000
0.5	8.00
1.0	14.50
1.5	20.50
2.0	24.00
2.5	26.50
3.0	26.50
3.5	26.50

What is the average rate of reaction?

A 0.10 $cm^3\ min^{-1}$
B 7.60 $cm^3\ min^{-1}$
C 10.60 $cm^3\ min^{-1}$
D 37.40 $cm^3\ min^{-1}$

[MRSM05-44] The table shows the total volume of hydrogen gas collected at regular time interval for the reaction between magnesium and nitric acid.

Time/ s	0	30	60	90	120
Gas volume / cm^3	0	15	25	30	30

What is the average rate of the reaction?
A 0.25 cm^3s^{-1}
B 0.33 cm^3s^{-1}
C 0.83 cm^3s^{-1}
D 1.11 cm^3s^{-1}

[SPM04-45] The reaction between hydrochloric acid and zinc produces hydrogen gas. The reaction is complete in 50 seconds and the maximum volume of gas produced is 25 cm^3.

What is the average rate of the reaction?

A 0.5 $cm^3\ s^{-1}$
B 1.0 $cm^3\ s^{-1}$
C 2.0 $cm^3\ s^{-1}$
D 4.0 $cm^3\ s^{-1}$

[SBPmidYearF5-15] The table shows the total volume of gas collected at regular intervals in a reaction

Time (s)	0	30	60	90	120	150	180	210
Volume of gas (cm^3)	0	2.0	3.7	5.2	6.4	7.3	8.6	8.6

What is the average rate of reaction in this experiment?

A 0.041 cm^3 /s
B 0.048 cm^3 /s
C 0.049 cm^3 /s
D 0.053 cm^3 /s

[SBPtrial11-35] Table 3 shows the volume of oxygen gas released from the decomposition of hydrogen peroxide:

Time / minute	0	1	2	3	4	5	6
Volume of gas / cm^3	0	5	10	13	15	15	15

What is the average rate of decomposition of hydrogen peroxide for the first four minutes?

A 2.50 $cm^3\ min^{-1}$
B 3.00 $cm^3\ min^{-1}$
C 3.75 $cm^3\ min^{-1}$
D 15.00 $cm^3\ min^{-1}$

[MRSM04-45] Table 4 shows the total volume of gas evolved at different intervals for the dissociation of hydrogen peroxide.

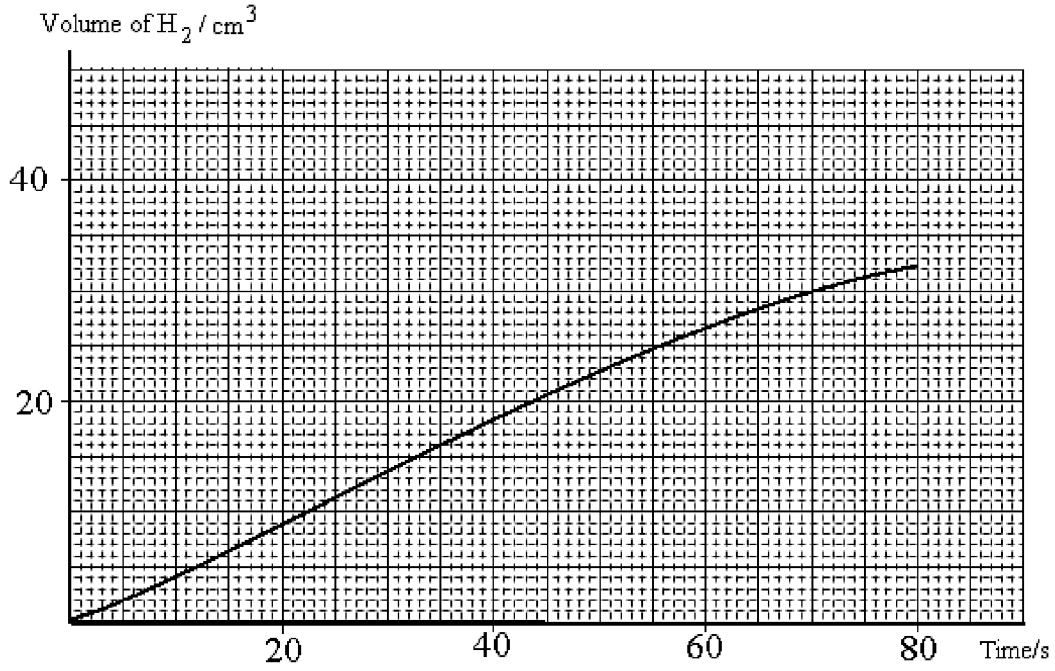
Time (min)	0.0	1.0	1.5	2.0	2.5	3.0
Volume of gas (cm^3)	0.0	10.0	20.0	28.0	35.0	35.0

TABLE 4

What is the average rate of reaction in the second minute?

A 14.0 $cm^3\ min^{-1}$
B 16.0 $cm^3\ min^{-1}$
C 18.0 $cm^3\ min^{-1}$
D 28.0 $cm^3\ min^{-1}$

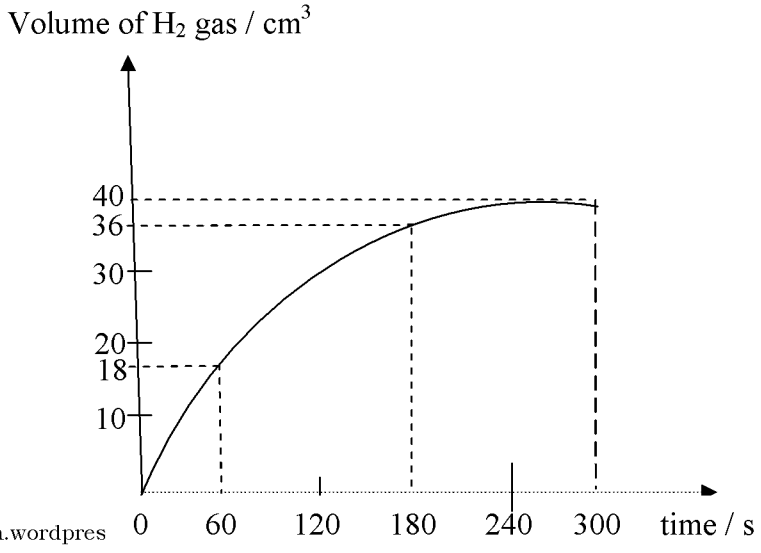
[MRSM07-43] Dilute hydrochloric acid was reacted with magnesium ribbon and the volume of hydrogen gas evolved was measured for the first 80 s.



What was the average rate of production of hydrogen?

A 0.4 cm^3/ s
B 2.5 cm^3/ s
C 4.0 cm^3/ s
D 40.0 cm^3/ s

[SBPTrial07-35]



A group of students carried out an experiment to determine the rate of reaction of zinc metal with dilute hydrochloric acid. The diagram above shows the graph for the total volume of gas collected against time. The average rate of reaction for the whole experiment is:

A 0.3 cm^3/s
B 0.25 cm^3/s
C 0.17 cm^3/s
D 0.13 cm^3/s

[MRSM09-44] Table 5 shows the volume of hydrogen gas collected in the reaction between zinc granules and dilute hydrochloric acid.

Min	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5
Volume of gas (cm^3)	0.0	5.4	9.5	12.8	15.0	15.9	16.3	16.5

What is the average rate of reaction during the second minute?

A 1.50 $cm^3\ min^{-1}$
B 2.20 $cm^3\ min^{-1}$
C 5.50 $cm^3\ min^{-1}$
D 7.50 $cm^3\ min^{-1}$

[SPM03-44] Table 4 shows the total volume of gas collected at regular intervals in a reaction.

Time/s	0	30	60	90	120	150	180	210
Volume of gas/cm^3	0	2.0	3.7	5.2	6.4	7.3	8.6	8.6

What is the average rate of reaction in the second minute?

A 0.040 $cm^3\ s^{-1}$
B 0.045 $cm^3\ s^{-1}$
C 0.053 $cm^3\ s^{-1}$
D 0.062 $cm^3\ s^{-1}$

[SPM07-43] Table 2 shows the volume of carbon dioxide gas, CO_2, collected in the reaction between limestone powder and hydrochloric acid.

Time/ minute	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5
Volume of CO_2/cm^3	0.0	4.5	7.5	10.0	12.5	14.5	16.0	17.0

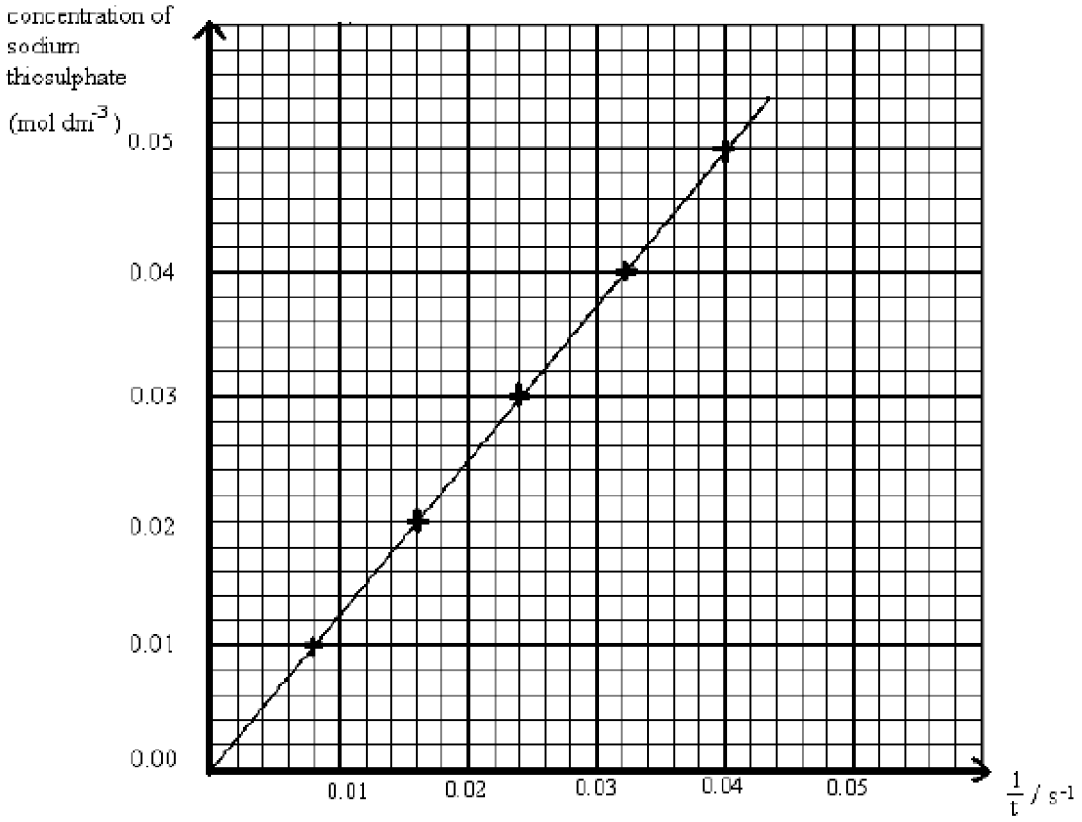
Table 2

What is the average rate of reaction during the second minute?

A 1.25 $cm^3\ minute^{-1}$
B 2.50 $cm^3\ minute^{-1}$
C 5.00 $cm^3\ minute^{-1}$
D 12.50 $cm^3\ minute^{-1}$

[MRSM06-43] An experiment is carried out to study the effect of concentration on the rate of reaction between sodium thiosulphate and hydrochloric acid.

Graph of the concentration of sodium thiosulphate against 1/time is as shown.



Based on the graph, what is the value of t if the experiment is repeated using sodium thiosulphate solution 0.025 mol dm^{-3}.

A 32.3 s
B 50.0 s
C 0.020 s
D 0.031s

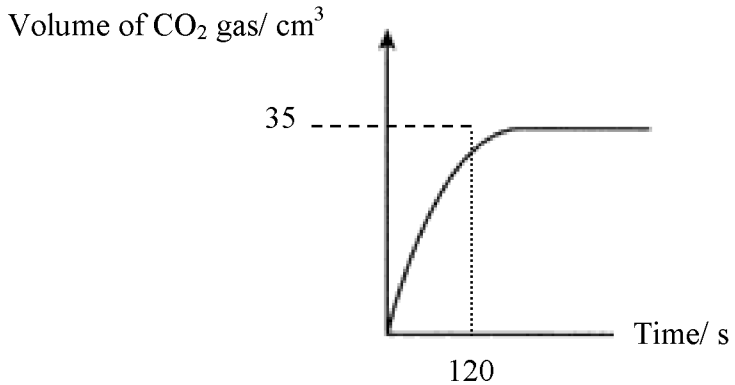
[MRSM05–39] The following equation represents the reaction between hydrochloric acid with excess powdered zinc.

$$Zn + 2\,HCl \text{ -- > } ZnCl_2 + H_2$$

If 19.50 g of powdered zinc reacts with 100 cm^3 of 2.0 mol dm^{-3} hydrochloric acid, what is the mass of the unreacted zinc? [Relative atomic mass of Zn=65]

A 13.0 g
B 6.5 g
C 0.4 g
D 0.3 g

[SBPmidYearF508-30] The graph shows the maximum volume of carbon dioxide gas evolved when calcium carbonate react with hydrochloric acid.

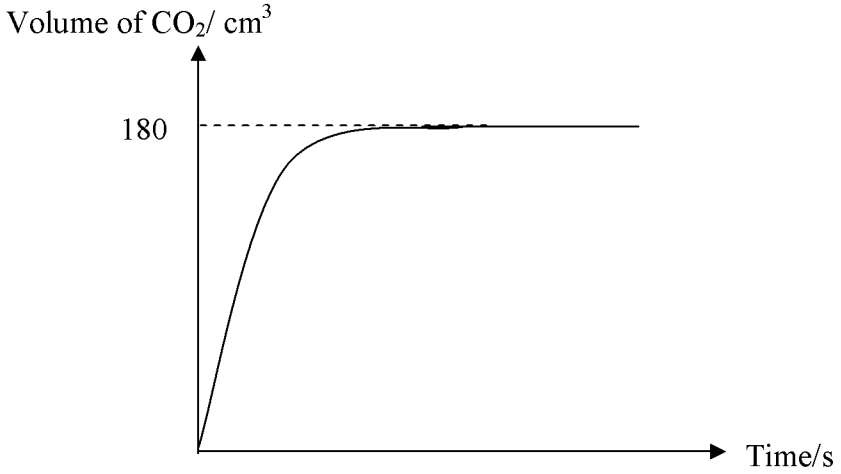


What is the rate of reaction at 120 s?

A 0.00 cm^3 s^{-1}
B 0.15 cm^3 s^{-1}
C 0.29 cm^3 s^{-1}
D 0.35 cm^3 s^{-1}

[SBPmidYearF508-40] The graph shows the volume of carbon dioxide gas released against time for the reaction between 25 cm^3 of hydrochloric acid with excess marble.

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$$



What is the concentration of acid used?
[Molar volume: 24 dm^3 mol^{-1} at room temperature]

A 0.3 mol dm^{-3}
B 0.4 mol dm^{-3}
C 0.5 mol dm^{-3}
D 0.6 mol dm^{-3}

[SBPTrial08-10] Diagram 4 shows the graph of volume of carbon dioxide gas against time when 5 g of marble chips is added to 50 cm^3 of 0.2 mol dm^{-3} hydrochloric acid.

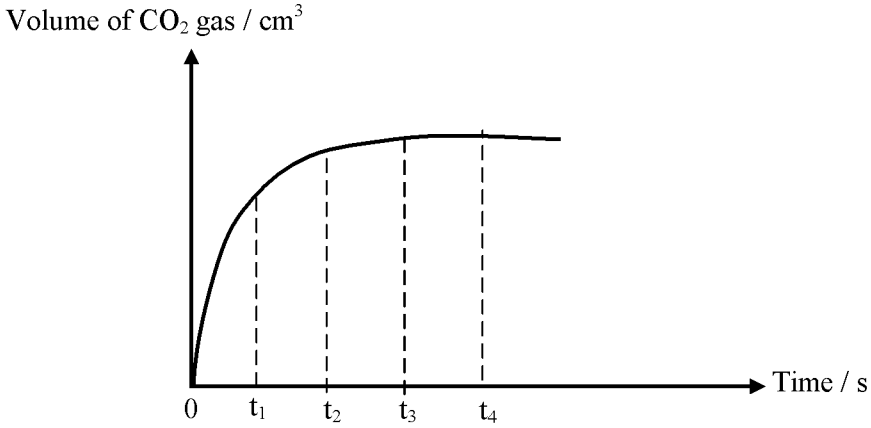


Diagram 4

At what time the rate of reaction the highest?

A t_1
B t_2
C t_3
D t_4

[MRSM10-29] Diagram 7 shows a graph of the volume of gas produced against time for the reaction between zinc granules and hydrochloric acid.

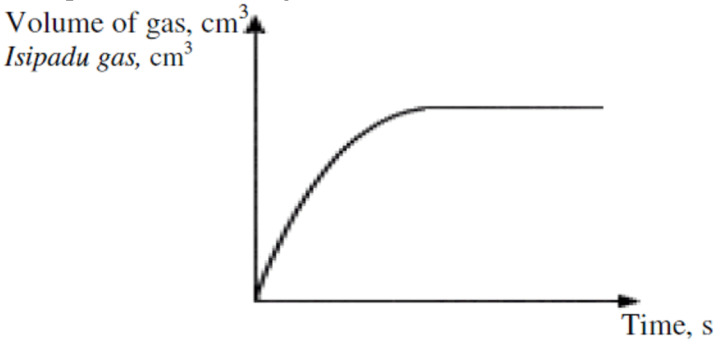
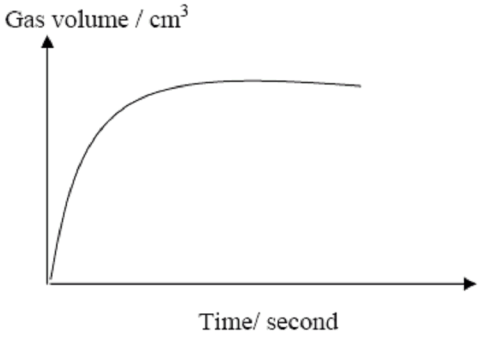


Diagram 7

The gradient of the graph decreases with time because

A catalyst is not used
B volume of mixture decreases
C temperature of reaction decreases
D concentration of hydrochloric acid decreases

[MRSM05-14] The graph shows the volume of gas produced against time for the reaction of sodium carbonate and hydrochloric acid.



The gradient of the graph decreases with time because

A catalyst is not used
B temperature of reaction decreases
C volume of mixture decreases
D concentration of hydrochloric acid decreases

[MRSM06-30] The chemical equation shows a reaction between calcium carbonate with hydrochloric acid.

$$CaCO_3 + 2HCl \text{ -- > } CaCl_2 + CO_2 + H_2O$$

Which of the following changes cannot be used to determine the rate of reaction?

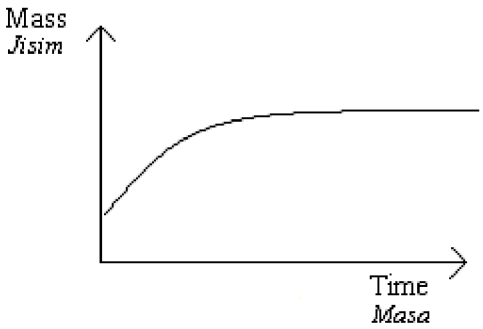
A Change in the pH of the mixture
B Decrease in mass of calcium carbonate
C Increase in mass of calcium chloride
D Change in volume of carbon dioxide released

[MRSM09-30] The equation represents the reaction between sodium carbonate and hydrochloric acid.

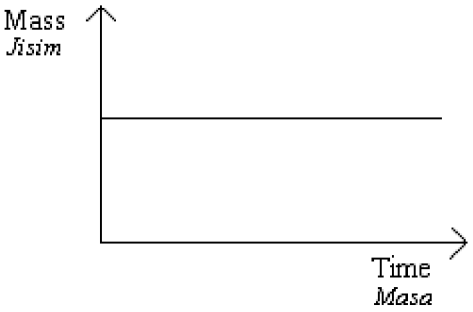
$$Na_2CO_3 + 2\ HCl \rightarrow 2\ NaCl + H_2O + CO_2$$

The mass of the beaker and its contents is plotted against time.
Which graph represents what happens when sodium carbonate reacts with an excess of dilute hydrochloric acid?

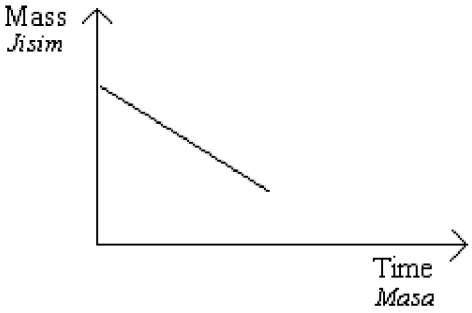
A



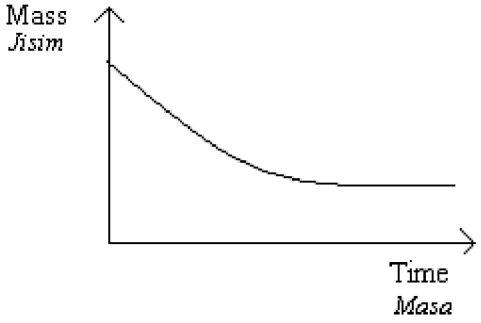
B



C



D

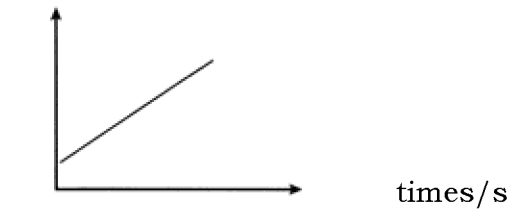


[SBPTrial09-23] The following equation shows the reaction between excess zinc powder and dilute nitric acid:

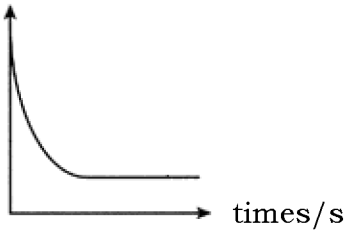
$$Zn\ (s) + 2HNO_3\ (aq) \text{ -- > } Zn(NO_3)_2\ (aq) + H_2\ (g)$$

Which of the following graphs represents the mass of zinc against time?

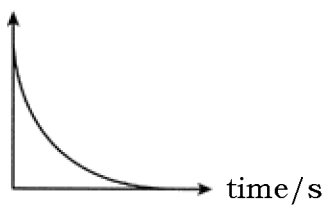
A



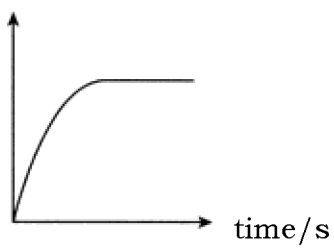
B



C



D



[SPM03-27] The equation below shows a reaction to produce hydrogen gas.

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

Which of the following is true of the equation?

A Increase the time of reaction
B Increase the volume of acid
C Increase the size of granulated zinc
D Increase the temperature of the mixture

Factor of Size

[MRSM11-29] Diagram 11 shows the apparatus setup for the reaction between excess dilute hydrochloric acid and marble chips

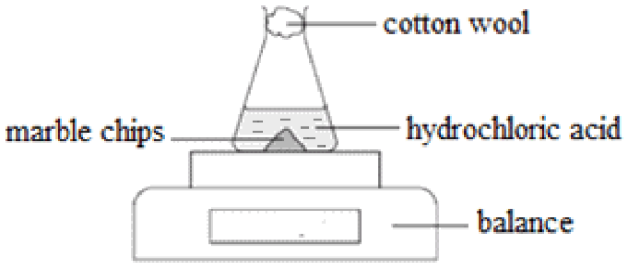
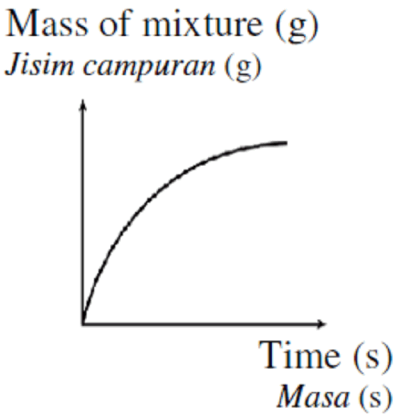
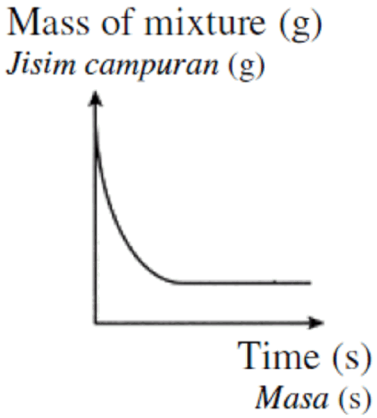
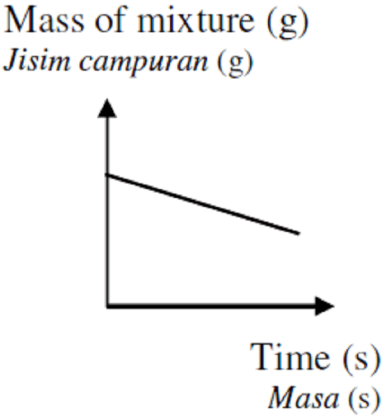


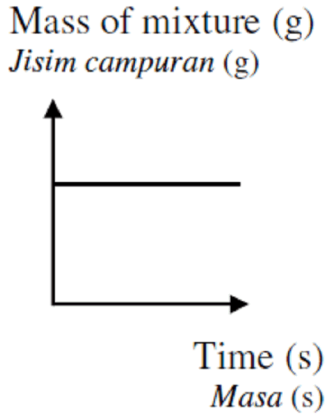
Diagram 11

Which of the following graphs best represents the changes in the mass of mixture against time?

A


B


C


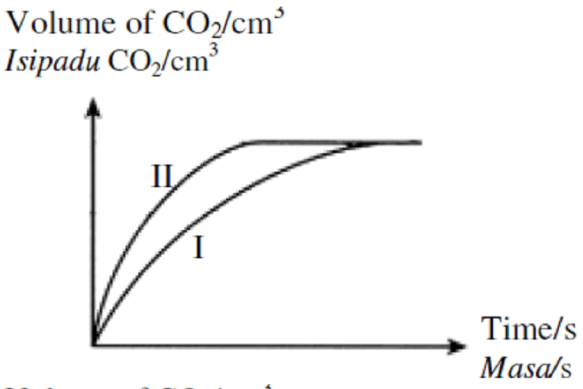
D


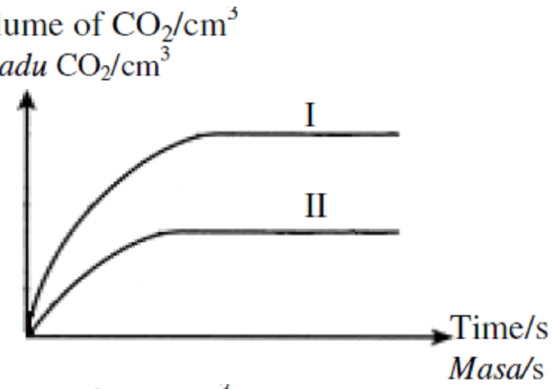
[MRSM10-48] Table 9 shows the experiments carried out to study the rate of reaction between zinc carbonate and nitric acid.

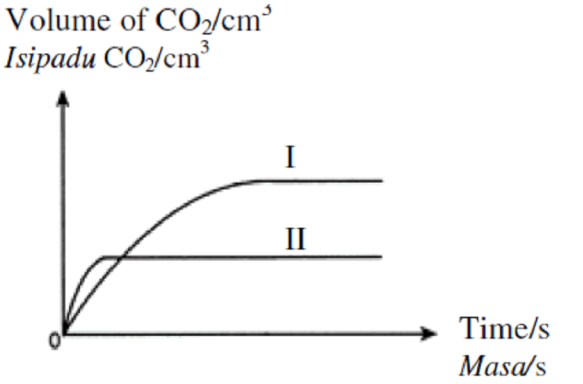
Experiment	Zinc carbonate, $ZnCO_3$		Nitric acid, HNO_3	
	Mass (g)	State	Volume(cm^3)	Concentration ($moldm^{-3}$)
I	5	Granule	50	0.1
II	5	Powder	25	0.2

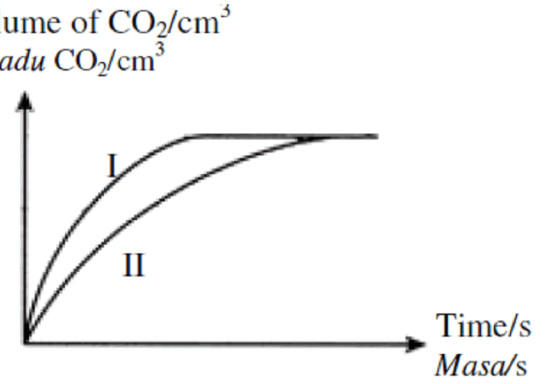
Table 9

Which of the following graph represents the two experiments?

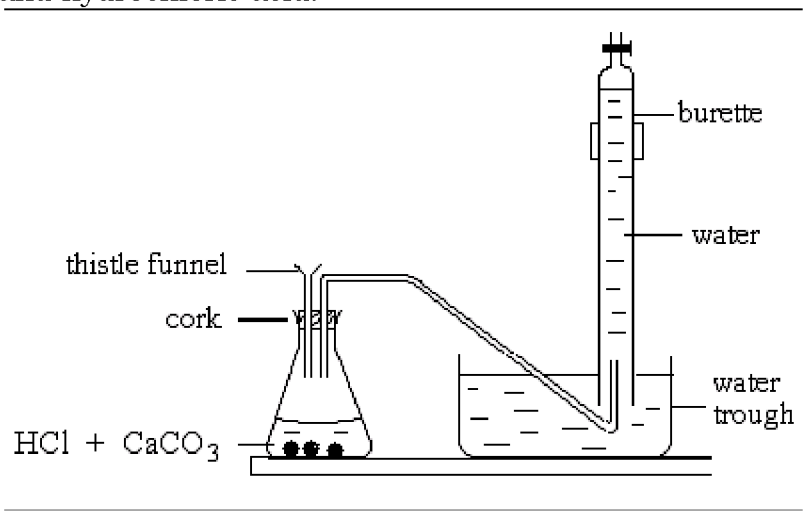
A


B


C


D


[MRSM04-34] Figure 12 shows the apparatus set-up to determine the rate of reaction between calcium carbonate and hydrochloric acid.



Which of the following is not correct in the apparatus set-up for this experiment?

I Fixing of cork
II Position of thistle funnel
III Position of the delivery tube in the basin.
IV Position of the delivery tube in the conical flask.

A I and III only
B II and III only
C II and IV only
D I, II, III and IV

[SBPmidYearF5-34] 1g of magnesium was allowed to react with 50 cm^3 of sulphuric acid, 1 mol dm^{-3}. Three experiments were conducted using three different sizes of magnesium. The time taken to collect 20cm^3 of hydrogen gas is as below.

Experiment	**I**	**II**	**III**
Time/s	16	7	25

Which of the following experiments show the arrangement of the size of magnesium in decreasing order?

A I, II, III
B II, I, III
C III, II, I
D III, I, II

[SBPmidYearF5-14] Aluminium powder reacts faster with hydrochloric acid than an aluminium strip because

A the particles in the aluminium strip are packed closely
B the particles of aluminium powder have more kinetic energy
C the aluminium powder has a larger total surface area
D there is a layer of aluminium oxide on the aluminium

[MRSM07-45] Calcium carbonate reacts with excess hydrochloric acid at room temperature and is represented by the equation

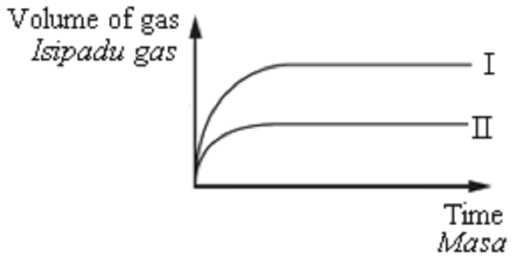
$$\mathbf{CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2}$$

Two experiments were carried out.

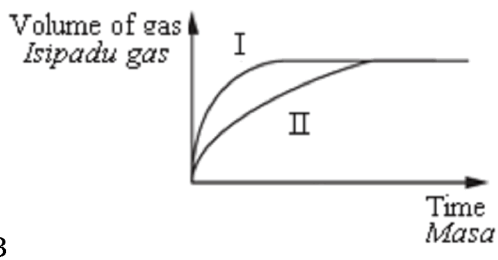
Experiment I : 10 g of calcium carbonate in large lumps.
Experiment II : 5 g of calcium carbonate as a fine powder.

Which of the following graph of volume of gas against time is correct?

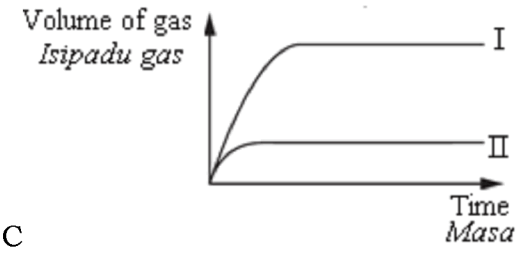
A



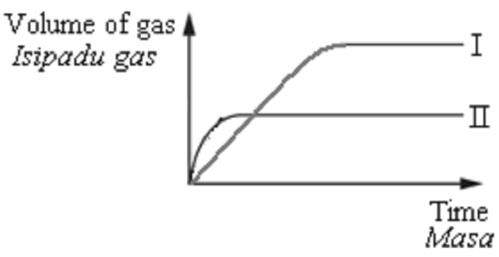
B



C



D



[SBPtrial11-22] Diagram 8 show the apparatus set up used to study the rate of reaction of calcium carbonate and hydrochloric acid

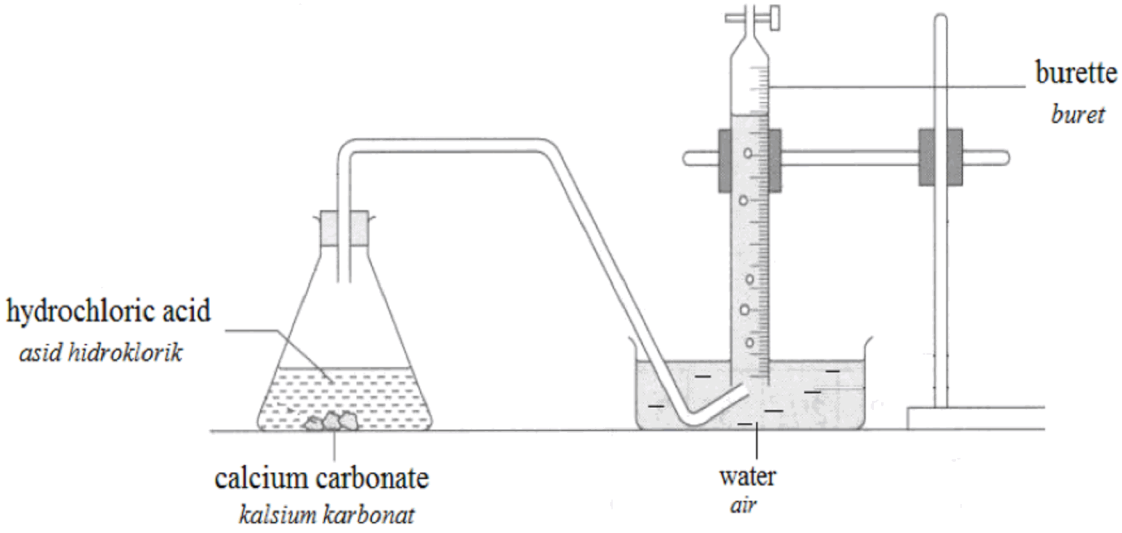


Diagram 8

The rate of the above reaction can be increased by

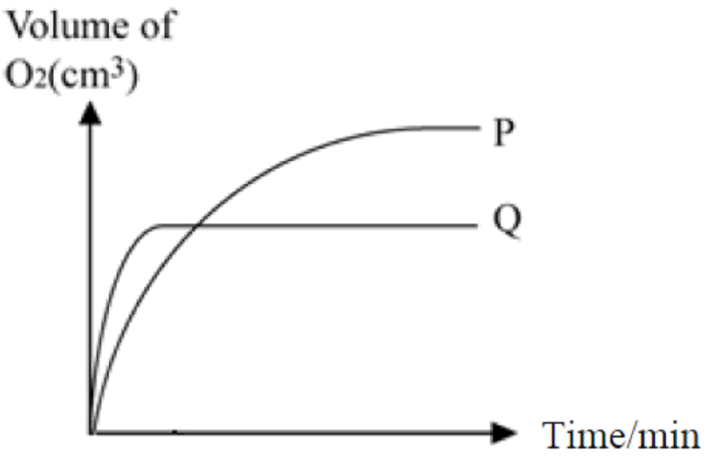
A Grinding the marble chips
B Lowering the temperature of hydrochloric acid
C Using a larger flask
D Adding water to hydrochloric acid

Factor of Concentration

[MRSM10-30] Magnesium reacts with acid to produce hydrogen gas, H_2.Which solution would give the highest initial rate of reaction?

A 100 cm^3 of 1.0 mol dm^{-3} of nitric acid, HNO_3
B 100 cm^3 of 1.0 mol dm^{-3} of hydrochloric acid, HCl
C 100 cm^3 of 1.0 mol dm^{-3} of sulphuric acid, H_2SO_4
D 100 cm^3 of 1.0 mol dm^{-3} of ethanoic acid, CH_3COOH

[SBPtrial11-42] The rate of catalytic decomposition of 20 cm^3 of 1.0 mol dm^{-3} of hydrogen peroxide is shown in curve Q.

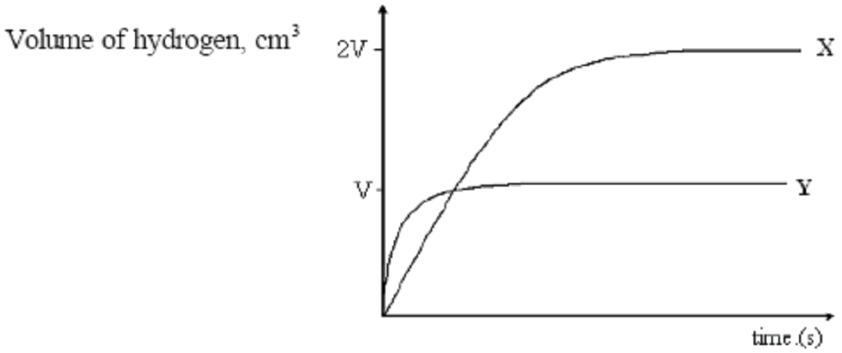


Which of the following changes to the experiment will produce curve P?

A Cool the hydrogen peroxide solution to lower temperature.
B Repeat the experiment by using 50 cm^3 of 0.5 mol dm^{-3} of hydrogen peroxide solution.
C Repeat the experiment by using 20 cm^3 of 1.5 mol dm^{-3} of hydrogen peroxide solution.
D Adding more catalyst to the 20 cm^3 of 1.0 mol dm^{-3} of hydrogen peroxide solution.

[MRSM06-32] In an experiment, 100 cm^3 of 1.0 mol dm^{-3} hydrochloric acid reacts with excess magnesium to produce hydrogen gas.

The graph of the volume of hydrogen gas against time is drawn and curve X is obtained.



If the experiment is repeated using another solution, which solution will produce curve Y?

A 50 cm^3 of 1.0 mol dm^{-3} nitric acid
B 50 cm^3 of 1.0 mol dm^{-3} ethanoic acid
C 25 cm^3 of 1.0 mol dm^{-3} sulphuric acid
D 25 cm^3 of 1.0 mol dm^{-3} hydrochloric acid

[MRSM07-30] In an experiment, 25 cm^3 of 0.2 mol dm^{-3} hydrogen peroxide solution decomposes to produce oxygen gas. Graph of volume of oxygen gas against time is sketched and curve R is obtained as shown in Diagram 12.

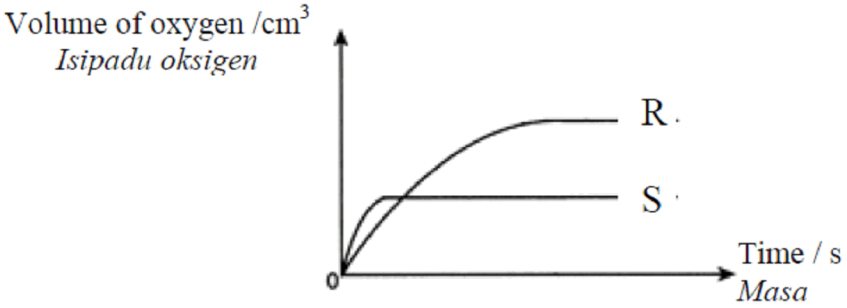


DIAGRAM 12

Which of the following solution will produce curve S?

A 20 cm^3 of 0.10 mol dm^{-3} hydrogen peroxide
B 30 cm^3 of 0.20 mol dm^{-3} hydrogen peroxide
C 20 cm^3 of 0.30 mol dm^{-3} hydrogen peroxide
D 10 cm^3 of 0.30 mol dm^{-3} hydrogen peroxide

[MRSM07-47] Excess calcium carbonate is added to 50 cm^3 of 0.1 mol dm^{-3} hydrochloric acid. Volume of carbon dioxide gas released is recorded and plotted against time taken. Diagram 18 shows the graph of volume of carbon dioxide against time for the reaction

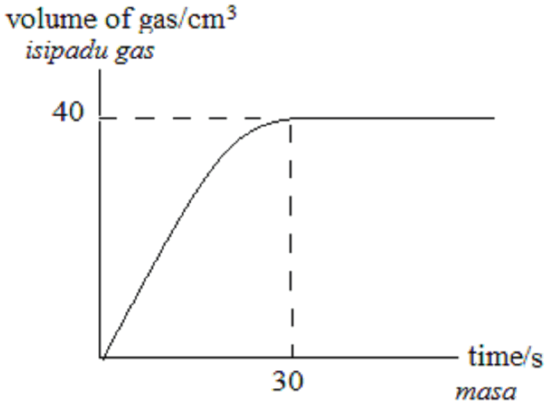
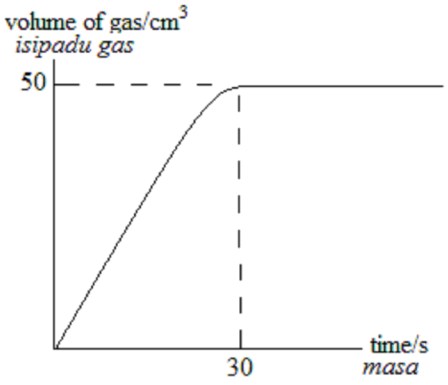


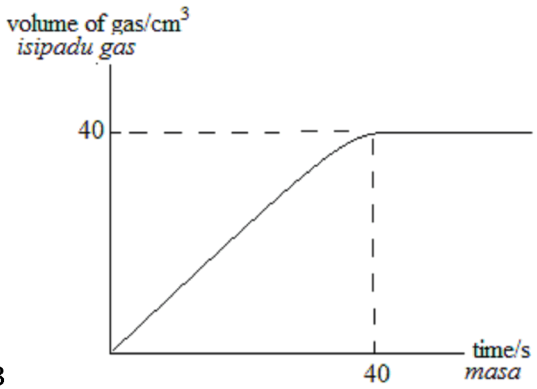
DIAGRAM 18

Which of the following graph is possible if the experiment is repeated using 25 cm^3 of 0.2 mol dm^{-3} hydrochloric acid?

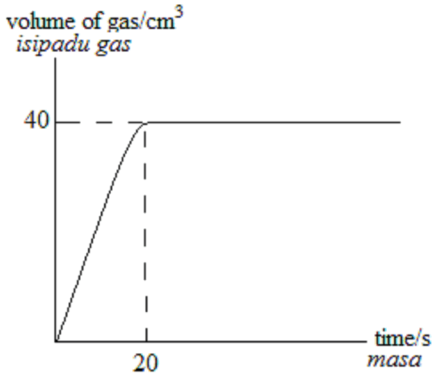
A



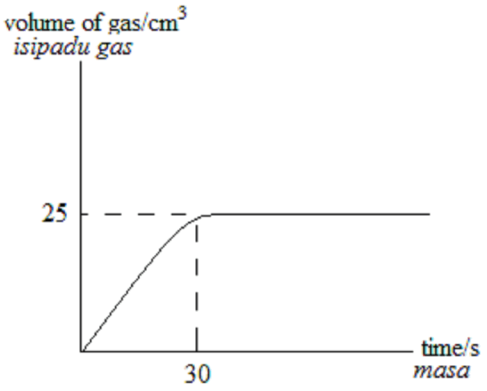
B



C



D

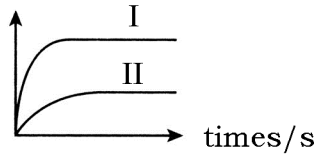


[SPM04-30] An experiment is carried out to study the rate of reaction between marble and hydrochloric acid to produce carbon dioxide gas.

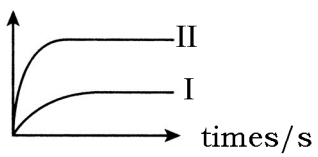
Experiment	**Substance**
I	Excess marble and 50.0 cm^3 of 2 mol dm^3 hydrochloric
II	Excess marble and 50.0 cm^3 of 1 mol dm^3 hydrochloric

Which of the following graphs represents the two experiments?

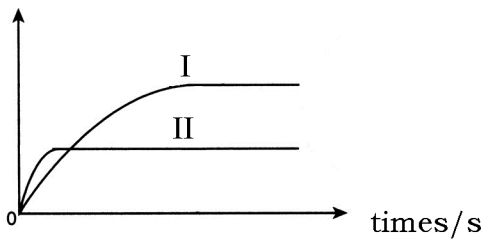
A



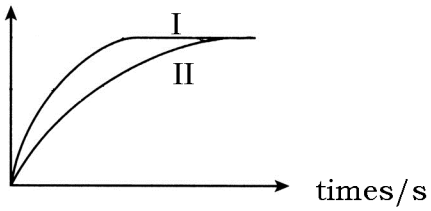
B



C



D



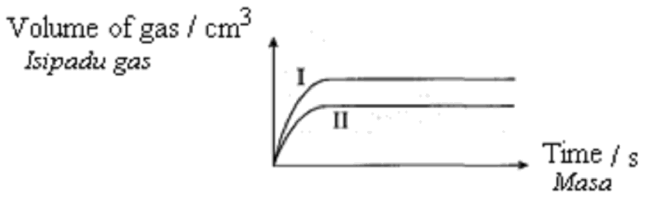
[MRSM09-45] Table 6 shows the substances used to study the rate of reaction between marble and nitric acid.

Experiment	**Substance**
I	Excess marble and 50 cm^3 of 0.2 mol dm^{-3} nitric acid
II	Excess marble and 100 cm^3 of 0.1 mol dm^{-3} nitric acid

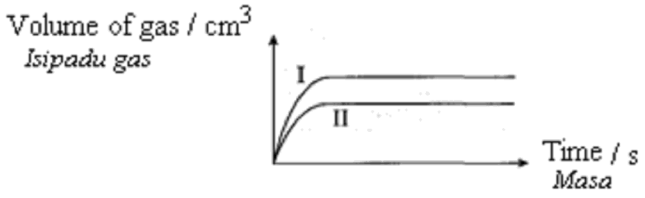
Table 6

Which of the following graphs represents the two experiments?

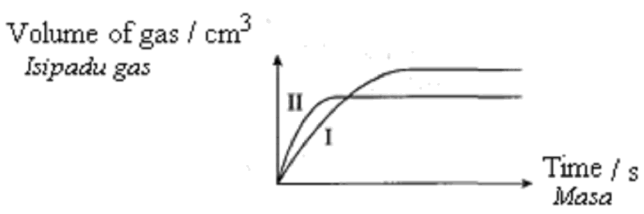
A



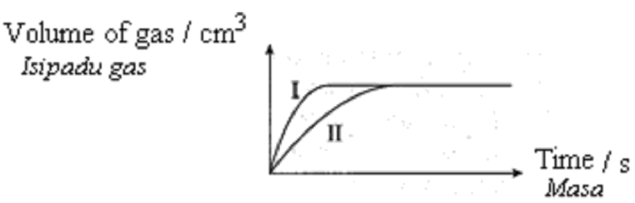
B



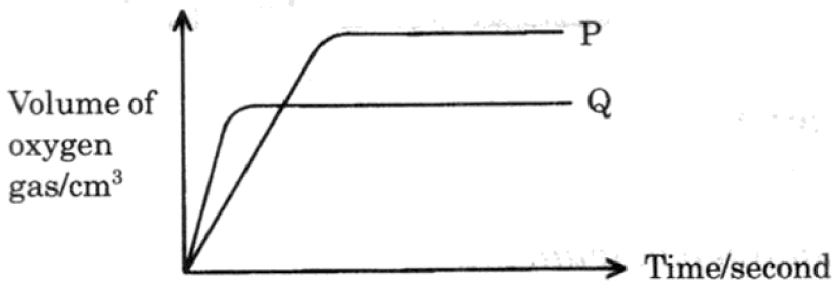
C



D



[SPM05-46] In an experiment, the decomposition of 25 cm^3 of 0.1 mol dm^{-3} hydrogen peroxide solution produces oxygen gas.



If the experiment is repeated using another solution, which solution will produce curve Q?

A 25 cm^3 of 0.15 mol dm^{-3} hydrogen peroxide
B 20 cm^3 of 0.15 mol dm^{-3} hydrogen peroxide
C 15 cm^3 of 0.15 mol dm^{-3} hydrogen peroxide
D 10 cm^3 of 0.15 mol dm^{-3} hydrogen peroxide

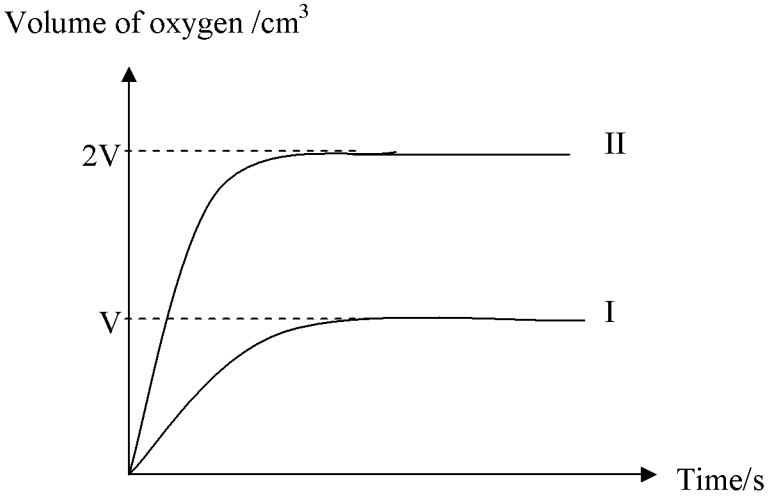
[SPM06-44] Which of the following reactants produces the highest rate of reaction with zinc powder?

A 25 cm^3 of sulphuric acid 0.1mol dm^{-3}
B 25 cm^3 of ethanoic acid 0.1mol dm^{-3}
C 25 cm^3 of nitric acid 0.1mol dm^{-3}
D 25 cm^3 of hydrochloric acid 0.1mol dm^{-3}

[SBPTrial09-47] Excess calcium carbonate powder reacts with 50 cm^3 of 0.1 mol dm^{-3} hydrochloric acid to produce carbon dioxide gas.
Which of the following acids will produce a highest rate of reaction?

A 50 cm^3 of 0.2 mol dm^{-3} sulphuric acid
B 50 cm^3 of 0.2 mol dm^{-3} ethanoic acid
C 50 cm^3 of 0.2 mol dm^{-3} carbonic acid
D 50 cm^3 of 0.2 mol dm^{-3} nitric acid

[SBPmidYearF508-50] The diagram shows the graph of volume of oxygen gas against time. Curve I is obtained from the decomposition of 20 cm^3 of 0.2 mol dm^{-3} hydrogen peroxide solution.



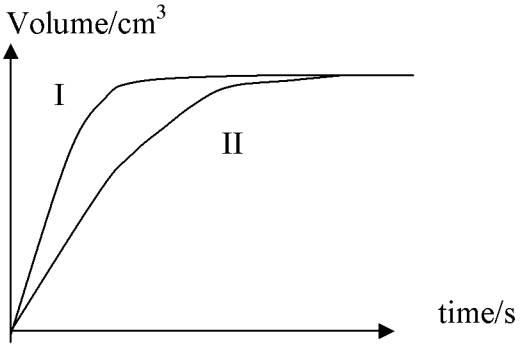
Which of the following solutions will produce curve II?

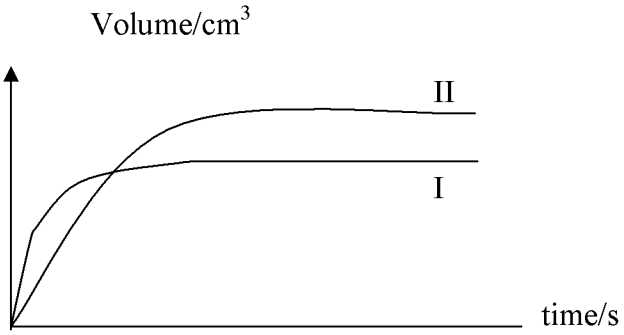
A 40 cm^3 0.1 mol dm^{-3} hydrogen peroxide solution
B 20 cm^3 0.4 mol dm^{-3} hydrogen peroxide solution
C 30 cm^3 0.2 mol dm^{-3} hydrogen peroxide solution
D 40 cm^3 0.4 mol dm^{-3} hydrogen peroxide solution

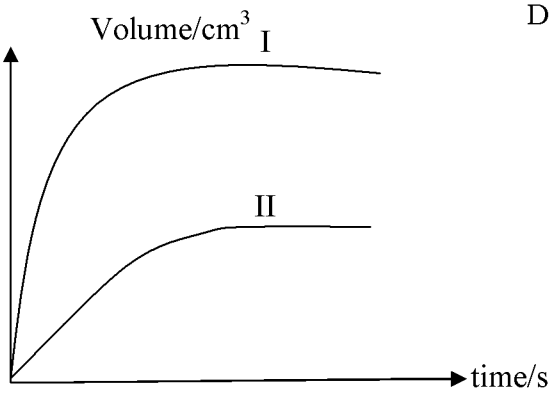
[SBPmidYearF5-39] Two experiments were conducted to study the rate of reaction between excess calcium carbonate and sulphuric acid as shown below.

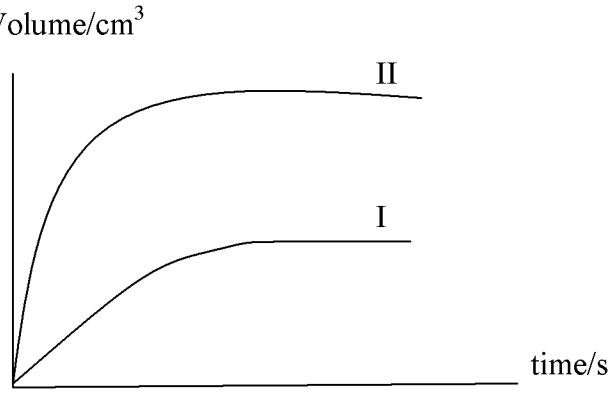
Experiment	Sulphuric acid
I	25cm^3 H_2SO4, 1 mol dm^{-3}
II	50cm^3 H_2SO4, 0.5 mol dm^{-3}

Which of the following graphs best describes the results of the above experiments?

A


C


B


D


[MRSM03-26]

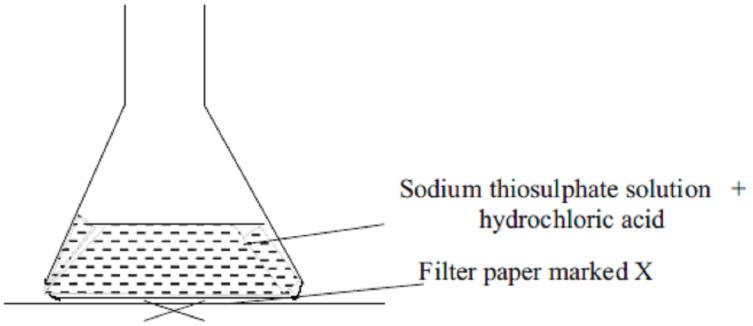
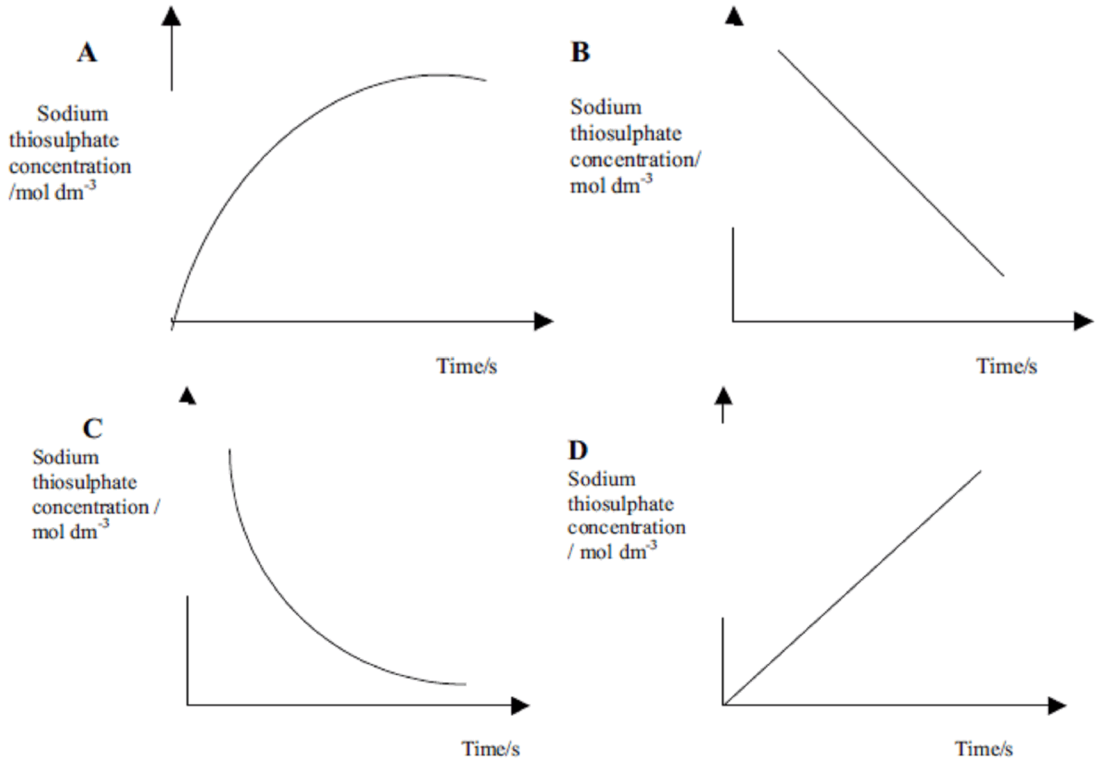


Figure 4

Sodium thiosulphate solution reacts with hydrochloric acid to form a yellow precipitate as shown in Figure 4. Time taken for the mark 'X' to be obscured from vision represents the reaction time. Which of the following graphs below shows the relationship between sodium thiosulphate concentration and the reaction time?



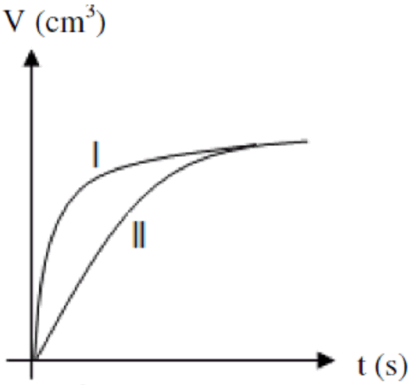
Factor of Temperature

[MRSM11-49] Two sets of experiments are carried out as follows:

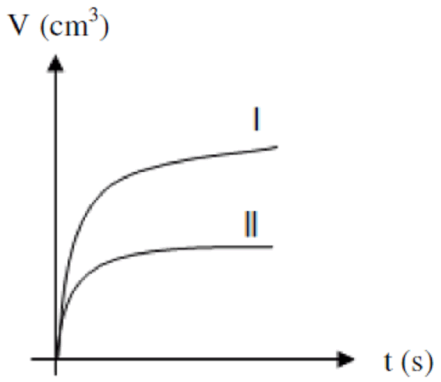
Set	Reactant 1	Reactant 2	Temperature
I	100 cm^3 1.0 mol dm^{-3} hydrochloric acid	10 g of marble chips	30 °C
II	50 cm^3 1.0 mol dm^{-3} hydrochloric acid	10 g of marble chips	50 °C

Which graphs of volume of carbon dioxide collected against time in both sets is correct?

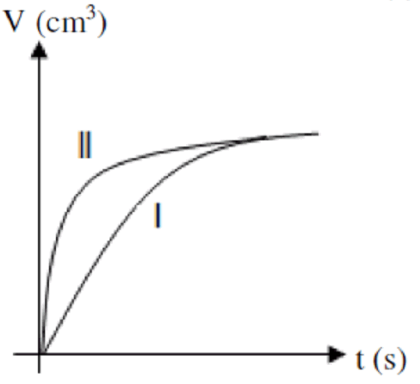
A



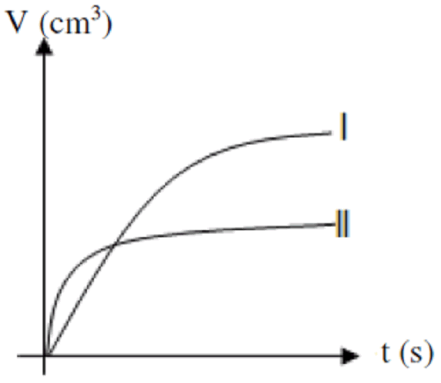
B



C



D



[SPM04-46] The table shows the mass of sulphur trioxide formed at different temperature during the Contact process.

Temperature/ °C	300	400	500	600
Mass of sulphur trioxide / kg	350	200	120	100
Time taken	5 hours	2 hours	6 minutes	9 minutes

At what temperature is the production rate of sulphur trioxide the highest?

A 300 °C
B 400 °C
C 500 °C
D 600 °C

[SPM10-30] When the temperature of a reacting mixture increases, the rate of reaction increases. Which statement explains why the rate of reaction increases?

A The total surface area of the reactant particles increases.
B The total number of the reactant particles per unit volume increases.
C The reactant particles move faster and collide more often with one another
D The reactant particles which collide more often are able to overcome the lower activation energy

[SPM10-32] The following equation shows the reaction between zinc powder and hydrochloric acid.

$$Zn\,(p) + 2\,HCl\,(aq) \rightarrow ZnCl_2\,(aq) + H_2\,(g)$$

How can the rate of production of hydrogen be increased?

A Increases the size of the zinc
B Increases the volume of water in the acid
C Increases the volume of the hydrochloric acid
D Increases the temperature of the hydrochloric acid

Factor of catalyst

[SPM11-29] When a few drops of copper(II) sulphate solution is added to a mixture of zinc powder and dilute sulphuric acid, the rate of reaction increases. Which statement best explains why the rate of reaction increases?

A Lowers the activation energy
B Increases the collision frequency
C Increases the concentration of sulphate ion in the mixture
D Makes the orientation of collision between the reacting particles favourable

[SBPtrial10-44] The rate of decomposition of hydrogen peroxide solution is increased by adding a little manganese(IV) oxide as a catalyst. Which of the following is a role of catalyst to increase the rate of decomposition hydrogen peroxide solution?

A It increase the kinetic energy of the reacting particle
B It increase the surface area of the reacting particle
C It lowers the level of activation energy in the reaction
D It decrease the number of collision per second in the reaction

[SPM10-14] How does a catalyst increase the rate of reaction?

A Increase the number of effective collisions
B Increase the activation energy of the reaction
C Increase the total number of reactant particles
D Increase the kinetic energy of reactant particles

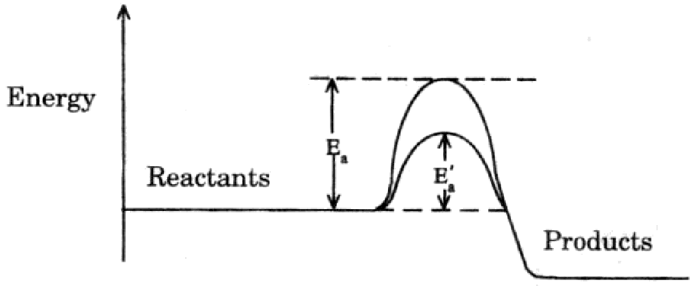
[SPM06-13] Which manufacturing of the following is **not** a characteristic of catalyst?

A A catalyst is specific in its reaction.
B A catalyst influences the quantity of product of a reaction.
C The chemical property of a catalyst remains unchanged at the end of the reaction.
D Only a little amount of a catalyst is needed to influence the rate of reaction.

[SPM08-48] Which of the following is a characteristic of a catalyst?

A It change the amount of product in the reaction
B Chemically unchanged at the end of the reaction
C Equal amount of catalyst and reactants are needed for the reaction
D The amount of the catalyst decreases at the end of the reaction

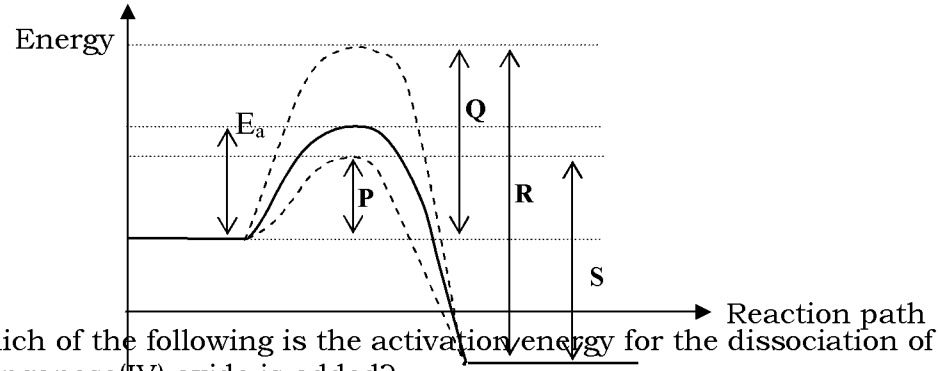
[SPM05-12] The diagram shows the energy profile of a reaction. E_a is the activation energy for this reaction.



What will change the activation energy from E_a to E_a'?

A Temperature
B Catalyst
C Concentration
D Total Surface Area

[SBPTrial09-34] Diagram 12 shows an energy profile diagram. E_a is the activation energy for the decomposition of hydrogen peroxide.



Which of the following is the activation energy for the dissociation of hydrogen peroxide when manganese(IV) oxide is added?

A P
B Q
C R
D S

[MRSM07-11] A solution of hydrogen peroxide releases oxygen slowly at room temperature.

Hydrogen peroxide → water + oxygen

Diagram 5 shows the effect of adding manganese(IV) oxide to the solution.

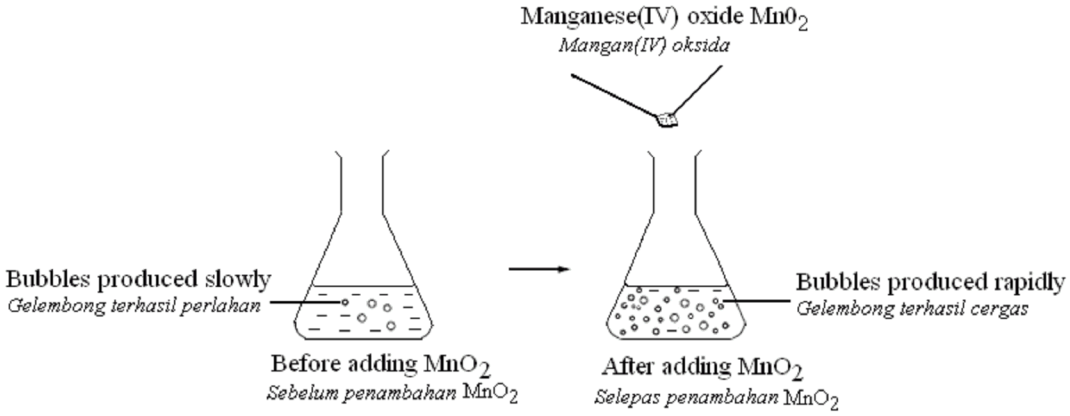
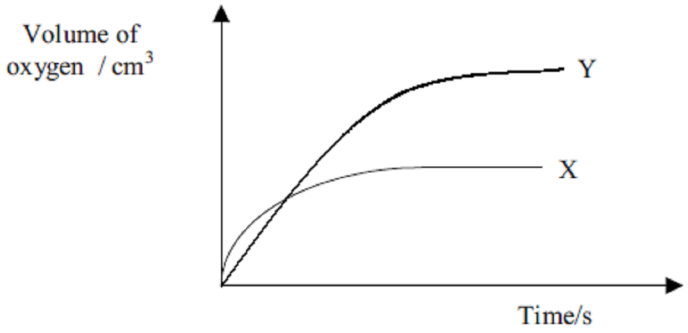


Diagram 5

What could be the reason for the observed change?

A Manganese(IV) oxide acts as a catalyst
B Manganese(IV) oxide reacts with the hydrogen peroxide
C The hydrogen peroxide is neutralised by manganese(IV) oxide
D The hydrogen peroxide becomes more concentrated

[MRSM03-31]



Hydrogen peroxide decomposes according to the equation below.

$$2H_2O_2 \text{ -- > } \quad 2H_2O + O_2$$

The rate of decomposition for 100 cm^3 of 1.0 mol dm^{-3} hydrogen peroxide using manganese(IV) oxide as a catalyst is shown as curve X in Figure 8. Which of the following changes will produce curve Y?

A Increasing the quantity of manganese (IV) oxide
B Addition of water to hydrogen peroxide solution, 1.0 mol dm^{-3}
C Addition of 50 cm^3, 0.2 mol dm^{-3} hydrogen peroxide solution to the original solution
D Using granules of manganese(IV) oxide instead of powdered manganese (IV) oxide

Collision Theory

[SPM05-13] Which of the following explains the meaning of *effective collision*?

A The collision where its energy is less than the activation energy
B The collision that has a low energy
C The collision which takes place before a reaction
D The collision that causes a reaction

[SBPTrial07-10] Which of the following statements correctly explains the meaning of effective collision?

A The collision which takes place before reaction.
B The collision where its energy is less than the activation energy.
C The collision that can causes reaction.
D The collision that has the highest energy.

[SBPmidYearF508-10] Which of the following is the meaning of activation energy?

A The maximum energy that the particles need to produce effective collision
B The amount of energy used by the particles during a collision
C The amount of kinetic energy of molecules during a collision
D The minimum amount of energy that particles must have in order to react

[SPM06-30] The following statements are related to the collision theory of a reaction.

I The total surface area of the reactant particles increases
II The kinetic energy of the reactant particles increases
III The frequency of the collision between the reactant particles increases
IV The number of the reactant particles per one unit of volume increases

Which of the following combinations is true about the effect of the rise in temperature on the reactant particles?

A I and II only
B II and III only
C III and IV only
D I and IV only

Mix

[MRSM11-30] Table 2 shows three sets of experiments using sulphuric acid and magnesium.

Set	Reactants	Initial rate of reaction
I	3.0 g magnesium powder with 15 cm^3 of 1 mol dm^{-3} sulphuric acid.	t
II	3.0 g magnesium strip with 15 cm^3 of 1 mol dm^{-3} sulphuric acid	u
III	3.0 g magnesium powder with 15 cm^{-3} of 2 mol dm^{-3} sulphuric acid	v

Table 2

Which of the following shows the initial rate of reaction between magnesium and sulphuric acid for the three experiments in ascending order?

A u, t, v
B t, u, v
C v, t, u
D u, v, t

[MRSM11-15] Diagram 4 shows a graph of volume of hydrogen gas liberated against time when magnesium ribbon is placed in dilute sulphuric acid.

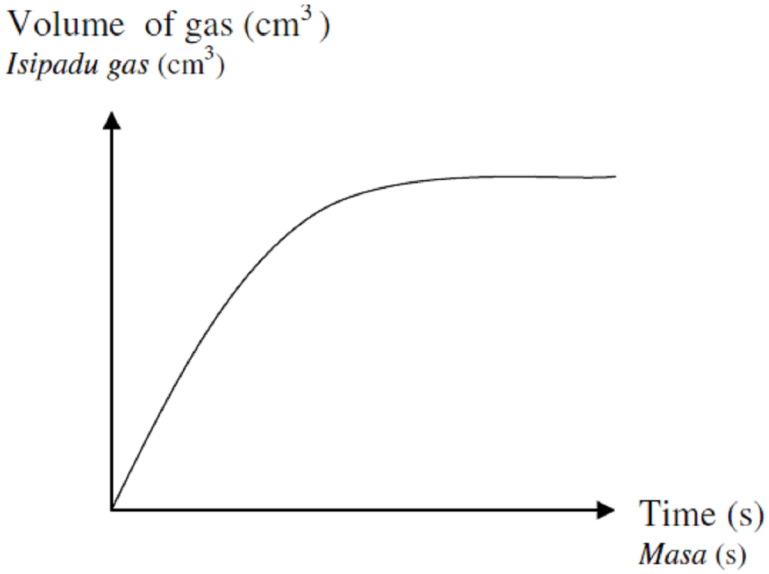


Diagram 4

Which of the following statements explains the change in the gradient of the curve?

A Total surface area of magnesium ribbon increases
B Temperature of the reacting mixture decreases
C Mass of magnesium sulphate formed increases
D Concentration of sulphuric acid decreases

[SBPtrial10-08] Which of the following is the slowest reaction?

A A few manganese(IV) oxide powder is added to hydrogen peroxide solution
B Lead(II) nitrate solution is added to sodium chloride solution
C Dilute sulphuric acid is added to sodium thiosulphate solution
D A few zinc powder is added to copper(II) sulphate solution.

[SBPtrial11-48] The following information shows the effect of a particular factor on the rate of reaction.

- Particles have high kinetic energy
- Numbers of particles with activation energy increases
- Frequency of collision between particles increases
- Frequency of effective collision increases

Which of the following can cause the above effect?

A Increasing total surface area of reactants.
B Increasing the concentration of reactants.
C Adding a catalyst.
D Increasing temperature of reactants

[SBPtrial10-38] The following equation represents the reaction between calcium carbonate and hydrochloric acid.

$$CaCO_{3\,(s)} + 2\,HCl_{(aq)} \rightarrow CaCl_{2(s)} + H_2O_{(l)} + CO_{2(g)}$$

Which of the following factors **cannot** increase the rate of this reaction?

A Decrease the size of calcium carbonate
B Increase the temperature of the mixture
C Increase the concentration of hydrochloric acid
D Increase the volume of hydrochloric acid

[MRSM06-31] The equation shows the reaction between zinc and hydrochloric acid.

$$Zn_{(s)} + 2HCl_{(aq)} \text{ -- > } ZnCl_{2(aq)} + H_{2(g)}$$

Which of the following statements are true about the reaction?
I The mass of zinc decreases with time
II pH of hydrochloric acid increases with time
III Rate of hydrogen gas released increases with time
IV Frequency of collisions between H + ions and zinc atoms decreases with time

A I and III only
B III and IV only
C I, II and IV only
D II, III and IV only

[MRSM03-48]

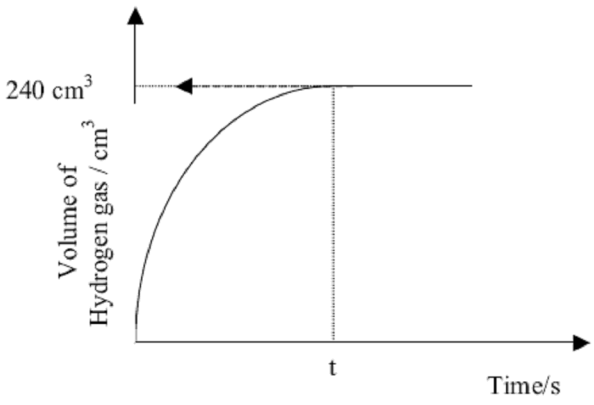


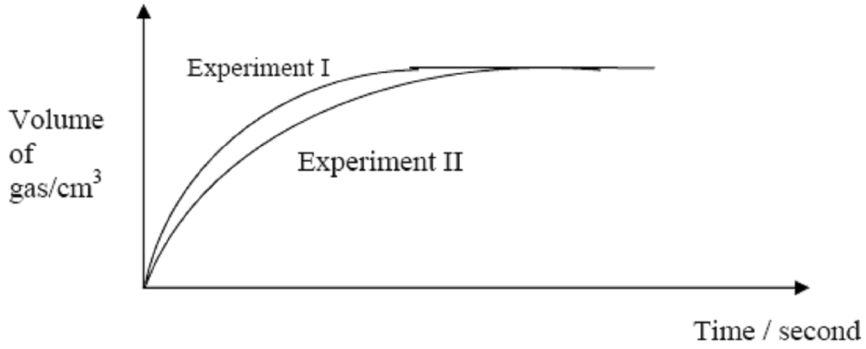
Figure 14

Figure 14 shows the graph of volume of hydrogen gas evolved against time when magnesium reacted with excess 0.5 mol dm^{-3} sulphuric acid solution. Which of the following statements are true?
[Relative atomic mass: Mg=24; Molar volume of gas=24.0 dm^3 at room conditions]

I 0.1 mol sulphuric acid was used up
II 0.24 g of magnesium reacted
III Rate of gas evolved decreases with time
IV Rate of reaction can be increased by adding manganese(IV) oxide

A I and IV only
B II and III only
C I, II and III only
D I, II, III and IV

[MRSM05-28] The graph shows the total volume of carbon dioxide against time for the reaction between calcium carbonate and excess hydrochloric acid.



Which of the following will produce the curves shown?

A Both experiments conducted in different temperature
B Both experiment conducted by using the same acid concentration
C Smaller size of calcium carbonate granules is used in experiment II
D Mass of calcium carbonate used in experiment I is greater.

[MRSM07-46] The following information shows the effect of a particular factor on the rate of reaction.

- Particles have high kinetic energy
- Numbers of particles with activation energy increases
- Frequency of collision between particles increases
- Frequency of effective collision increases

Which of the following can cause the above effect?

A Increasing total surface area of reactants.
B Increasing the concentration of reactants.
C Adding a catalyst.
D Increasing temperature of reactants

[MRSM07-12] Diagram 3 shows the apparatus set-up used to study the rate of reaction of calcium carbonate and hydrochloric acid.

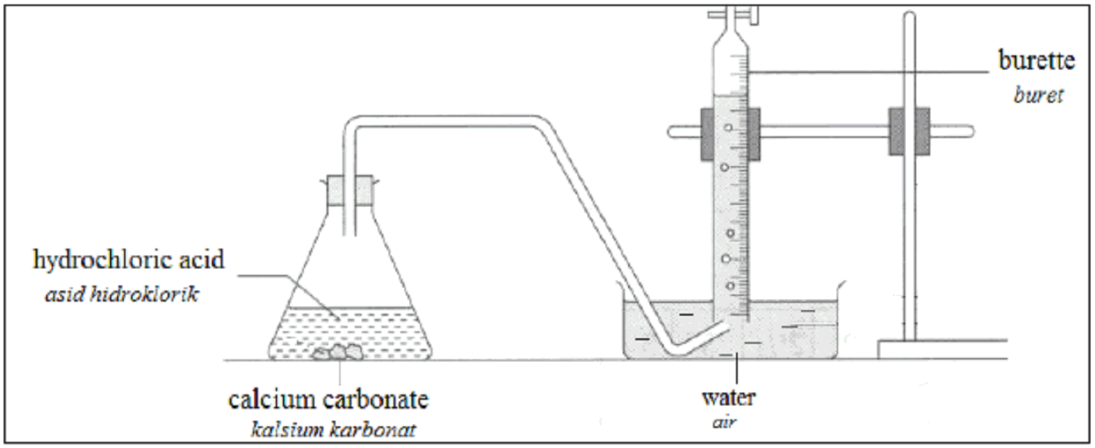
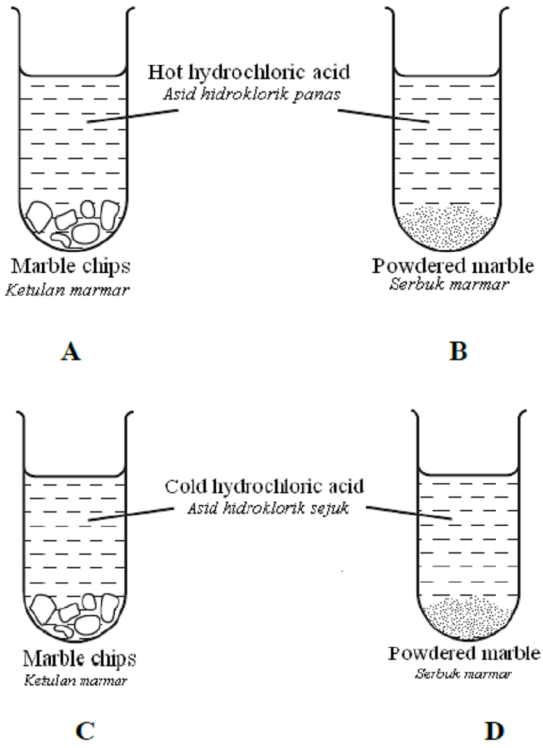


DIAGRAM 3

The rate of the above reaction can be increased by

A grinding the marble chips
B lowering the temperature of hydrochloric acid
C using a larger flask
D adding water to hydrochloric acid

[MRSM07-13] 2 g of marble is added to 10 cm3 of hydrochloric acid in four different test tubes. In which test tube is the reaction fastest?



[MRSM07-30] Diagram 17 shows set up of apparatus to study the rate of reaction. Magnesium is added to excess dilute hydrochloric acid at 25 °C.

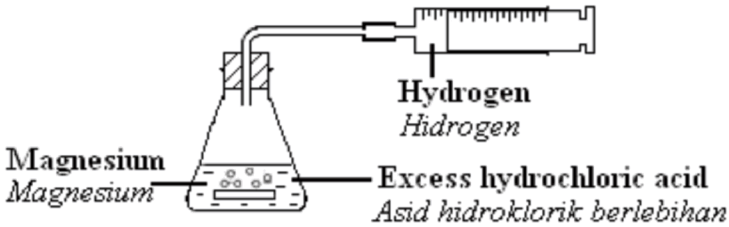


Diagram 17

Which of the following effects on rate and amount of product are correct when the concentration of acid and temperature are increased?

	Increase concentration of acid	**Increase temperature**	**Amount of product**
A	Increase rate of reaction	Increase rate of reaction	no change
B	Decrease rate of reaction	Decrease rate of reaction	Increase
C	Decrease rate of reaction	Increase rate of reaction	Decrease
D	Increase rate of reaction	Decrease rate of reaction	Increase

[MRSM09-29] Diagram 11 shows the graph of the volume of hydrogen gas against time for the reaction between granulated zinc and 50 cm^3 1.0 mol dm^{-3} sulphuric acid.

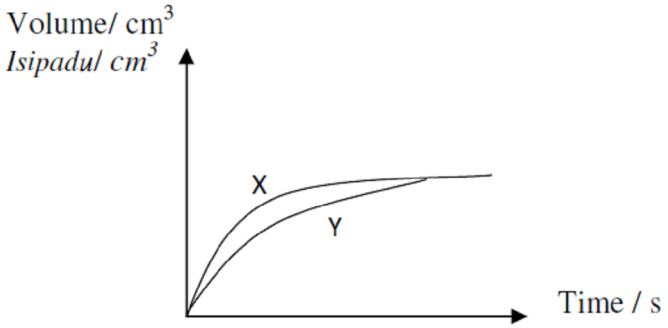


Diagram 11

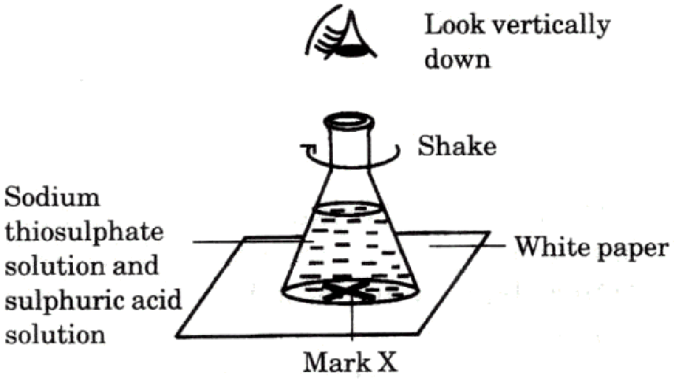
Curve X is obtained when excess granulated zinc is reacted with 50 cm^3 1.0 mol dm^{-3} sulphuric acid. Which of the following must be done to produce curve Y?

A Add distilled water to sulphuric acid
B Replace granulated zinc with zinc powder
C Add a few drops of copper (II) sulphate solution
D Add sulphuric acid to the mixture

[SPM04-14] The rate of reaction for the decomposition of hydrogen peroxide decreases with time because

A product of reaction decreases
B temperature of hydrogen peroxide decreases
C volume of hydrogen peroxide decreases
D concentration of hydrogen peroxide decreases

[SPM05-45] The diagram shows the set up of the apparatus for an experiment to determine the rate of reaction between sodium thiosulphate and sulphuric acid.



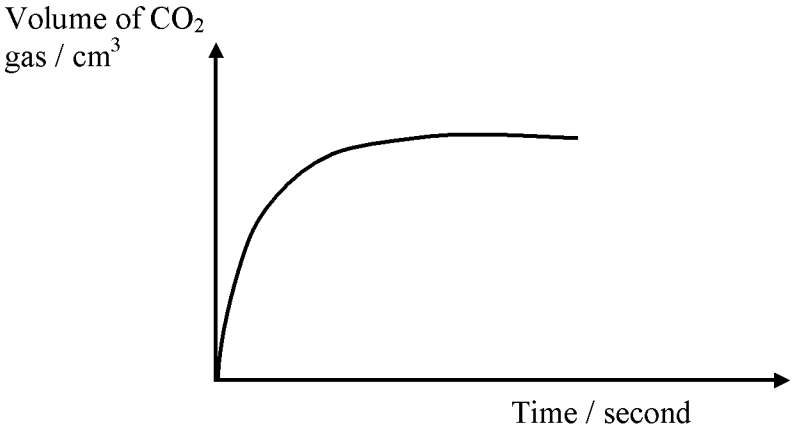
Which of the following combination of conditions take the shortest time for the mark X to disappear from sight?

	Sulphuric acid		Sodium Thiosulphate		Temperature
	Volume/cm^3	Concentration/ mol dm^3	Volume/cm^3	Concentration/ mol dm^3	
A	10	1.0	50	0.5	30
B	10	1.0	50	0.5	40
C	10	0.5	50	0.5	30
D	20	0.5	40	0.5	40

[SPM08-08] Which factor does **not** affect the rate of reaction?

A Size of the solid reactant
B Volume of the reactant
C Concentration of the reactant
D Temperature of the reactant

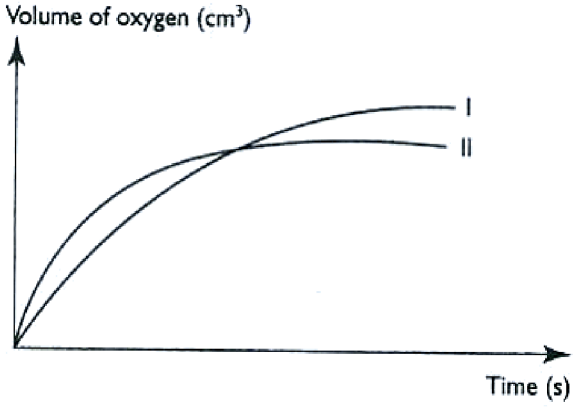
[SBPTrial07-22] The graph shows the volume of carbon dioxide gas produced against time for the reaction of calcium carbonate and sulphuric acid.



The gradient of the graph decreases with time because

A catalyst is not used
B volume of mixture decreases
C temperature of reaction decreases
D concentration of sulphuric acid decreases

[SBPTrial07-48] Graph represents the decomposition of 25 cm^3 hydrogen peroxide of 0.5 mol dm^{-3} with manganese(IV) oxide as a catalyst at a temperature of 30 °C.



Which of the following experiments will produce graph II?

	Volume of hydrogen peroxide/cm^3	Concentration of hydrogen peroxide/mol dm^{-3}	Temperature of hydrogen peroxide/°C
A	15	0.7	30
B	15	0.5	30
C	40	0.7	30
D	40	0.5	20

[SBPTrial08-43] Diagram 15 shows curve W obtained from the decomposition of 20 cm^3 of 0.40 mol dm^{-3} hydrogen peroxide solution, H_2O_2, using 0.2 g of manganese (IV) oxide as catalyst at a temperature of 30 ^oC.

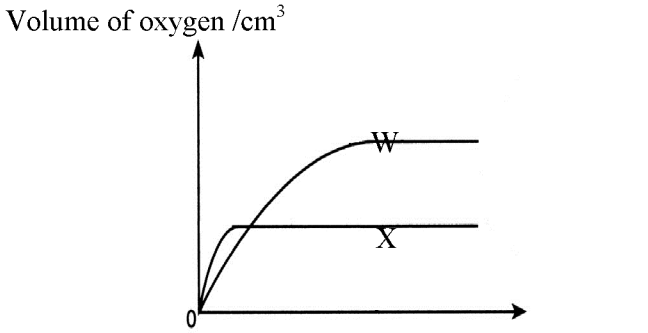


Diagram 15

Which of the following experiments will produce curve X?

	Volume of H_2O_2 /cm^3	Concentration of H_2O_2/ mol dm^{-3}	Temperature/°C
A	10	0.60	30
B	15	0.20	30
C	20	0.60	40
D	30	0.30	40

[SPM09-24] In which of the chemical reactions can the rate be determined by measuring the change in the gas volume?

A acidified potassium manganate(VIII) solution with iron(II) sulphate solution
B sodium hydroxide solution with dilute hydrochloric acid
C silver nitrate solution with sodium chloride solution
D calcium carbonate with dilute hydrochloric acid

[SBPTrial08-37] Diagram 12 shows curve X obtained when 8 g of granulated zinc (in excess) is reacted with 50 cm^3 of 1 mol dm^{-3} sulphuric acid.

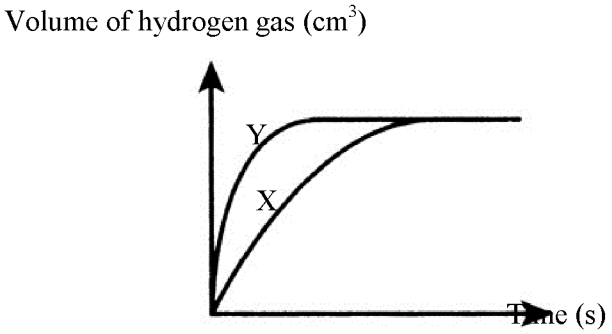


Diagram 12

Which of the following reactions produces curve Y?

A 8 g zinc powder + 50 cm^3 of 2 mol dm^{-3} sulphuric acid
B 8 g zinc powder + 50 cm^3 of 1 mol dm^{-3} of sulphuric acid
C 8 g granulated zinc + 100 cm^3 of 1 mol dm^{-3} of sulphuric acid
D 8 g granulated zinc + 50 cm^3 of 2 mol dm^{-3} of sulphuric acid

[SBPmidYearF508-20] Chemical equation shows the reaction between zinc and sulphuric acid.

$$H_2SO_4(aq) + Zn(s) \text{ -- > } ZnSO_4(aq) + H_2(g)$$

Which of the following factors increases the rate of reaction?

A Increases of volume of sulphuric acid
B Use of lower concentration of sulphuric acid
C Addition of small amount of copper(II) sulphate
D Use bigger size of zinc

Application

[SPM06-43] If you want to cook 100 potatoes within a short time, which is the most suitable method?

A Boil the potatoes in a pan
B Boil the potatoes in a pressure cooker
C Steam the potatoes in a steamer
D Fry the potatoes in a wok

Structure {Paper02}

[MRSM11-05]

Diagram 5.1 shows the apparatus set up for the reaction between 40.0 cm^3 of 0.1 mol dm^{-3} hydrochloric acid and excess small calcium carbonate chips.

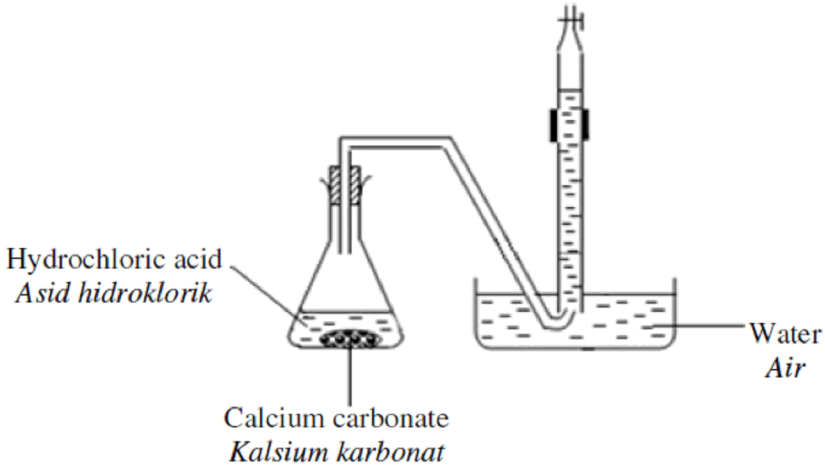


Diagram 5.1

The volume of gas produced is measured at 30 second intervals. Table 5.2 shows the results obtained.

Time (s)	0	30	60	90	120	150	180	210	240	270
Volume of gas produced (cm^3)	0.00	13.00	22.00	28.50	34.00	39.00	42.50	45.00	45.00	45.00

Table 5.2

(*a*) Write the chemical equation for the reaction. [2M]

.....

(*b*) Draw the graph of volume of gas produced against time. [3M]

(*c*) From the graph, determine the rate of reaction at 60 seconds. [2M]

(*d*) On the graph that you have drawn in **5**(*b*) sketch a curve that you would get if the experiment is repeated using excess large calcium carbonate chips. [1M]

(*e*) Based on collision theory, explain how the size of calcium carbonate affects the rate of reaction. [3M]

.....

.....

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.....

[MRSM04-05]

An experiment was done to determine the rate of reaction between 50 cm^3 hydrochloric acid 0.1 mol dm^{-3} and excess calcium carbonate chips. The volume of gas evolved during the reaction is recorded every 20 seconds as shown in Table 2.

Time (s)	0	20	40	60	80	100	120	140	160
Total volume of CO_2 gas evolved (cm^3)	0.00	24.00	33.00	39.00	43.50	46.50	48.00	49.00	49.00

Table 2

(a) Write the chemical equation for this reaction. [1M]

.....

(b) Draw the graph of the volume of carbon dioxide gas against time on the graph paper.[4M]

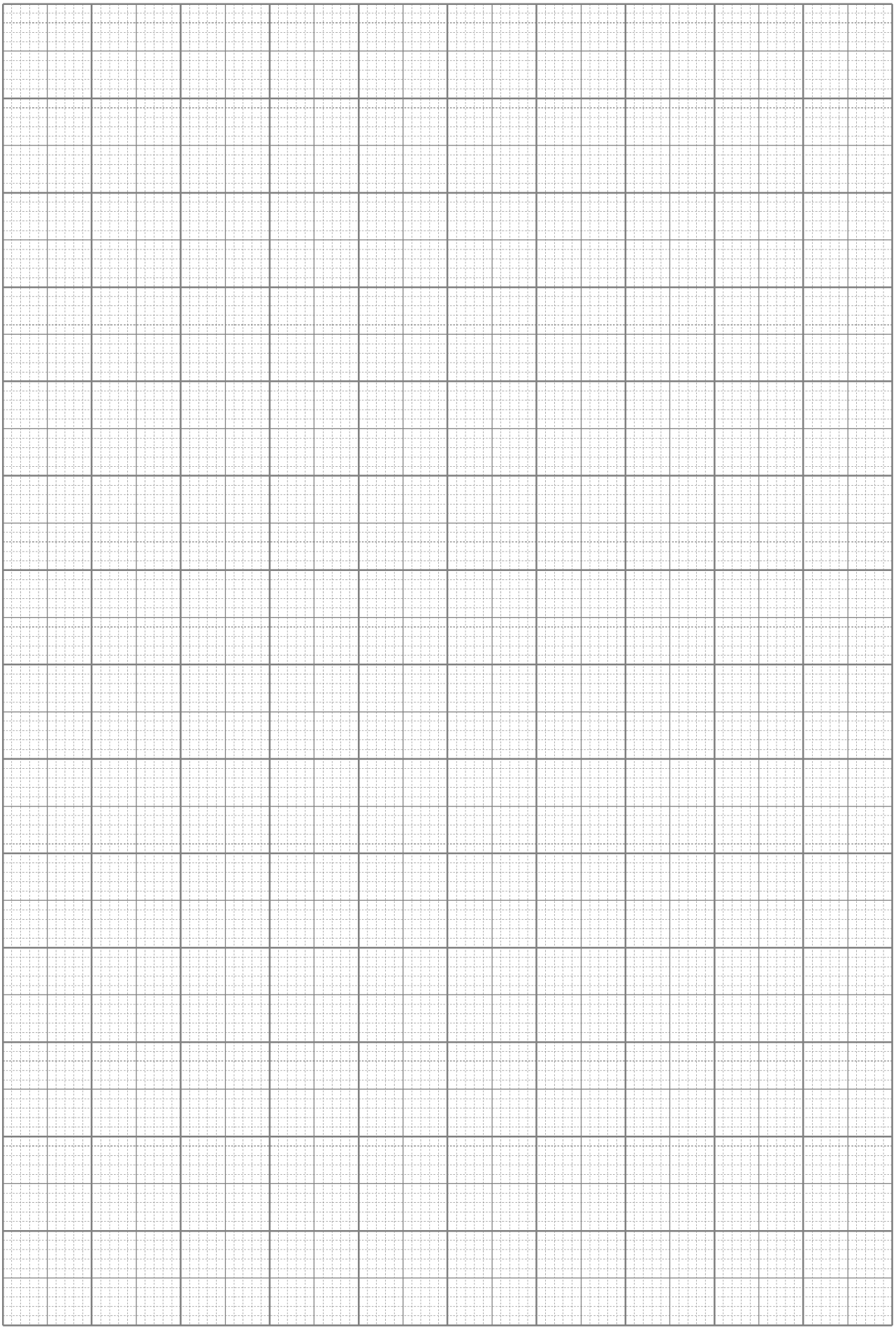
(c) Based on the graph in (b), how does the rate of reaction changes with time? Explain your answer. [2M]

.....

.....

.....

(d) Calculate the rate of reaction at 80 seconds. [2M]



(e) Suggest **two** ways to increase the rate of reaction between calcium carbonate and hydrochloric acid. [2M]

.....

.....

[SPM09-05]

Diagram 5 shows two sets of experiment to study the factor affecting the rate of reaction between hydrochloric acid, HCl and calcium carbonate, $CaCO_3$.

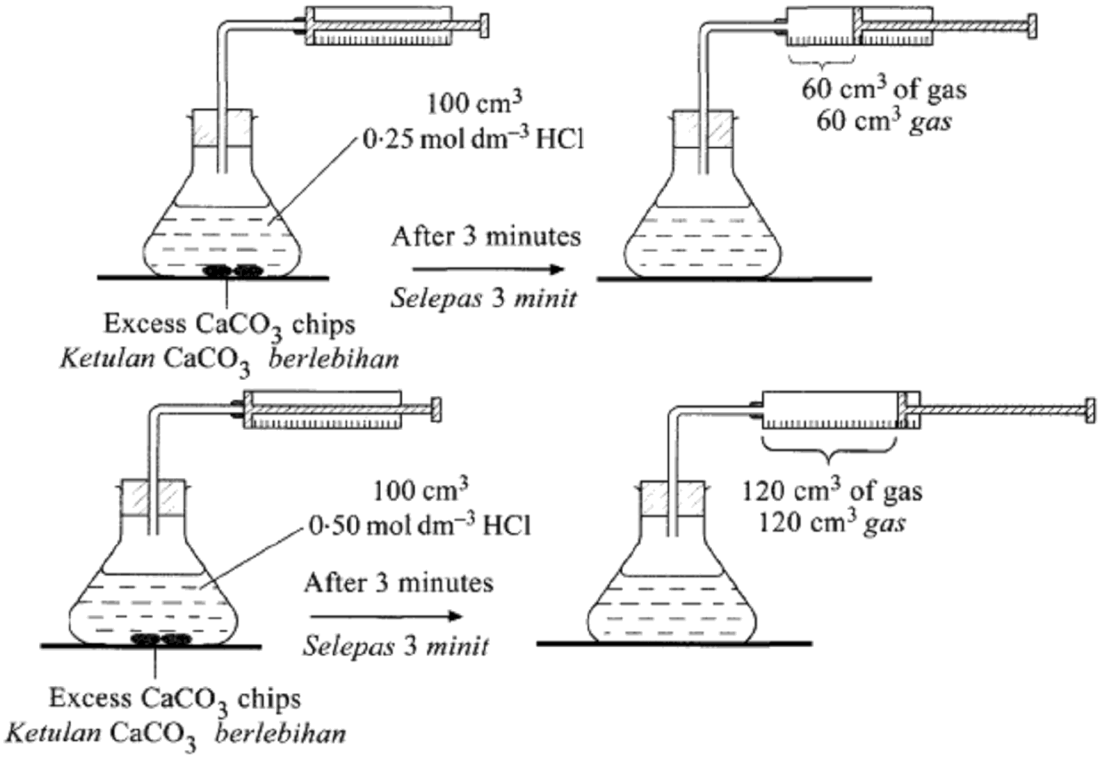


Diagram 5

(a) Write a balanced chemical equation for the reaction in these experiments.[2M]

.....

(b) What is the reading needed to be recorded in both experiments to determine the rate of reaction in 3 minute? [1M]

.....

(c) Calculate the average rate of reaction in set I. [1M]

(d)(i) Compare the rate of reaction in set I and set II. Explain your answer based on the factor affecting the rate of reaction. [2M]

.....

.....

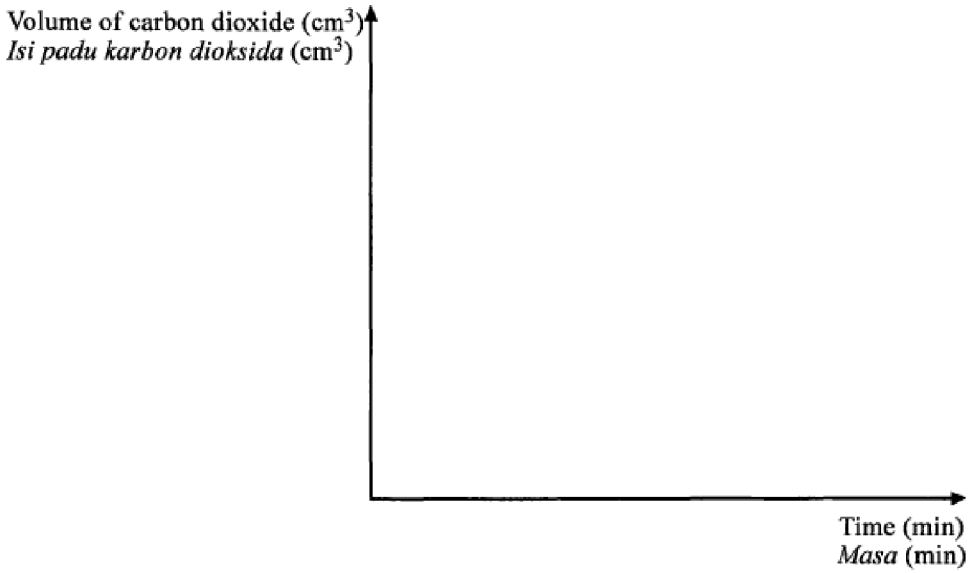
(ii)Explain the answer in 5(d)(i) with reference to the collision theory.[3M]

.....

.....

.....

(e) Sketch the graph of the volume of carbon dioxide gas produced against time for both sets of experiment in the first 3 minute. [2M]



[SBPtrial04-04] {Translate}

Two experiments were done to determine the reaction between acid with sodium carbonate powder. Table below shows the time taken to collect 25.0 cm^3 gas released for every experiment.

Experiment	Mixture of substance of experiment	Temperature/°C	Time/ s
I	20.0 cm^3 of 1.0 mol dm^{-3} hydrochloric acid + 4.0 g sodium carbonate powder	28.0	60
II	20.0 cm^3 of 1.0 mol dm^{-3} ethanoic acid + 4.0 g sodium carbonate powder	28.0	90

(a) Write the ionic equation for the reaction happen. [1M]

.....

(b) Used collision theory, explain why the time taken for experiment I is shorter than experiment II. [3M]

.....

.....

.....

(c) Draw the diagram for set-up in the experiment. [2M]

(d)(i) Calculate the mass of sodium carbonate, Na_2CO_3 reacted with acid to produce 25 cm^3 of gas. [3M]
[1 mol of gas occupies 24 dm^3 at room condition, Relative atomic mass: Na=23, C=12, O=16]

(e) Calculate the average of rate of reaction for experiment I. [1M]

[MRSM07-04]

An experiment is carried out to study the effect of concentration on rate of reaction. 50.0 cm^3 of 0.5 mol dm^{-3} hydrochloric acid and excess granulated calcium carbonate is put into a conical flask and is placed on an electronic balance as shown in Diagram 4.

The mass of the conical flask and its contents is recorded at 60 seconds intervals.

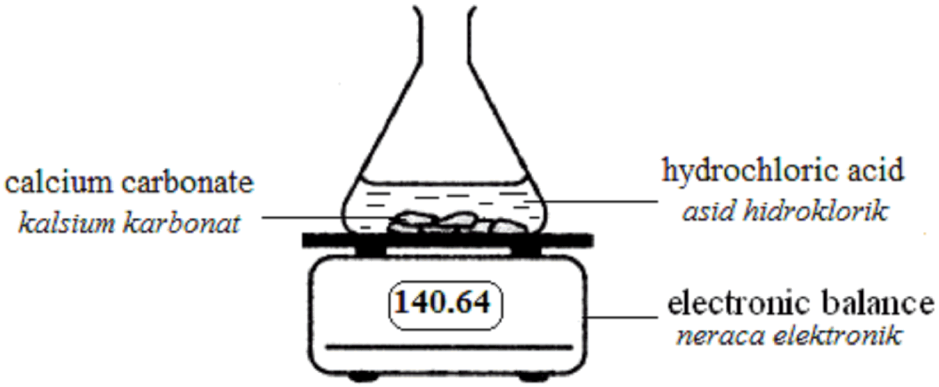


Diagram 4

Table 4 shows the results.

Time/s.	0	60	120	180	240	300	360	420	480
Balance readings/ g	140.64	140.48	140.37	140.31	140.26	140.22	140.20	140.20	140.20

Table 4

(a) Give the definition of rate of reaction. [1M[

.....

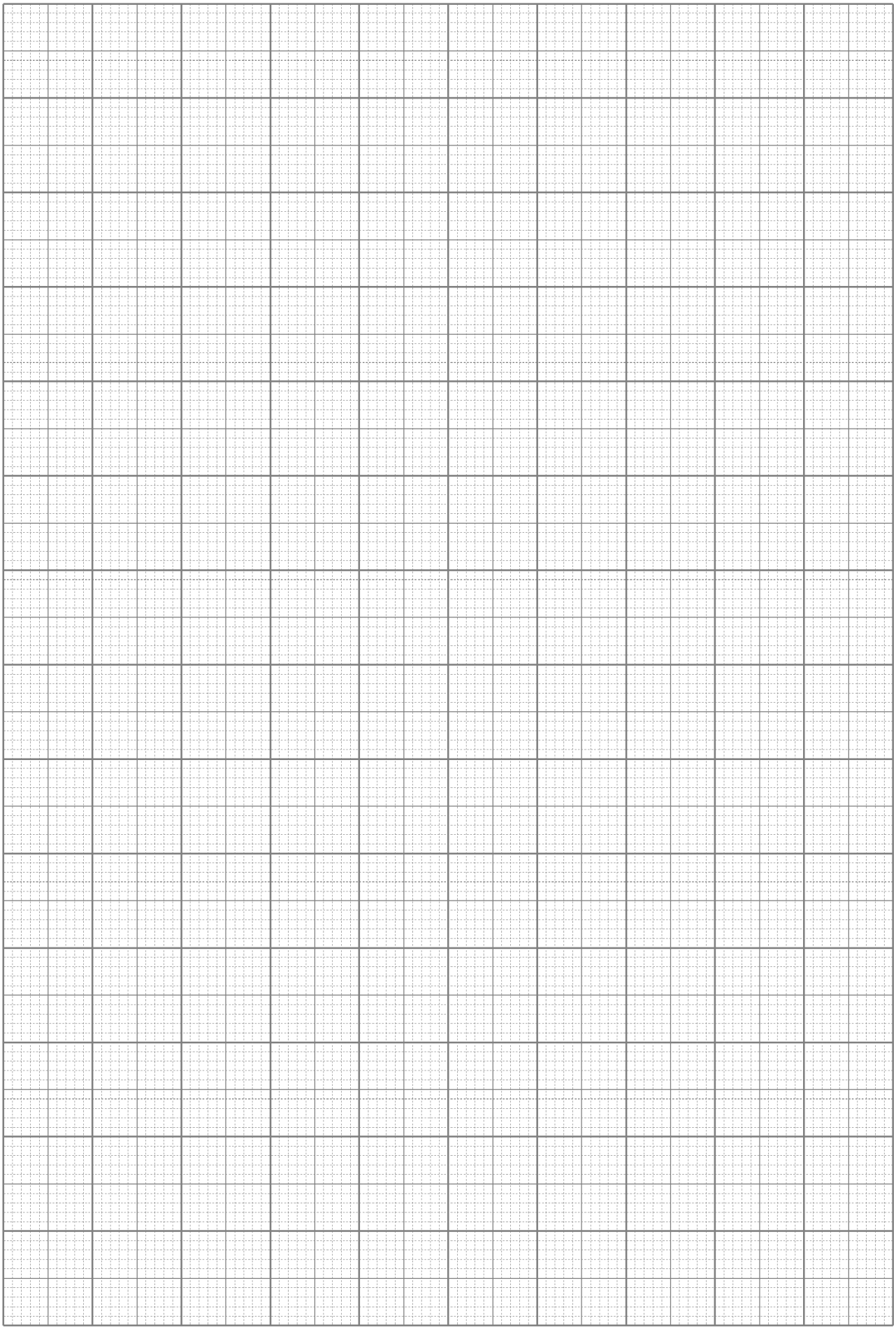
(b) Explain why the mass of the conical flask and its content decreases with time. [1M]

.....

.....

(c) Based on Table 4, plot a graph of the mass of the conical flask and its content versus time on the graph paper below. [3M]

(d) (i) Calculate the mass of carbon dioxide gas produced. [1M]



(ii) Calculate the expected volume of gas produced at room condition.
[1 mol of gas occupies 24 dm^3 at room condition; relative molecular mass of CO_2 is 44]

[SBPtrial11-05]

A student carried out two experiments to investigate the effects of the factor influencing the rate of reaction. Table 5 shows the results of the experiments.

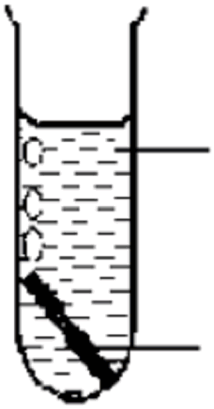
Experiment	Set up of the apparatus	Temperature/ °C	Time taken for all the magnesium to dissolve/s
I	 **Excess hydrochloric acid** ***Asid hydroklorik berlebihan*** **0.24 g magnesium ribbon** ***0.24 g pita magnesium***	30	50
II	 **Excess hydrochloric acid** ***Asid hydroklorik berlebihan*** **0.24 g magnesium ribbon** ***0.24 g pita magnesium***	40	20

Diagram 5

(a) (i) What is the factor that influences the rate of reaction in both experiment. [1M]

.....

(ii) Calculate the maximum volume of hydrogen gas produced. [2M]
[Relative atomic mass : Mg = 24 ; molar gas volume = 24 dm3mol-1 at room condition]

(b) Calculate the average rate of reaction in [2M]

(i) Experiment I:

(ii) Experiment II:

(c) (i) Compare the rate of reaction between Experiment I and Experiment II. [1M]

.....

(ii) Explain the answer in (c)(i) with reference to the collision theory. [3M]

.....

.....

.....

(d) Sketch the graphs for the volume of hydrogen gas against time for Experiment I and Exeriment II on the same axes. [2M]

[SBPtrial08-04]

Two experiments were carried out to investigate factors that affect the rate of reaction. Table 4 shows the description of each experiment.

Experiment	**Reactant**	**Temperature, °C**	**Total volume of gas collected at 2 minutes (cm^3)**
I	Excess zinc powder + 20 cm^3 of 0.1 mol dm^{-3} sulphuric acid	30	20.0
II	Excess zinc powder + 20 cm^3 of 0.1 mol dm^{-3} sulphuric acid + copper(II) sulphate solution	30	32.0

Table 4

(a) Draw a diagram of the set-up of apparatus to carry out this experiment. [2M]

(b) Write the chemical equation for the reaction between zinc and sulphuric acid. [1M]

.....

(c) Calculate the average rate of the reaction for the first two minutes of experiment I and experiment II in $cm^3\ s^{-1}$. [2M]

Experiment I:

Experiment II:

(d) Calculate the maximum volume of gas produced in experiment II. [2M]
[1 mol of gas occupies 24 dm^3 at room condition]

(e) Compare the rate of reaction between experiment I and experiment II, explain why there is a difference in the rate of reaction based on the collision theory. [3M]

.....

.....

.....

[SPM11-02]

In an experiment to investigate the rate of reaction, 50.0 cm^3 of 0. 2 mol dm^{-3} sodium thiosulphate solution and 5.0 cm^3 of 1.0 mol dm^{-3} of sulphuric acid, are used. The sulphur formed can be used to measure the rate of reaction.

The equation for the reaction is given below.

$$Na_2S_2O_3 + H_2SO_4 \rightarrow Na_2SO_4 + SO_2 + S + H_2O$$

(a) What is the colour of sulphur? [1M]

.....

(b) The number of moles of a solute can be calculated using the formula, n = MV.
[n = Number of moles of solute (mol), M = Molarity of solution (mol dm^{-3}),
V = Volume of solution (dm^3)]

Calculate:
(i). The number of mole of sodium thiosulphate in the solution. [1M]

(ii) The number of mole of sulphuric acid. [1M]

(c). Based on the answers in 2(b)(i) and 2(b)(ii), name the reactant which determines the quantity of sulphur formed at the end of the reaction. [1M]

.....

(d) (i). State **three** factors that can affect the rate of reaction in this experiment. [3M]

1. .....

2. .....

3. .....

(ii) Using the collision theory, explain how any **one** of the factors in 2(d)(i) increases the rate of reaction. [2M]

.....

.....

.....

[SBPmidyearF508-05]

Table 5 shows the data of two experiments that have been carried out to determine the rate of decomposition of hydrogen peroxide to water and oxygen gas by using manganase(IV) oxide as a catalyst.

Experiment	**Volume of hydrogen peroxide/cm^3**	**Concentration of hydrogen peroxide/mol dm^{-3}**
I	20	2
II	20	4

Table 5

(a) Write the chemical equation for decomposition of hydrogen peroxide. [1M]

.....

(b) Calculate the volume of oxygen gas released in experiment I at room condition. [1 mole of gas occupies 24 dm^3 at room condition][3M]

(c) (i) Compare the rate of decomposition of hydrogen peroxide between experiment I and II. [1M]

.....

(ii) Based on collision theory, explain your answer in (c) (i). [3M]

.....

.....

.....

(d) Sketch the graph of volume oxygen gas against time for experiment I and experiment II by using the same axis. [2M]

[MRSM08-05]

In an experiment, 50.0 cm^3 of hydrogen peroxide solution is mixed with 1.0g of manganese(IV) oxide powder. The total volume of oxygen gas liberated is measured at 30 seconds intervals.
Table 5 shows the result of the experiment.

Time (s)	0	30	60	90	120	150	180	210
Volume of oxygen (cm^3)	00.00	12.50	17.50	23.00	26.00	28.00	30.00	30.00

Table 5

(a) What is the function of manganese (IV) oxide? [1M]

.....

(b) Write a balanced chemical equation for the decomposition of hydrogen peroxide. [1M]

.....

(c) Plot a graph of the volume of oxygen gas against time. [3M]

(d) How long does it take for the decomposition of hydrogen peroxide to be completed? [1M]

.....

(e) From the graph obtained in (c), calculate:
(i) the instantaneous rate of reaction at 30^{th} second.[2M]

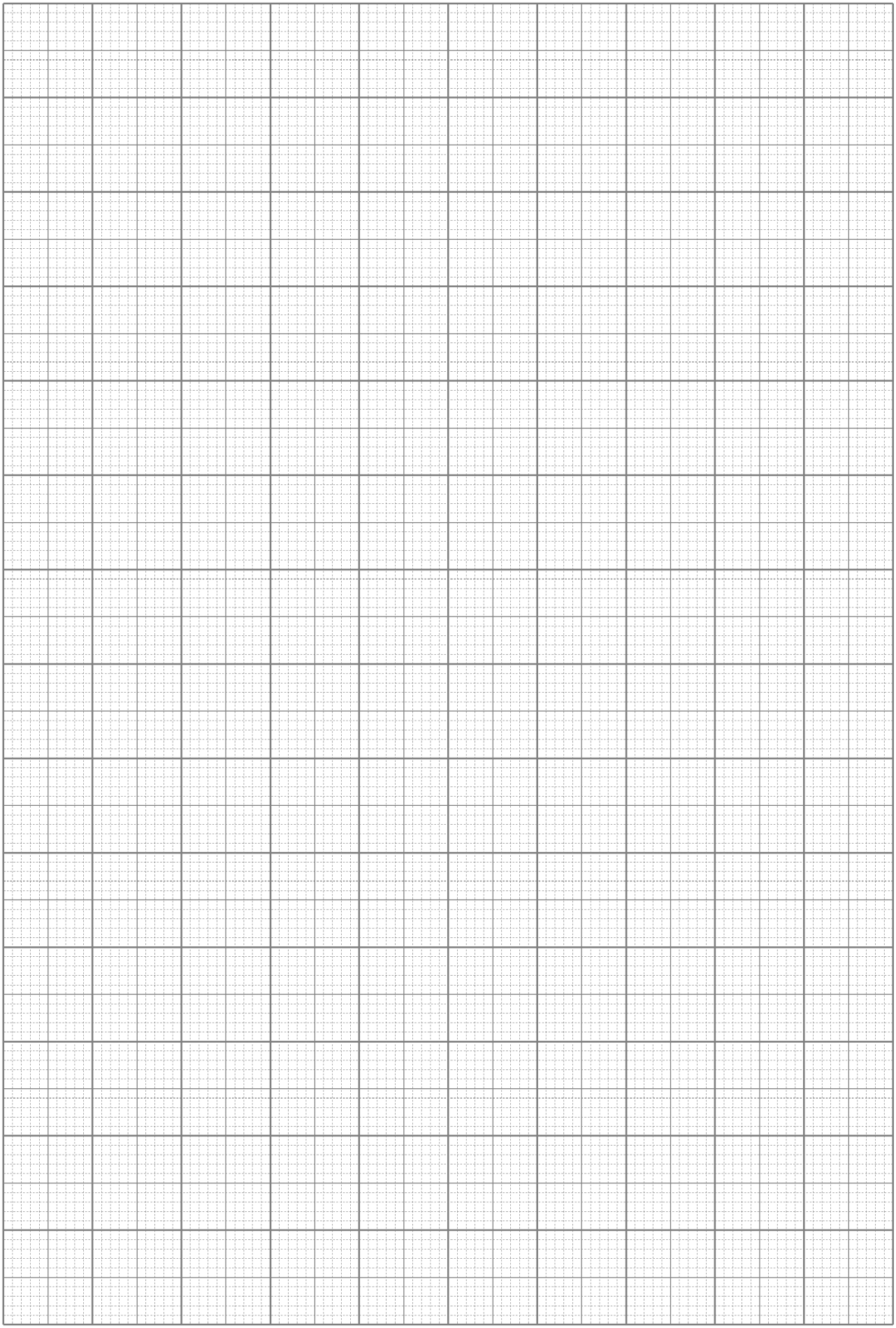
(ii) the average rate of reaction for the first 90 seconds. [1M]

(f) The experiment is repeated using 2.0 g of manganese (IV) oxide. The reaction stops at 120 seconds. Explain. [2M]

.....

.....

.....



[MRSM06-04]

Table 4 shows the data obtained by a student in an experiment to investigate the rate of hydrogen peroxide dissociation using manganese (IV) oxide as a catalyst.

Time (s)	0	30	60	90	120	150	180	210	240	270
Volume of oxygen (cm^3)	0.00	18.00	31.00	39.00	43.00	46.00	48.00	49.00	50.00	50.00

Table 4

(a) Draw a labelled diagram of apparatus set-up for the experiment. [2M]

(b) Write the chemical equation for decomposition of hydrogen peroxide. [1M]

.....

(c) 2.0 g powdered manganese (IV) oxide is used at the beginning of the experiment and the mass remains the same at the end of the experiment. Explain why. [1M]

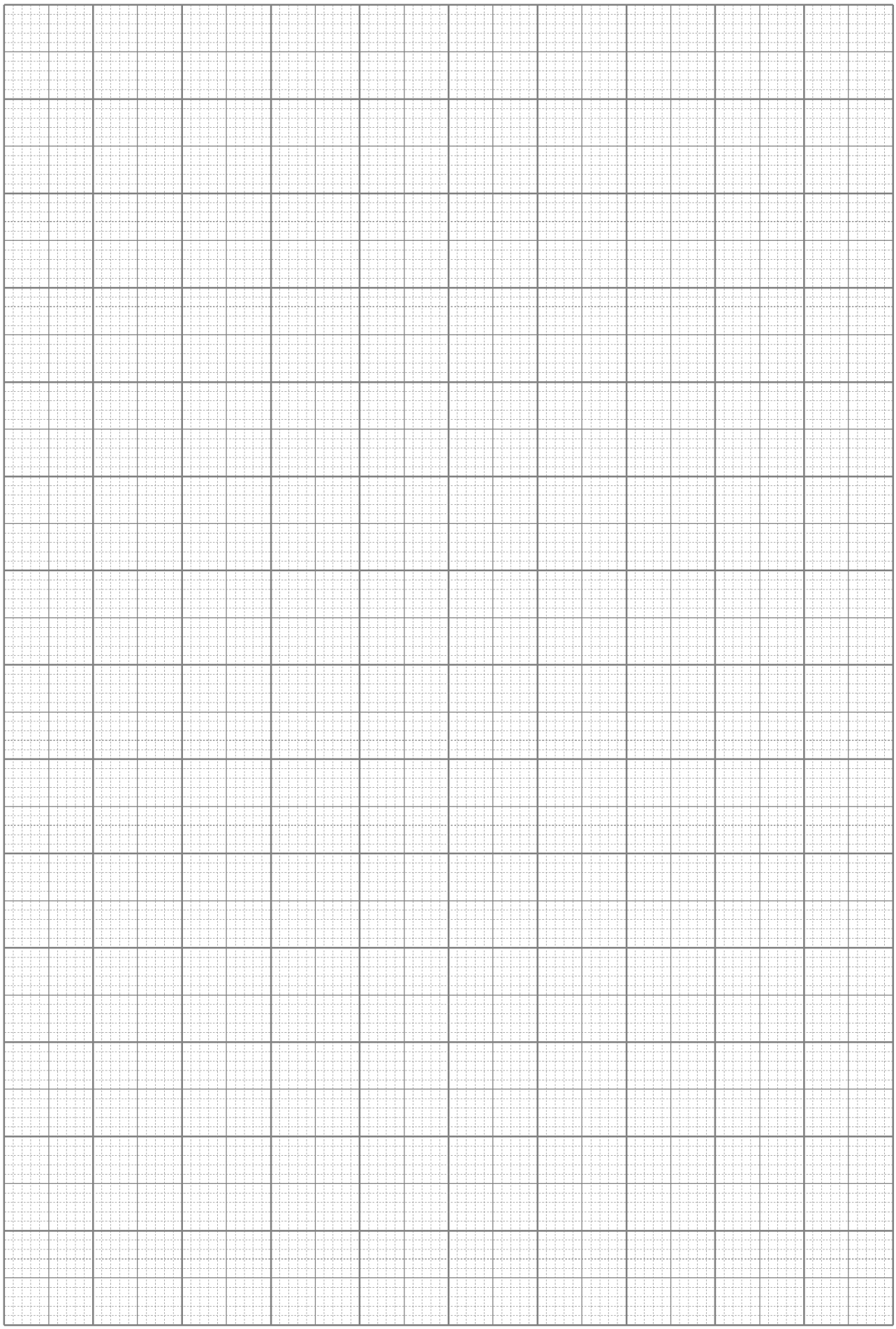
.....

(d) Why does the manganese (IV) oxide used is in the powdered form? [1M]

.....

(e)(i) Using the data in table 4, draw a graph of the volume of oxygen gas against time in the graph paper provided below. [3M]

(ii) Based on the graph in (e)(i) , calculate the rate of reaction at 90 seconds and show the tangent on the graph in (e) (ii). [2M]



[MRSM05-04]

Three experiments were carried out to investigate the effect of the factors influencing the rates of reactions. Table 2 shows the mixture of substances used and the time taken to accumulate 25 cm^3 of gas evolved from each experiment.

Experiment	**Mixture of substances**	**Time/s**
I	25.0 cm^3 of hydrochloric acid 1.0 mol dm^{-3} + 2.0 g of magnesium strip.	50
II	25.0 cm^3 of hydrochloric acid 1.0 mol dm^{-3} + 2.0 g of magnesium strip + 3 drops of copper (II) sulphate solution.	30
III	12.5 cm^3 of sulphuric acid 1.0 mol dm^{-3} + 2.0 g of magnesium strip.	20

Table 2

(a) Sketch the graphs for the three experiments that show the liberation of 25.0 cm^3 of gas on the axes given. [2M]

(b) Why is the time taken to collect 25.0 cm^3 of gas in Experiment II is shorter than in Experiment I?

.....

(c) Based on the collision theory, explain why the time taken to collect 25 cm^3 in Experiment III is shorter than in Experiment I. [3M]

.....

.....

.....

(d) Calculate the mass of magnesium that reacts with sulphuric acid to produce 25.0 cm^3 of gas in Experiment III. [4M]
[Use the information that 1 mole of gas occupies a volume of 24 dm^3 at room temperature and pressure, Relative atomic mass: Mg= 24, H=1, S=32 and O=16]

[SPM08-05]

An experiment is carried out to investigate the rate of reaction of zinc with hydrochloric acid. Excess zinc powder is added to 20 cm^3 of 0.2 mol dm^{-3} hydrochloric acid. The volume of gas collected at regular intervals is shown in Diagram 5.1.

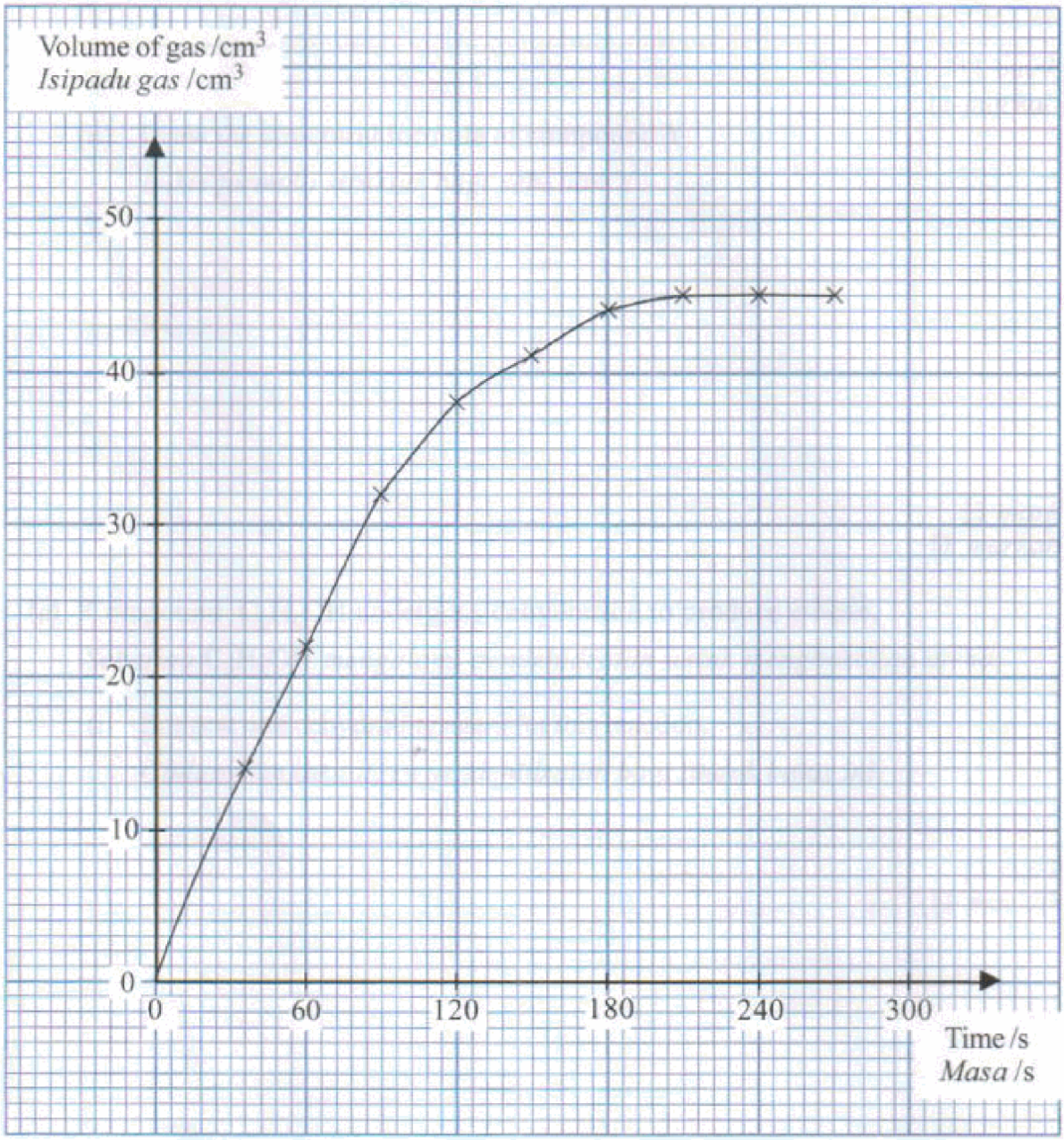


Diagram 5.1

(a) State the meaning of the rate of reaction. [1M]

.....

(b) From the graph in Diagram 5.1, determine:
(i) The rate of reaction at 120 s. [2M]

.....

(ii) The average rate of reaction between 60 s and 120 s. [1M]

.....

(c) Explain why the rate of reaction decreases with time. [1M]

.....

(d) Another experiment is carried out to study the factors that affect the rate of this reaction. The result of this experiment is shown in Diagram 5.2. Curve I represents the result of this experiment using excess zinc powder and 50 cm^3 of 1.0 mol dm^{-3} dilute hydrochloric acid.

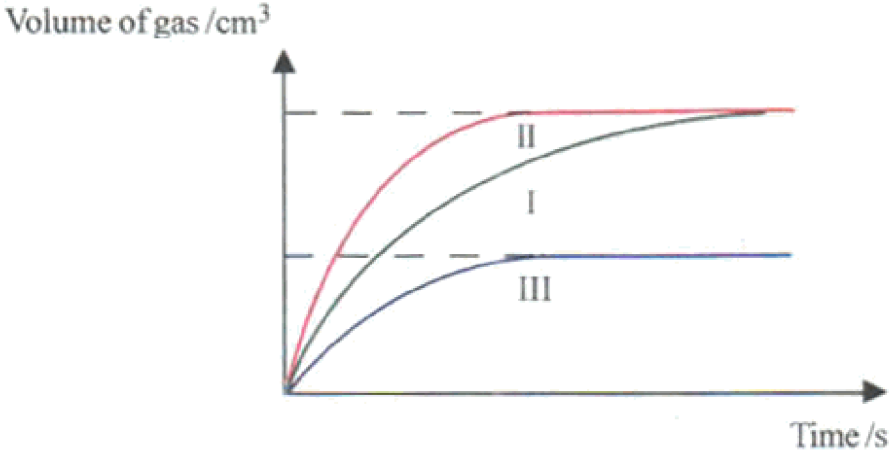


Diagram 5.2

(i) Suggest the factors that influence the rate of reaction to obtain the curves labelled II and III. [2M]

Curve II : .....

Curve III : .....

(ii) Describe briefly how to carry out the experiment to obtain the curve labelled III. [3M]

.....

.....

.....

.....

(iii) Give one reason why the final volume of gas obtained in curve III is half the final volume of gas in curve I. [1M]

.....

.....

[SPM06-06]

Diagram 6 shows two experiments to investigate one factor that influences the rate of a reaction.

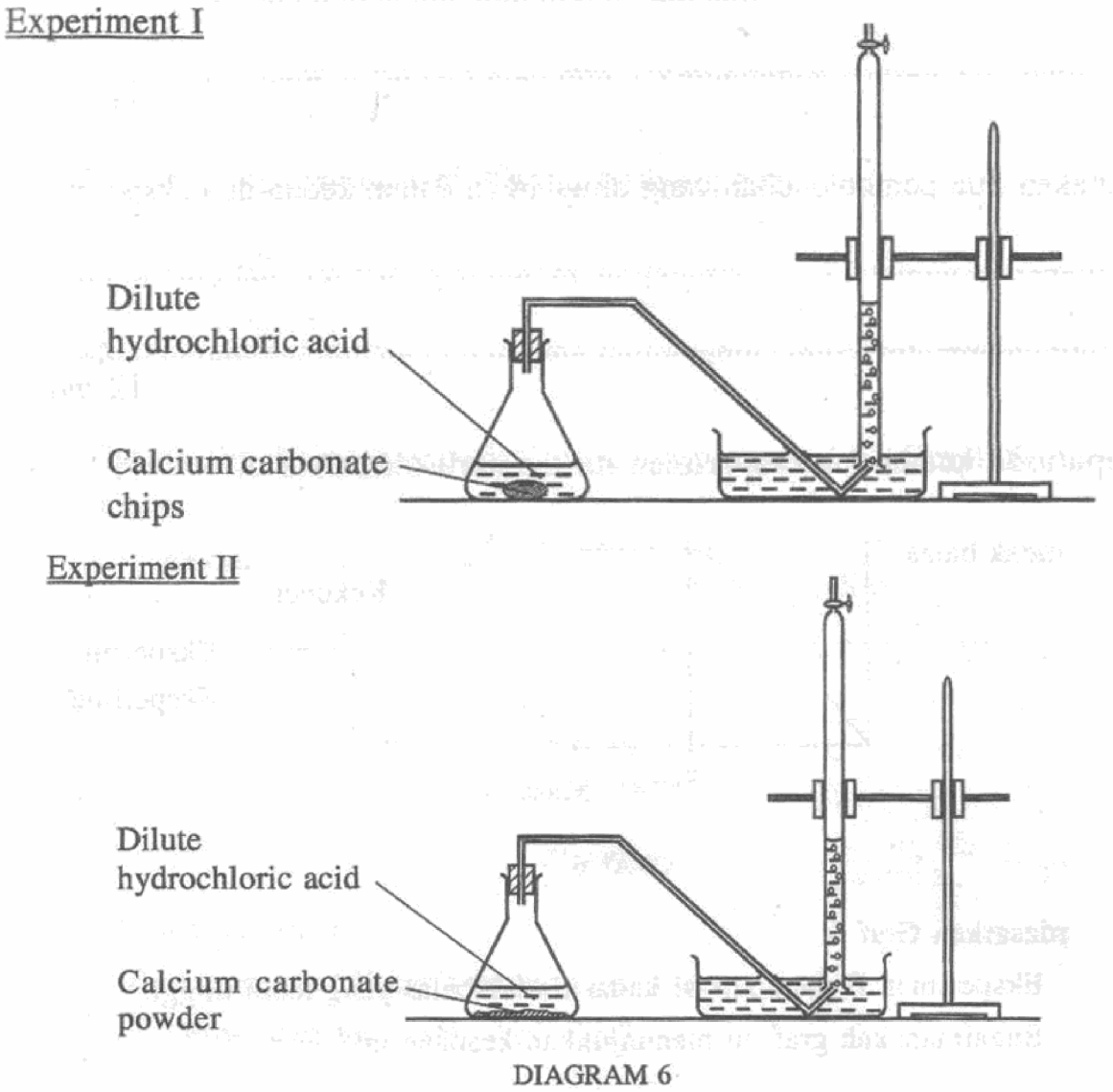


DIAGRAM 6

(a) What is the factor that influences the rate of reaction in both experiments? [1M]

.....

(b) The reaction in the experiment is represented by the following equation:

$$CaCO_3(s) + 2\ HCl(aq) \text{ -- > } CaCl_2(aq) + CO_2(g) + H_2O(l)$$

(i) Among the products stated in the equation, which is the most suitable to be chosen to determine the rate of reaction? [1M]

.....

(ii) State **one** reason for choosing the product in 6 (b)(i). [1M]

.....

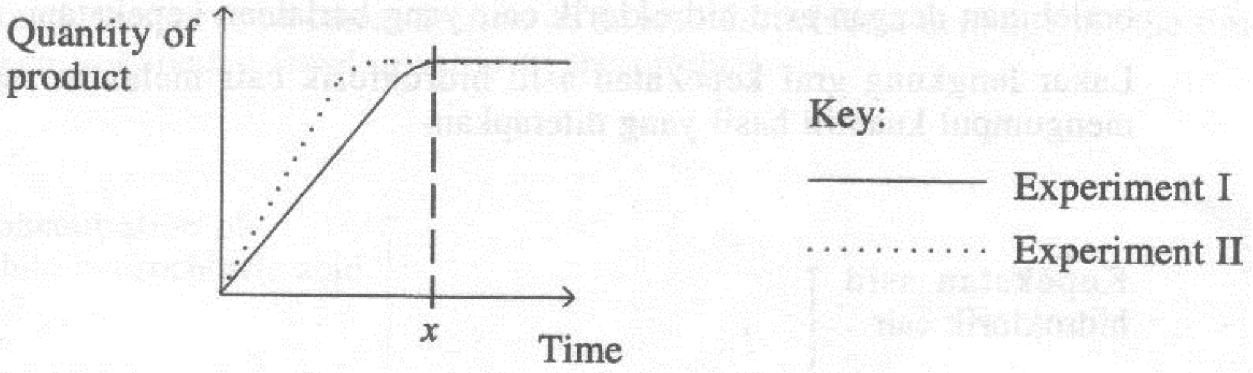
.....

(c) State **two** controlled variables in both experiments. [2M]

1. .....

2. .....

(d) The results for both experiments are represented by Graph 6.



Graph 6

Based on graph 6:

(i) Experiment II has a higher rate of reaction. How does the graph show this? [1M]

.....

(ii) What has happened to the reactants at time X? [1M]

.....

(iii) Why are both curves at the same level after time x? [1M]

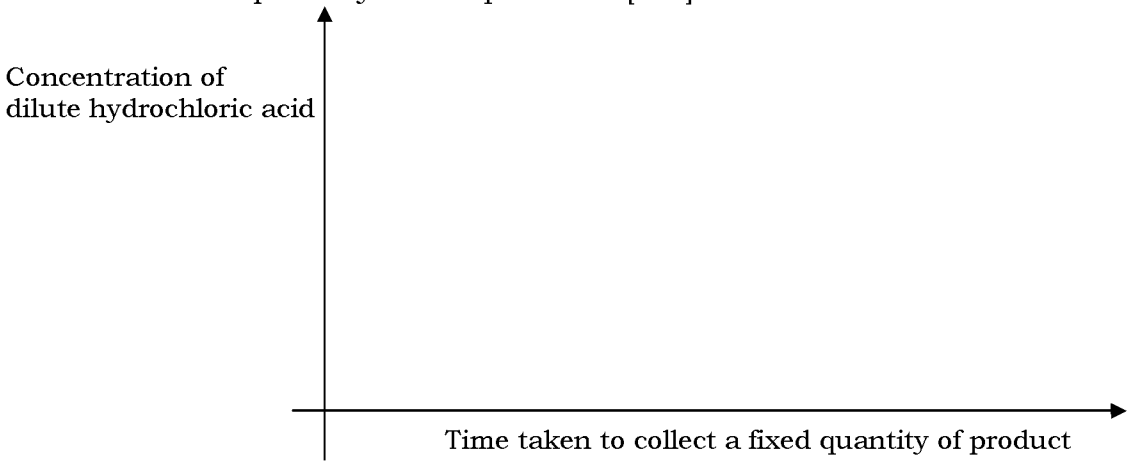
.....

(e) What is the conclusion for both experiments? [1M]

.....

.....

(f) Another experiment is carried out using excess calcium carbonate powder and dilute hydrochloric acid with different concentrations.
Sketch the curve of concentration of dilute hydrochloric acid against the time take to collect a fixed quantity of the product. [2M]



Essay {Paper02}

[MRSM10-07]

(*a*) Diagram 7 shows a graph of volume of gas against time for the reaction between excess magnesium carbonate and hydrochloric acid.

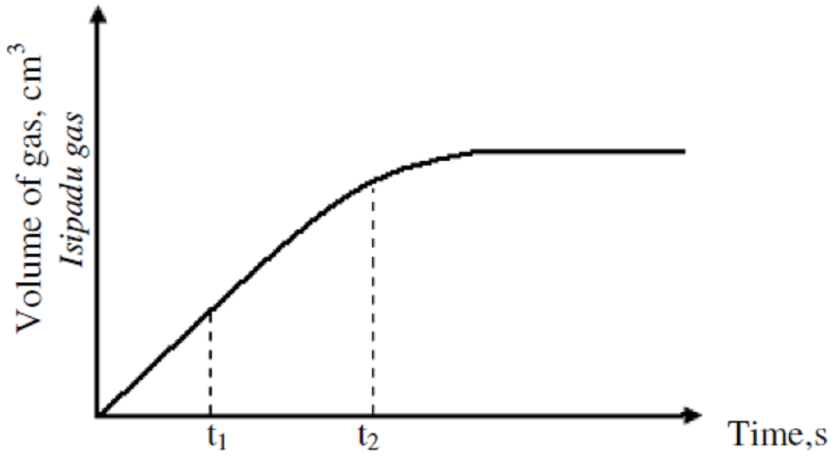


Diagram 7

Compare the rate of reaction at t1 and t2. Based on the graph, explain your answer. [3M]

(*b*) The following chemical equation shows the reaction between calcium carbonate and hydrochloric acid.

$$2\ HCl + CaCO_3 \rightarrow CaCl_2 + CO_2 + H_2O$$

Determine the mass of calcium carbonate needed in the reaction if 480 cm^3 of gas is released at room condition.
[The molar volume of gas at room condition: 24 dm3 mol-1, Relative atomic mass: C=12, O=16, Ca=40] [3M]

(*c*) Two experiments are carried out to study the effect of the size of calcium carbonate on the rate of reaction.

Experiment I : 1 g of calcium carbonate chips react with 20.0 cm^3 of 0.2 mol dm^{-3} hydrochloric acid.

Experiment II : 1 g of calcium carbonate powder react with 20.0 cm^3 of 0.2 mol dm^{-3} hydrochloric acid.

The volume of gas released is recorded in Table 7.1

	Time / s	0	60	120	180	240	300	360
Volume of gas/ cm^3	**Experiment I**	0.00	25.90	33.00	37.00	40.50	42.00	42.00
	Experiment II	0.00	28.00	36.50	41.00	42.00	42.00	42.00

Table 7.1

(i) Plot a graph of volume of gas against time for both experiments in the graph paper provided on page 28. [5M]

(ii) Based on the graph, determine the rate of reaction at 90 sec for Experiment I. [2M]

(*d*) Another set of experiment was carried out to study the effect of temperature on the rate of reaction between sodium thiosulphate solution and sulphuric acid as shown in Table 7.2

Experiment	**I**	**II**
Temperature of sodium Thiosulphate/°C	40	50

Table 7.2

(i) Write the ionic equation for the reaction. [2M]

(ii) Compare the rate of reaction between Experiment I and II by using Collision Theory. [5M]

----------oooOO aĎaŽ OOooo----------

[SPM10-08]

Three experiments, I, II and III are carried out to investigate the factors affecting the rate of reaction. Table 8 shows the reactants and the conditions of reaction involved.

Experiment	Reactants		Condition of reaction
I	Excess Zinc	50 cm^3 of 0.5 mol dm^{-3} hydrochloric acid	Room temperature
II	Excess Zinc	50 cm^3 of 0.5 mol dm^{-3} sulphuric acid	Room temperature
III	Excess Zinc	50 cm^3 of 0.5 mol dm^{-3} sulphuric acid	60 °C

Table 8

(a)(i) Referring to experiment I, II and III, state [3M]

- The meaning of rate of reaction
- Two factors that affect the rate of reaction.

(ii) Write a balanced chemical equation for the reaction in experiment I. [2M]

(b) Calculate the total volume of hydrogen gas released in experiment I. [3M]
[Molar gas volume at room conditions is 24 dm^3]

(c) Diagram 8 shows the results of experiments I, II and III.

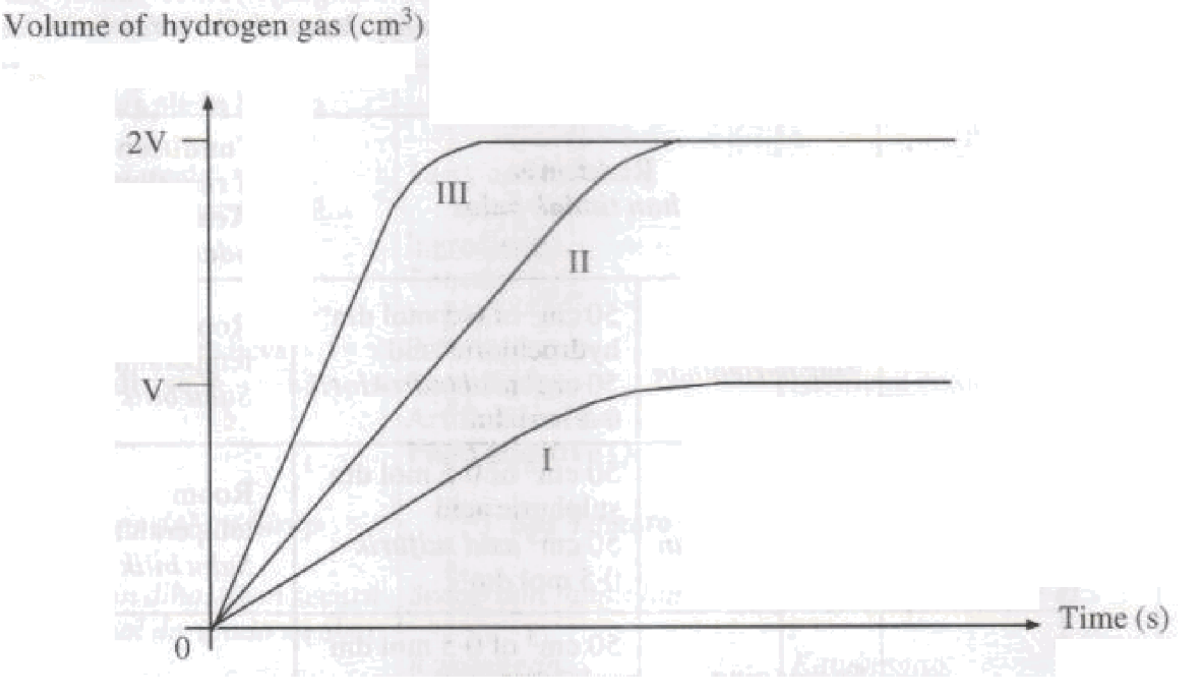


Diagram 8

Based on graph,

(i) Compare the rate of reaction between experiment I and experiment II. [5M]

(ii) Suggest one way to obtain curve III without changing the zinc, acid or temperature in experiment II. [5M]

(iii) Explain why the total volume of hydrogen gas released in experiment II is doubled that of experiment I. [2M]

----------oooOO aĎaŽ OOooo----------

[SBPTrial2010-10]

A student carried out three experiments to investigate the factors affecting the rate of reaction. Table 10 shows the results of the experiments. The reaction between sodium thiosulphate and hydrochloric acid produced sodium chloride, sulphur, sulphur dioxide and water.

Experiment	**Reactants**	**Temperature/ °C**	**Time taken for mark 'X' disappears from sight/s**
I	50 cm^3 of 0.2 $moldm^{-3}$ sodium thiosulphate solution + 5 cm^3 of 1 $moldm^{-3}$ hydrochloric acid	30.0	18.0

II	50 cm^3 of 0.2 $moldm^{-3}$ sodium thiosulphate solution + 5 cm^3 of 1 $moldm^{-3}$ hydrochloric acid	40.0	11.0
III	50 cm^3 of 0.2 mol dm^{-3} sodium thiosulphate solution + 5 cm^3 of 2 mol dm^{-3} hydrochloric acid	40.0	2.0

Table 10

(a) (i) Based on Table 10, [5M]

- arrange the rate of reaction for experiments I, II and III in ascending order.
- state the factor that affect the rate of reaction between
  - Experiment I and Experiment III
  - Experiment II and Experiment III
- write the chemical reaction for Experiment III

(ii) Explain using collision theory the difference in the rate of reaction between Experiment II and Experiment III. [5M]

(b) Referring to Table 10, describe a laboratory experiment using one of the factor that affecting the rate of reaction between sodium thiosulphate solution and hydrochloric acid. In your description, include an experiment procedure, observation and an ionic equation. [10M]

----------oooOO aĎaŽ OOooo----------

[MRSM03-08]

Time (sec)	0	60	120	180	240	300	360	420
Volume of gas (cm^3)	0.0	5.0	9.5	13.0	16.5	18.5	19.0	19.0

Table 5

Table 5 shows the data obtained when 2.0 g of calcium carbonate granules were added to 20.0 cm^3 of 0.1 mol dm^{-3} aqueous hydrochloric acid in a conical flask.

(a) Based on table 5, plot a graph of volume of gas produced against time. [4M]

(b) From graph, determine
(i) The average rate of reaction during the second of the 60 seconds intervals. [2M]

(ii) The rate of reaction at 210 seconds. [2M]

(ii) The average rate of reaction for the whole experiment. [2M]

(c) Using the Collision Theory, explain how temperature and size of particles affect the rate of reaction. [8M]

(d) Explain why potatoes fried in hot oil cooks faster than potatoes boiled in hot water. [2M]

----------oooOO aĎaŽ OOooo----------

[SPM05-07]

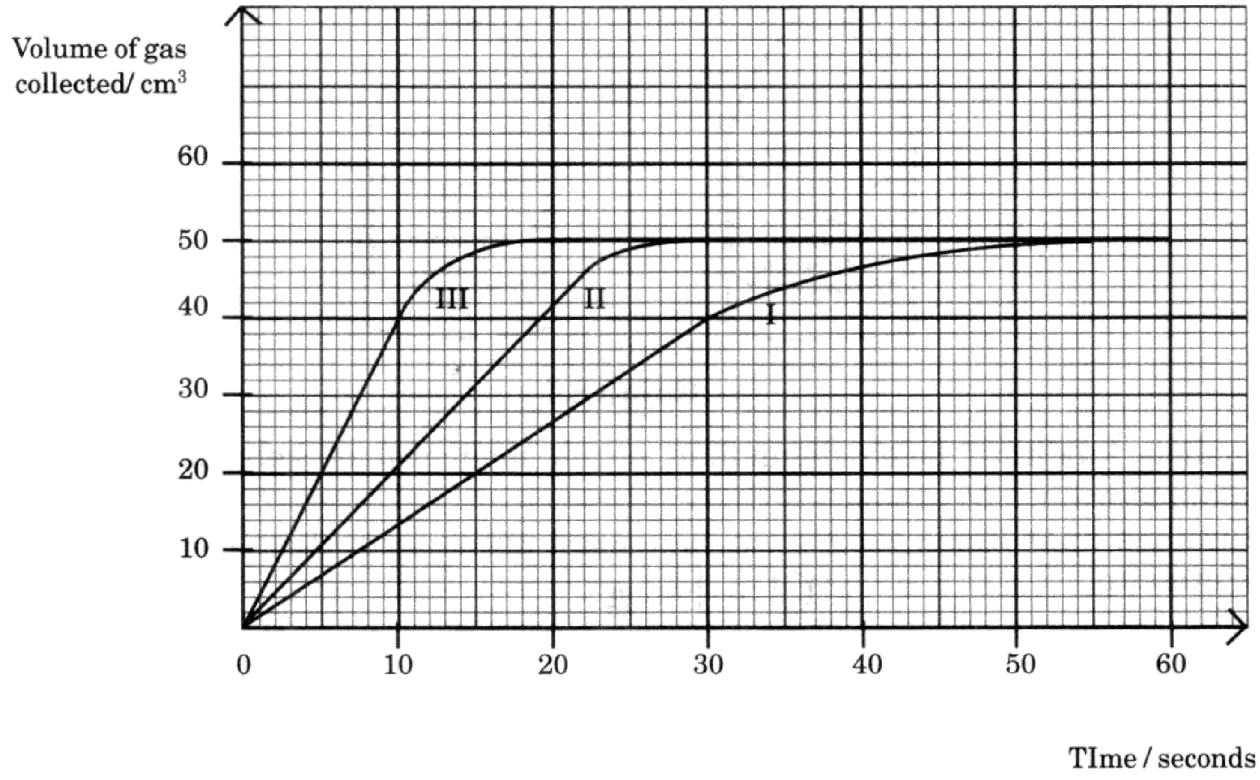
(a) Food stored in a refrigerator lasts longer than food stored in a kitchen cabinet. Explain why. [4M]

(b) A group of pupils carried out three experiments to investigate the factors affecting the rate of a reaction.
Table 7 shows information about the reactants and the temperature used in each experiment.

Experiment	**Reactants**	**Temperature /^{o}C**
I	Excess calcium carbonate chips and 30cm^3 of 0.5mol dm^{-3} hydrochloric acid	30
II	Excess calcium carbonate chips and 30cm^3 of 0.5mol dm^{-3} hydrochloric acid	40
III	Excess calcium carbonate powder and 30cm^3 of 0.5mol dm^{-3} hydrochloric acid	40

Table 7

Graph 7 shows the results of these experiments.



(i) Calculate the average rate of reaction for Experiment I. [2M]

(ii) Based on Table 7 and Graph 7, compare the rate of reaction between:

- Experiment I and Experiment II
- Experiment II and Experiment III

In each case explain the difference in rate of reaction with reference to the collision theory. [4M]

(iii) The chemical equation below shows the reaction between calcium carbonate and hydrochloric acid.

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$$

Given that the relative atomic mass of C=12, O=16, Ca=40 and the molar volume of any gas is 24 dm^3 mol^{-1} at room temperature and pressure.
Calculate the maximum volume of carbon dioxide gas produced in Experiment II. [4M]

----------oooOO aĎaŽ OOooo----------

[SPM03-07]

The rate of reaction is affected by several factors. One of the factors is the size of particles.

One kilogramme of meat, cut into big pieces, takes a longer time to cook compared to one kilogramme of meat cut into small pieces

(a) Explain the above statement based on the size of the particles. [2M]

(b) A student carried out three experiments to investigate the effects of the factors influencing the rate of reaction. Table I shows the results of the experiments.

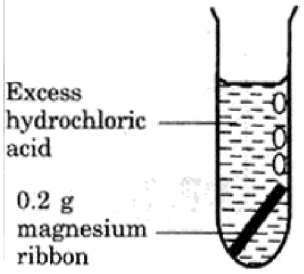
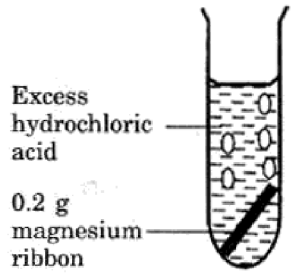
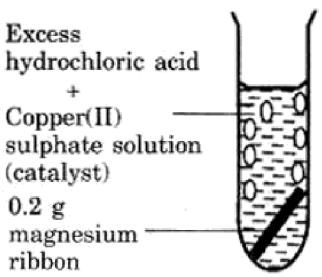
Experiment	I	II	III
Setup of apparatus			
Temperature/°C	30	40	40
Time taken for all the magnesium to dissolve	50	20	15

Table 1

(i) Write the chemical reaction equation for the reaction between magnesium and hydrochloric acid. Calculate the maximum volume of hydrogen gas produced. [4M]
[Relative atomic mass: Mg=24, molar gas volume=24 dm^3 mol^{-1} at room condition]

(ii) Sketch the graphs for the volume of hydrogen gas against time for experiment I, II and III on the same axis. [3M]

(iii) Calculate the average rate of reaction for experiment I and experiment II and between experiment II and experiment III.

With reference to collision theory, explain why there are differences in the rates of reaction in the experiments. [8M]

----------oooOO aĎaŽ OOooo----------

[SPM07-10]

Table 10 shows the data from experiment I and experiment II that were carried out to study the rate of reaction of zinc with two acids, P and Q.

Experiment	Reactants	Products	Observation
I	2.6 g of zinc and 50 cm^3 of acid P 2.0 mol dm^{-3}	Zinc chloride and hydrogen gas	The temperature of the mixture increases
II	2.6 g of zinc and 50 cm^3 of acid Q 2.0 mol dm^{-3}	Zinc sulphate and hydrogen gas	The temperature of the mixture increases

(a)(i) by choosing either experiment I or experiment II, state the name of the acid used. write the chemical equation for the reaction of this acid with zinc. [2M]

(ii) Draw an energy profile diagram for the reaction in 10(a)(i). On the energy profile diagram, show the: [10M]

- Heat of reaction, ΔH
- Activation energy without a catalyst, E_a
- Activation energy without a catalyst, E_a'
- Explain the energy profile diagram.

(b) The graph in diagram 10 shows the results of experiment I and experiment II.

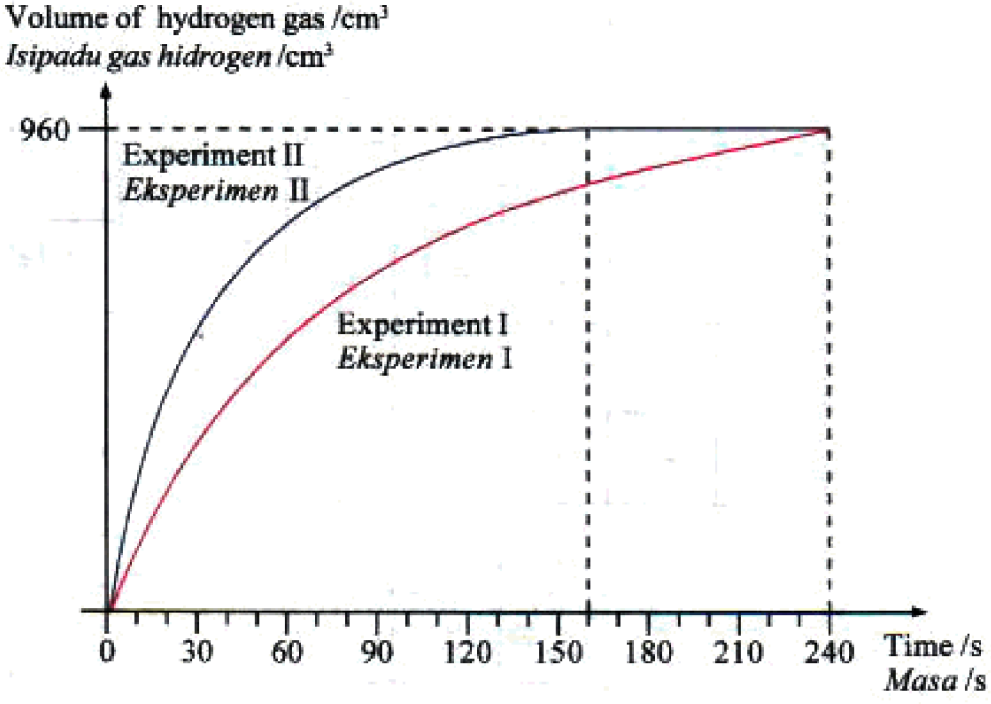


Diagram 10

Based on graph:

(i) Calculate the average rate of reaction for either experiment I or experiment II. [2M]
(ii) Explain the difference in the rate of reaction between experiment I and experiment II before 60s.

----------oooOO aĎaŽ OOooo----------

[SBPmidyearF507-07]

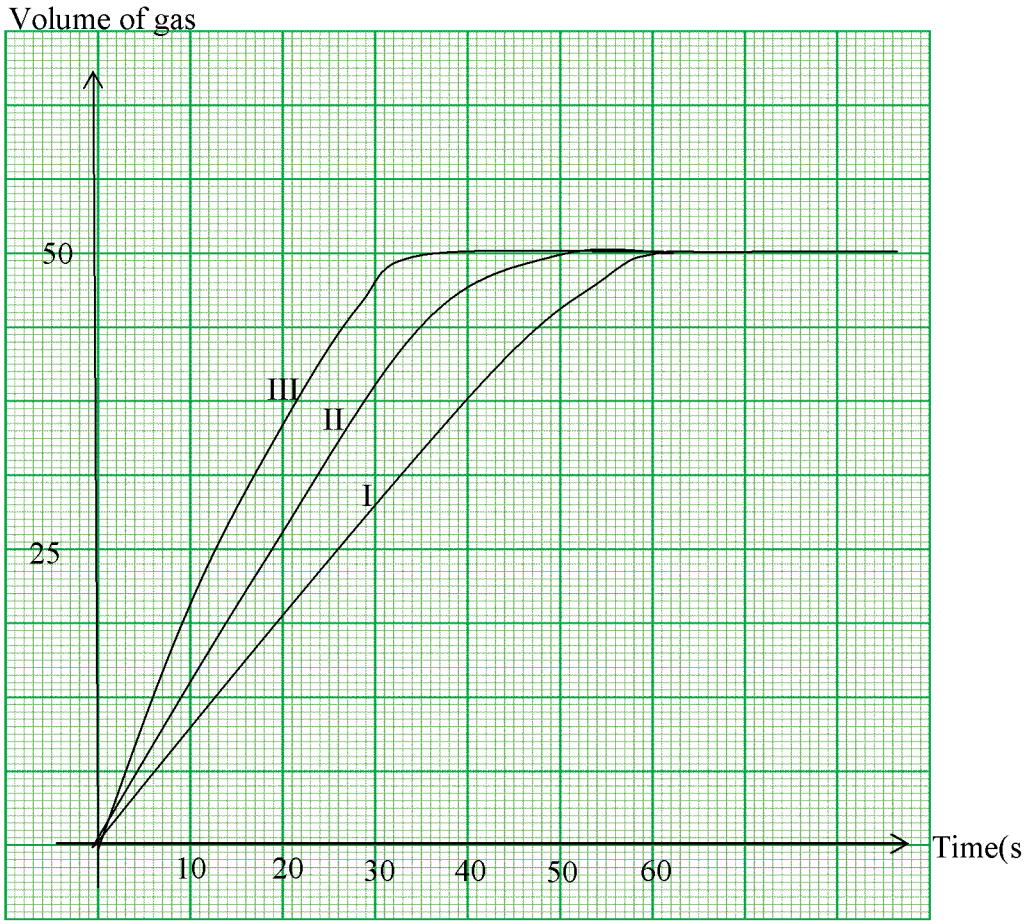
(a) Fried rice stored in a refrigerator lasts longer than fried rice stored in a kitchen cabinet. Explain why. [4M]

(b) A group of pupils carried out three experiments to investigate the factors affecting the rate of a reaction. Table 7 shows information about the reactants and the temperature used in each experiment.

Experiment	Reactants	Temperature/°C
I	Excess zinc granules and 25 cm^3 of 0.5 mol dm^{-3} hydrochloric acid	30
II	Excess zinc granules and 25 cm^3 of 0.5 mol dm^{-3} hydrochloric acid	40
III	Excess zinc powder and 25cm^3 of 0.5 mol dm^{-3} hydrochloric acid	40

TABLE 7

The graph shows the result of these experiments.



(i) Calculate the average rate of reaction for Experiment I. [2M]

(ii) Based on the table and graph, compare the rate of reaction between:

- Experiment I and II
- Experiment II and III

In each case, explain the difference in rate of reaction with reference to the collision theory. [10M]

(iii) The chemical equation below shows the reaction between zinc and hydrochloric acid.

$$Zn + 2HC1 \longrightarrow ZnC1_2 + H_2$$

Calculate the maximum volume of hydrogen gas produced in Experiment III. [4M]
[Relative atomic mass of Zn=65, the molar volume of any gas is 24 dm^3 mol^{-1} at room conditions.]

----------oooOO aĎaŽ OOooo----------

[SBPtrial05-04a,b]

(a) What mean by the catalyst? Give the one example of the using of catalyst reaction. [2M]

(b) Based on the collision theory, explain how the factors below influence the rate of reaction: [8M]

(i) size of substance
(ii) concentration

----------oooOO aĎaŽ OOooo----------

[SBPtrial07-10]

(a)(i) What is a catalyst?
(ii) State two characteristics of a catalyst.
(iii) Name one chemical process and the catalyst used in industry.
[4M]

(b) State two factors other than catalyst which can affect the rate of reaction.
Based on collision theory, explain how the factors that you mentioned can affect the rate of reaction. [8M]

(c) Knowledge about the factors that affect the rate of reaction is very useful in human life. State two activities at home and explain how the knowledge about the factors that affect the rate of reaction is applied in the activities mentioned. [8M]

----------oooOO aĎaŽ OOooo----------

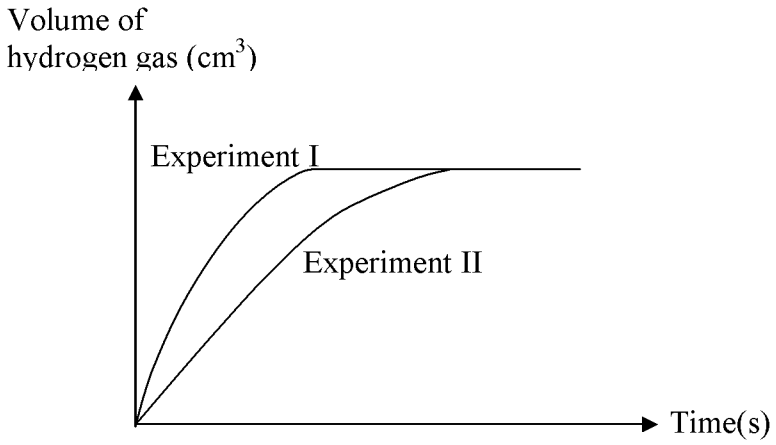
[SBPtrial09-09]

(a) The knowledge of factors affecting the rate of reaction is applied in Haber Process.

(i) Write a chemical equation to represent the formation of ammonia gas in Haber Process. [1M]

(ii) Describe three methods that can increase the rate of reaction to produce ammonia gas. [3M]

(b) Graph 9 shows the results of Experiment I and Experiment II to investigate the factor of catalyst in the reaction of zinc and hydrochloric acid.



(i) Which experiment used catalyst? State the name of the catalyst used. [2M]

(ii) The reaction between zinc and hydrochloric acid releases energy.
Draw an energy profile diagram for both reactions in Experiment I and Experiment II. Label E_a for the activation energy without a catalyst and E'_a for the activation energy with a catalyst. [4M]

(iii) Explain the difference in the rate of reaction between Experiment I and Experiment II based on the collision theory. [4M]

(c) Table 9 shows three experiments that were carried out to investigate the effect of concentration on the rate of reaction.

Experiment	**Reactants**
I	Excess of calcium carbonate powder + 40 cm^3 of 0.5 mol dm^{-3} hydrochloric acid.
II	Excess of calcium carbonate powder + 20 cm^3 of 1.0 mol dm^{-3} hydrochloric acid.
III	Excess of calcium carbonate powder + 20 cm^3 of 1.0 mol dm^{-3} sulphuric acid.

Table 9

Sketch a graph to show the volume of carbon dioxide gas released against time taken for the three experiments on the same axis. [3M]

Compare the volume of gas released between Experiment I and II and between Experiment II and III. Explain why. [3M]

[MRSM09-08]

(*a*) A student carried out an experiment to investigate the effect of catalyst on the rate of reaction.

Diagram 8 shows the decomposition of hydrogen peroxide in the presence of manganese(IV) oxide.

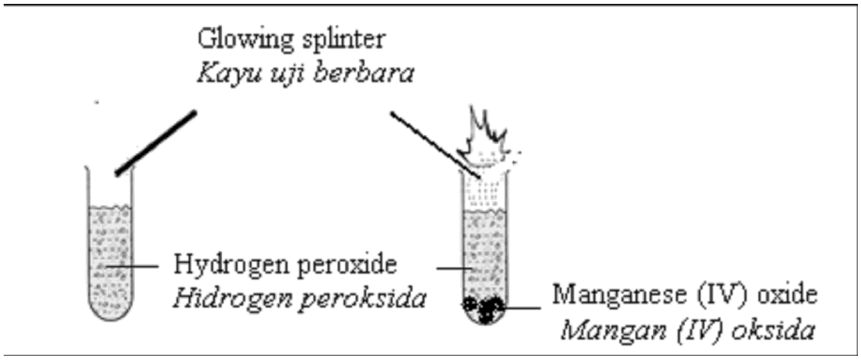


Diagram 8

Using Collision Theory, explain the effect of manganese(IV) oxide on the decomposition of hydrogen peroxide. [5M]

(*b*) A student carried out two experiments to determine the time taken to collect a maximum volume of 50 cm3 of gas. Table 8 shows the result of the experiments.

Experiment	**Reactant**	**Time/s**
I	50 cm^3 of 1-volume hydrogen peroxide solution and 1 g manganese(IV) oxide	40
II	25 cm^3 of 2-volume hydrogen peroxide solution and 1 g manganese(IV) oxide	20

Table 8

(i) Draw a labelled diagram of the apparatus set up for the experiment. [2M]

(ii) Sketch the graph for the gas liberated against time for Experiment I and Experiment II on the same axes. [2M]

(iii) Calculate the average rate of reaction for both experiments. [2M]

(iv) Compare the rate of reaction between Experiment I and Experiment II. Explain the differences based on Collision Theory. [5M]

(v) Calculate the concentration in mol dm-3 hydrogen peroxide used in Experiment I in order to produce 50 cm3 of oxygen. [4M]
[Molar volume of gas = 24 dm3 mol-1 at room conditions]

----------oooOO aĎaŽ OOooo----------

Structure {Paper03}

[SPM09-02]

A student carried out an experiment to investigate the rate of reaction between marble chips and hydrochloric acid.

Table 2 shows the data obtained from the experiment

Times(s)	Burette reading (cm^3)	Volume of gas evolved (cm^3)
0	50.00	0.00
30	38.00	12.00
60	30.50	19.50
90	----------	----------
120	----------	----------
130	19.50	30.50
180	18.50	31.50
210	18.00	32.00
240	18.00	32.00

Table 2

Diagram 2 shows the burette reading at 90 seconds and 120 seconds

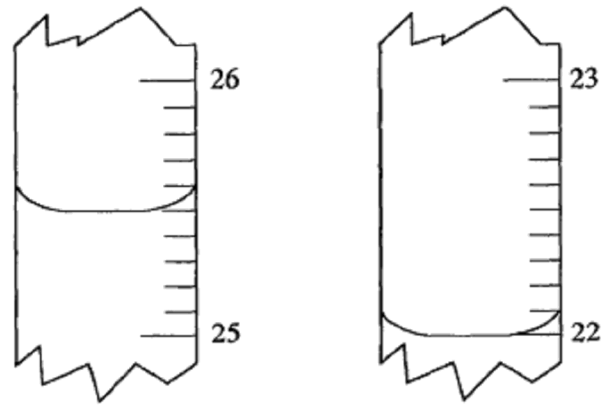


Diagram 2

(a) Based on Diagram 2, record the burette reading and volume of gas evolved at 90 seconds and 120 seconds in table 2.

(b) Based on table 2, state how the volume of gas evolved changes when the marble chips react with hydrochloric acid. [3M]

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(c) Based on this experiment, what is the meaning of the rate of reaction? [3M]

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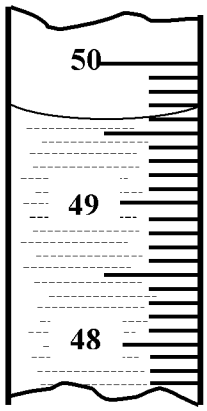
[SBPTrial07-01]

An experiment was carried out to investigate the effect of the size of the marble chips on the rate of reaction. A burette was filled with water and inverted in a basin containing water. The initial burette reading was recorded.

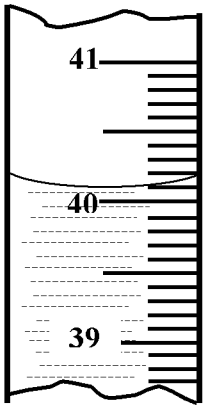
5.0 g of large marble chips were placed in a conical flask. 50 cm^3 of 0.1 mol dm^{-3} hydrochloric acid, HCl was added into a conical flask. The conical flask was closed with a stopper fitted with a delivery tube directed to the burette and the stop-watch was started simultaneously. The burette reading was recorded at 30-seconds intervals.

Experiment was repeated by using 5.0 g of small marble chips.
Diagrams below show the burette readings for the experiment between large marble chips with hydrochloric acid.

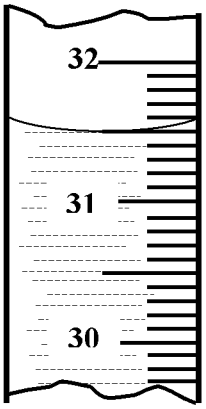
(a) Record the volume of carbon dioxide gas in the spaces provided. [3M]



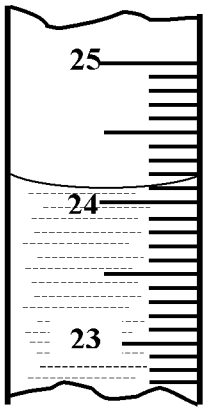
Burette reading
..... cm^3 at 0 min



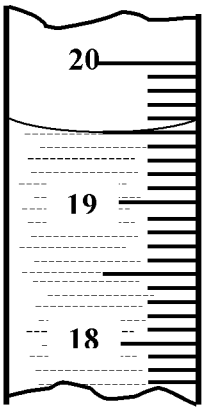
Burette reading
..... cm^3 at ½ min



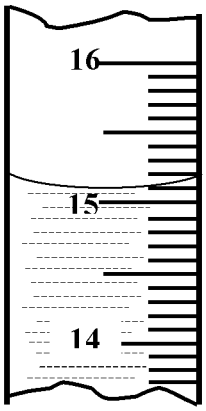
Burette reading
..... cm^3 at 1 min



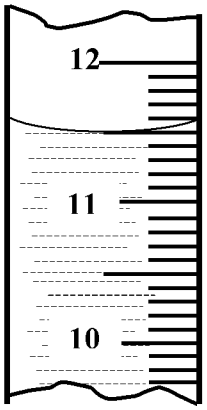
Burette reading
..... cm^3 at 1½ min



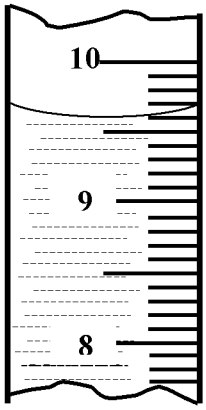
Burette reading
..... cm^3 at 2 min



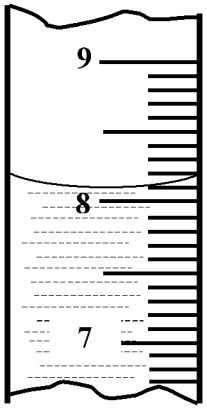
Burette reading
..... cm^3 at 2½ min



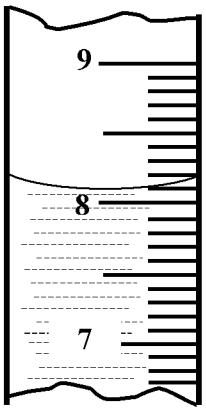
Burette reading
..... cm^3 at 3 min



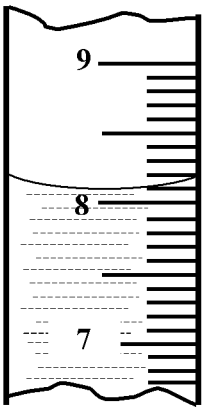
Burette reading
..... cm^3 at 3½ min



Burette reading
..... cm^3 at 4 min



Burette reading
..... cm^3 at 4½ min



Burette reading
..... cm^3 at 5 min

(b) Construct a table showing the changes of time, burette readings and volumes of carbon dioxide gas liberated for the experiment. [3M]

(c) Table 1 shows the volume of carbon dioxide gas liberated when the experiment was repeated by using 5.0 g of small marble chips.

Time /min	0	½	1	1 ½	2	2 ½	3	3 ½	4
Volume of carbon dioxide / cm^3	0.00	20.00	29.00	35.00	38.00	40.00	41.50	41.50	41.50

Table 1

Based on the data in (b) and Table 1, draw the graphs volume of carbon dioxide gas liberated against time for both experiments on the same axes.
[3M]

(d) State the relationship between the size of marble chips and the rate of reaction? [3M]

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(e) Meat which is cut into small pieces takes a shorter time to cook compared to meat that is cut into big pieces. Explain why? [3M]

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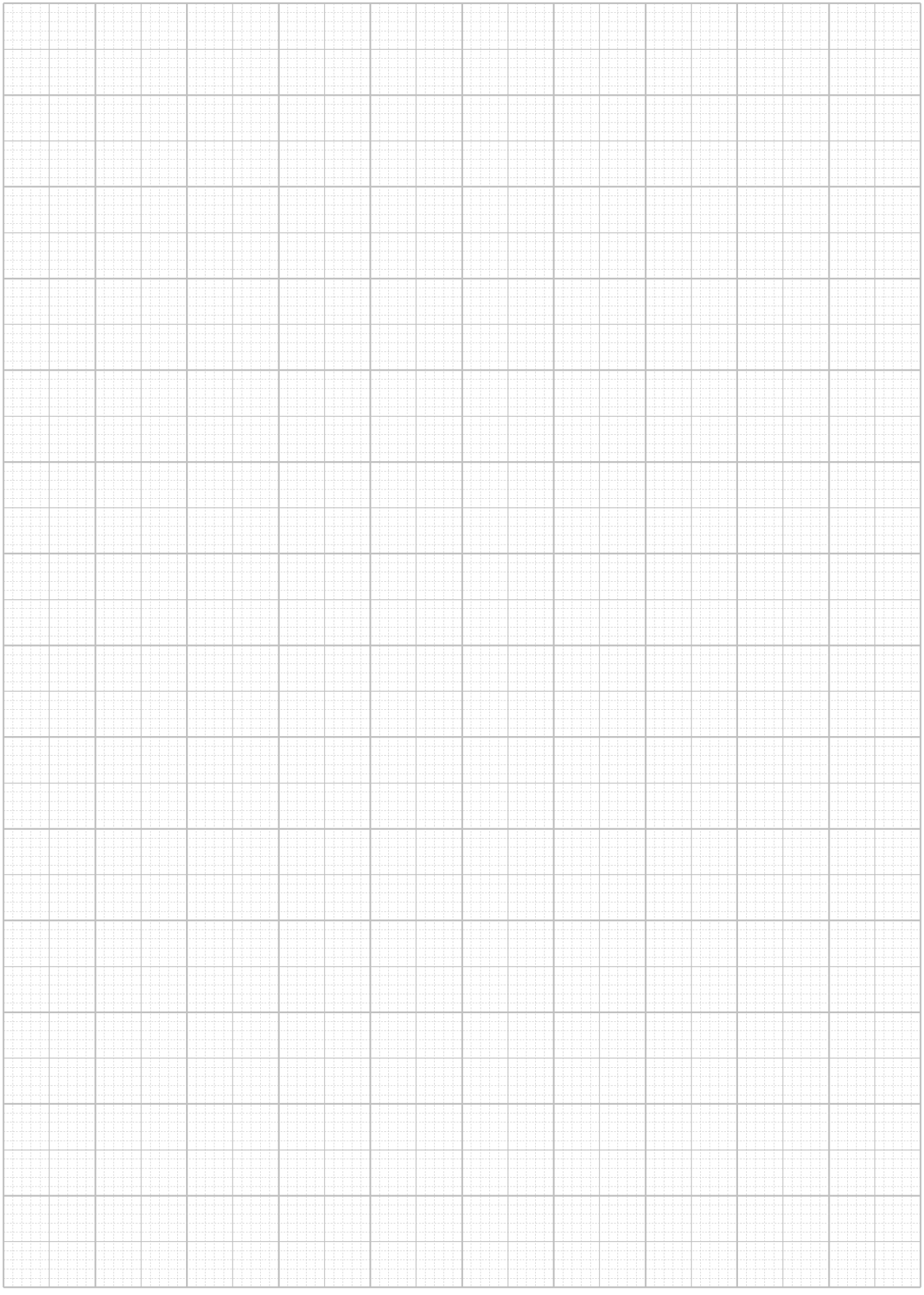

(e) Complete the table below based on the experiment. [3M]

Name of variables	**Action to be taken**
(i) Manipulated variable	(i) The way to manipulate variable ....
(ii) Responding variable	(ii) What to observe in the responding variable ....
(iii) Fixed variable	(iii) The way to maintain the fixed Variable ....

[SBPtrial04-01] {Translate}

The student does the two experiments to study the effect of size particles on the rate of reaction.

Experiment I : 50 cm^3 0.2 mol dm^{-3} hydrochloric acid was added into of 6.0 g granule of marble.
Experiment II : 50 cm^3 0.2 mol dm^{-3} hydrochloric acid was added into of 6.0 g powder of marble.

The total gas released was recorded interval 30 seconds. Table below show the observations was make by the student.

Time/s / Volume of gas/cm^3	0	30	60	90	120	150	180	210	240	270	300
Experiment I	0	12	23	32	40	48	56	61	68	74	78
Experiment II	0	22	40	56	68	77	84	89	93	95	98

(a) State the suitable hypothesis for this experiment. [3M]

.....

.....

(b) List all the variables in this experiment: [3M]

(i) Manipulated variable : .....

(ii) Responding variable : .....

(iii) Constant variable : .....

(c) With the same axis, draw a graph for volume of gas versus time for Experiment I and Experiment II at graph paper given. [3M]

(d) (i) Determine the rate of reaction at 120 second for Experiment I and Experiment II [Show at the graph how the rate was determine]

Experiment I	**Experiment II**

(ii) Based on graph at (c), what is the relationship between the size of particles with the rate of reaction? [3M]

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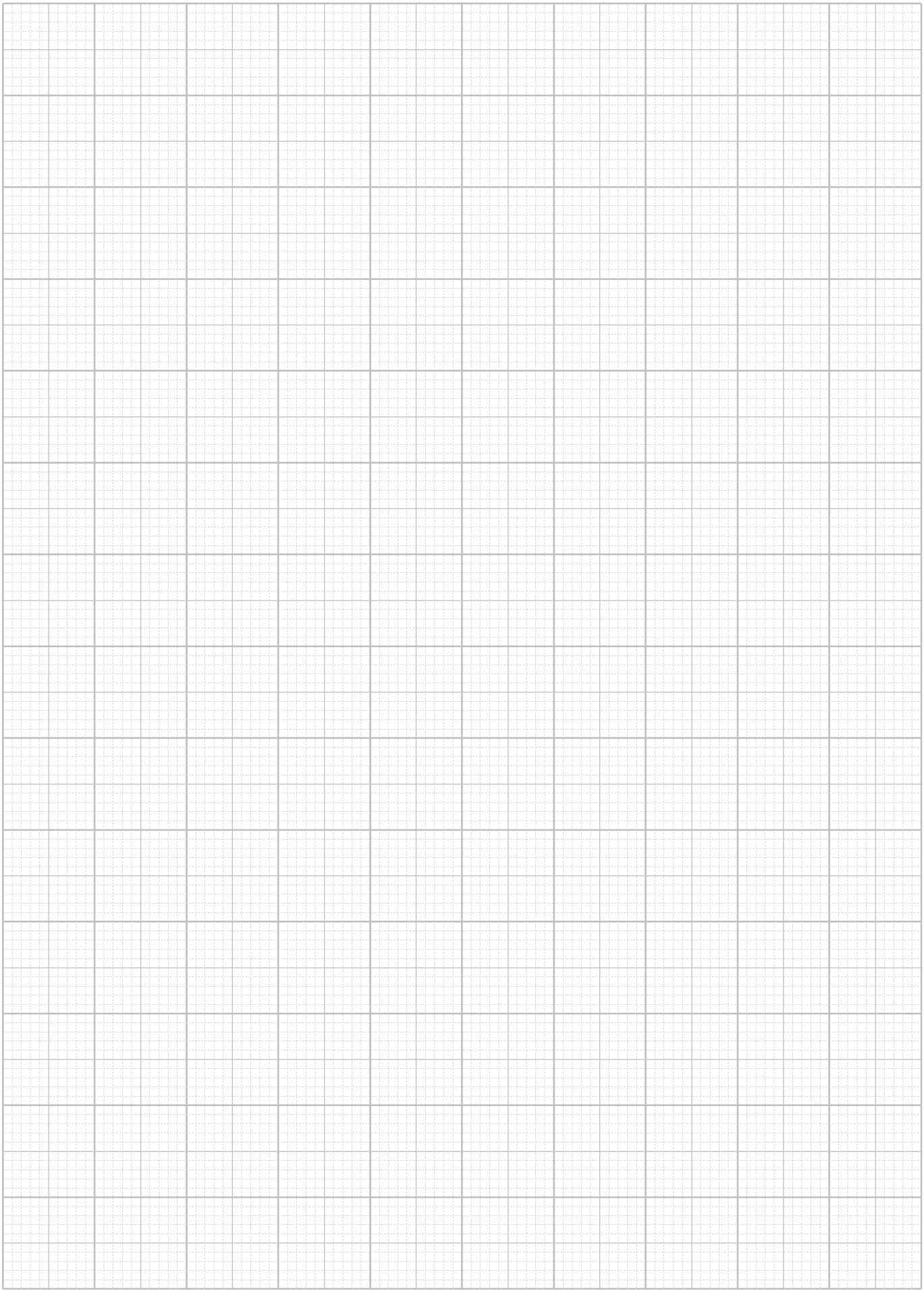

(e) **A group of scout was collected big size of wood for campfire.**

With your chemistry knowledge, state the relationship between the size of particle with rate of wood combustion. [3M]

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[SPM11-01]

Diagram 1.1, 1.2 and 1.3 shows the apparatus set-up for Set I, Set II, Set III and Set IV for an experiment to investigate the effect of concentration on the rate of reaction between sodium thiosulphate solution and hydrochloric acid. In each of the experiment, the size of the conical flask used in 250 cm^3.

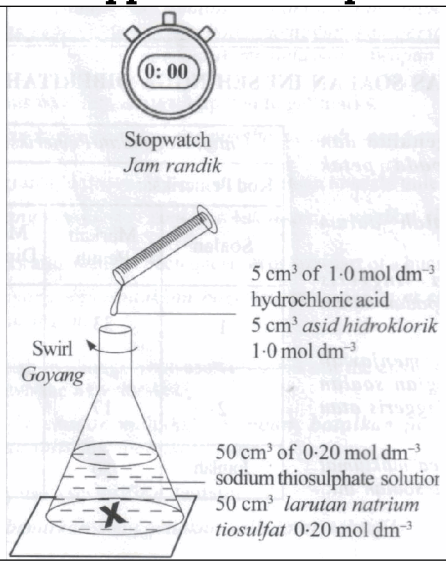
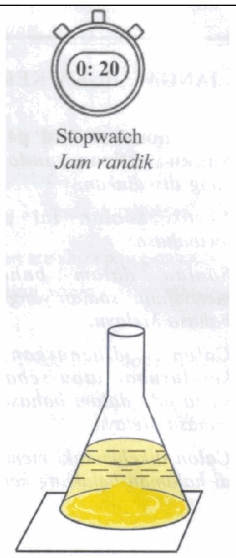
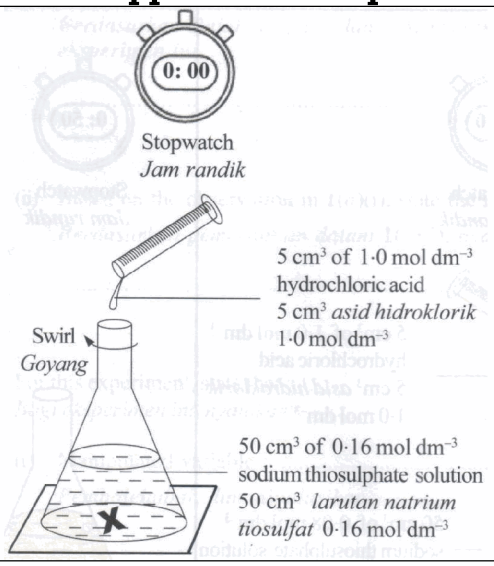
Set	Apparatus set-up	Observation
I		

Diagram 1.1

Set	Apparatus set-up	Observation
II		

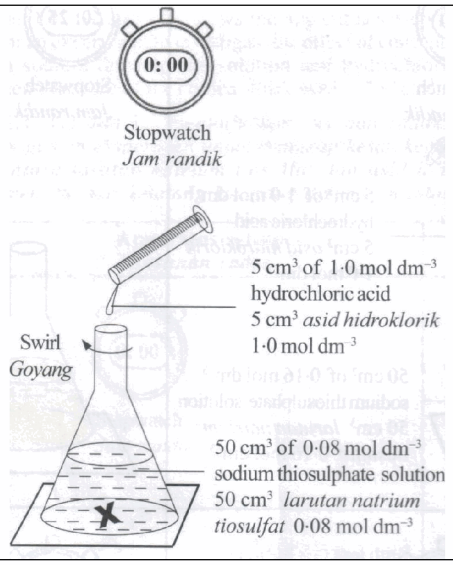
III		

Diagram 1.2

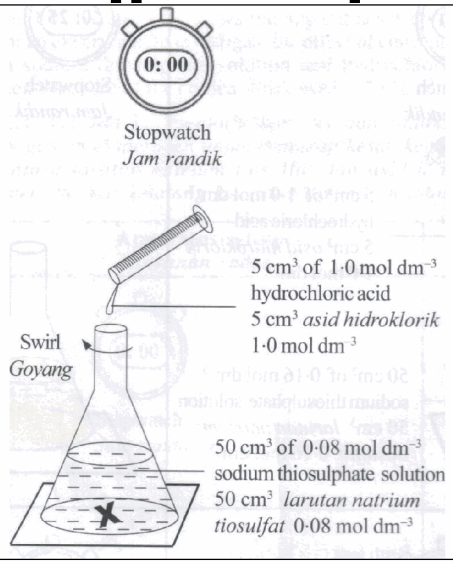
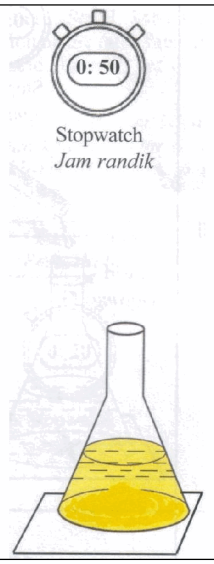
Set	Apparatus set-up	Observation
IV		

Diagram 1.3

1(a)(i) Based on Diagrams 1.1, 1.2 and 1.3, state **one** observation in this experiment. [3M]

.....

(ii) Based on the observation in 1(a)(i), state the inference. [3M]

.....

(b) For this experiment, state [3M]

(i) Manipulated variable : .....

(ii) Responding variable : .....

(iii) Constant variable : .....

(c) State **one** hypothesis for this experiment. [3M]

.....

(d) State the operational definition for the rate of reaction in this experiment. [3M]

.....

.....

(e)(i) Based on Diagrams 1.1, 1.2 and 1.3, complete Table 1.1.

Set	I	II	III	IV
Concentration of sodium thiosulphate solution ($moldm^{-3}$)	0.20	0.16	0.12	0.08
Time (s)	20			
$\frac{1}{time}$ (s^{-1})	0.05			

Table 1.1

(ii) Based on Table 1.1, plot a graph of concentration of sodium thiosulphate solution against 1/time. [3M]

(f) Based on the graph in 1(e)(ii),

(i) state the relationship between the concentration of sodium thiosulphate solution and the rate of reaction

.....

.....

(ii) Predict the time taken for the mark "X" to disappear from sight if the experiment is carried out using 0.22 mol dm^{-3} of sodium thiosulphate solution.

Show on the graph how you determine the time taken. [3M]

Time : .....s

(g) The experiment for the Set I is repeated by replacing the 250 cm^3 conical flask with a smaller conical flask.
The time taken for the mark "X" to disappear from the sight is less than 20 seconds. Explain why. [3M]

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(h) Classify the ions present in Set II by completing Table 1.2. [3M]

Anions	Cations

[SBPtrial06-02] {Translate}

A student has done one experiment to study effect of concentration of reaction between sodium thiosulphate with 1.0 ml dm^{-3} sulphuric acid.

The experiment was done by mixing the sodium thiosulphate solution and sulphuric acid solution into 250 cm^3 conical flask and was put on 'X' marks in white paper as show at diagram 2. At the same time, stopwatch was started. The time was taken when the 'X' marks was disappear.

The experiment was done for five time by used the different concentration of sodium thiosulphate, while the other was same.

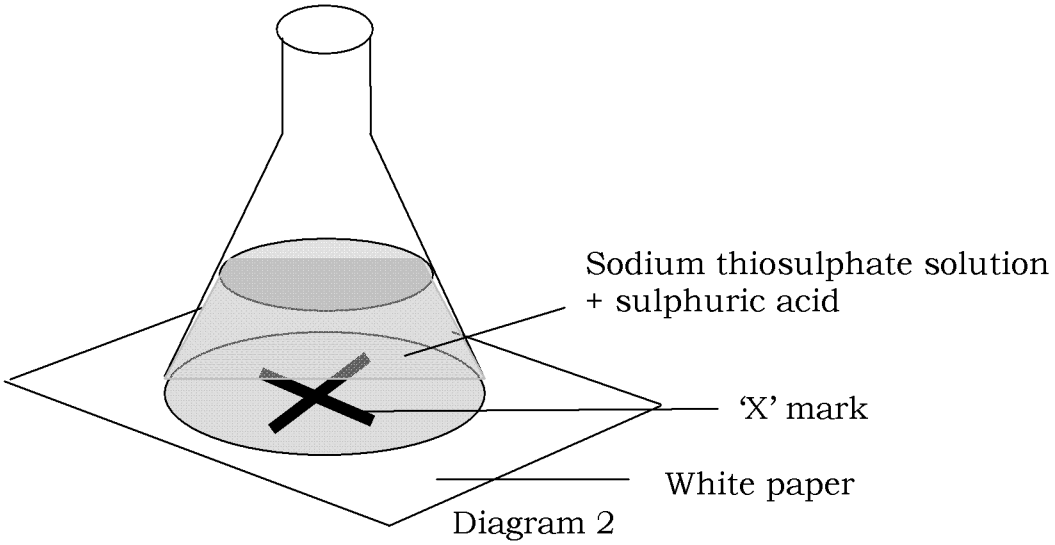


Diagram 2

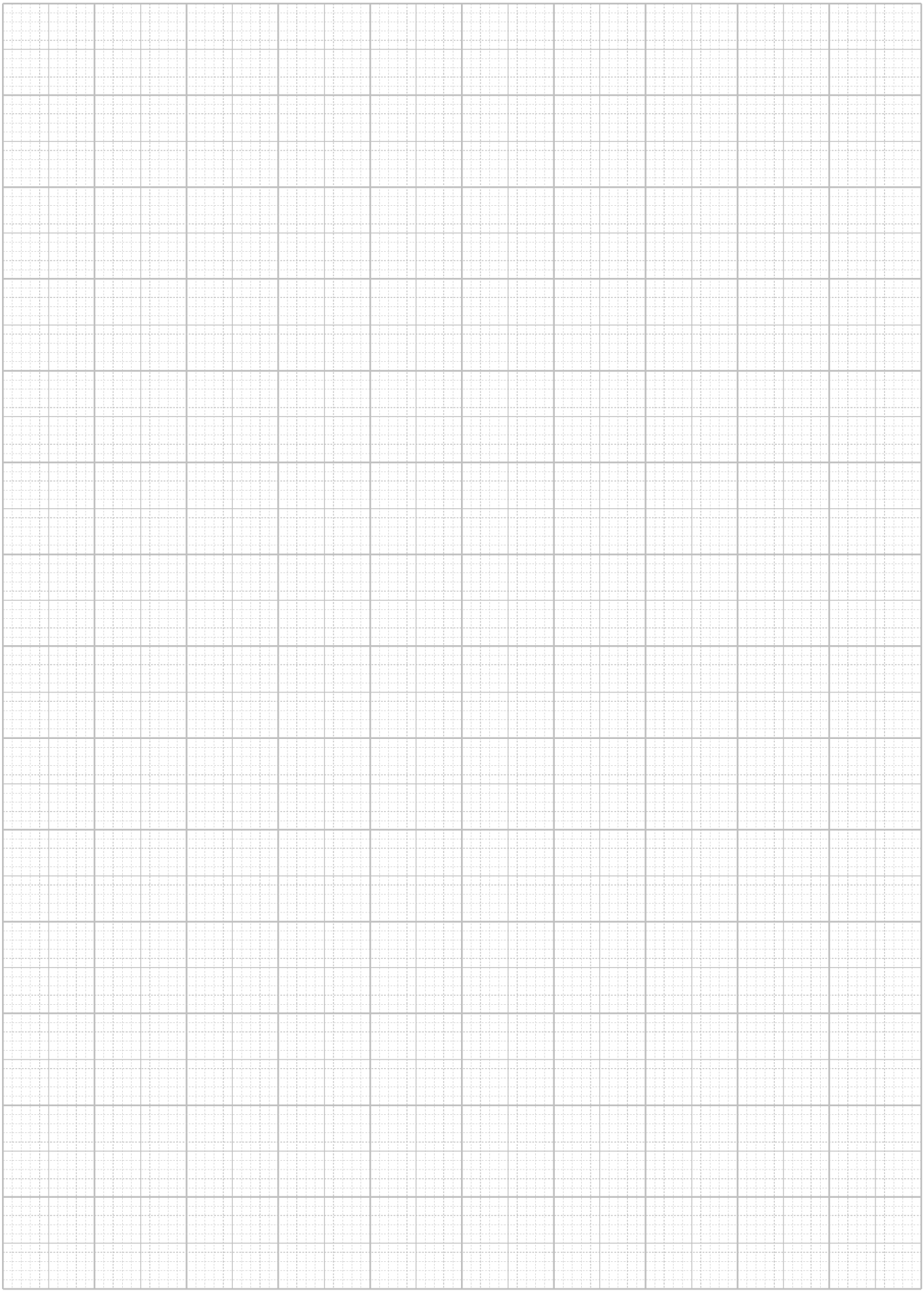
Table 2.1 show the result of the experiment.

Experiment	**Concentration of Sodium thiosulphate/mol dm^{-3}**	**Time/s**	**1/time (s^{-1})**
1	0.20	20	
2	0.16	25	
3	0.12	36	
4	0.08	50	
5	0.04	95	

Table 2.1

(a) (i) Complete the table 2.1 above.

(ii) Draw a graph for concentration sodium thiosulphate versus 1/time at graph paper given. [3M]



(b) Based on the graph at (a)(i), state the relationship between the rate of reaction with concentration of reactant. [3M]

.....

.....

.....

(c) State all the variables involve in the experiment. [3M]

Manipulated variable : .....

Responding variable : .....

Constant variable : .....

(d) State the hypothesis for this experiment. [3M]

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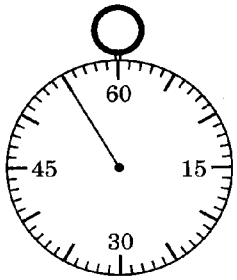
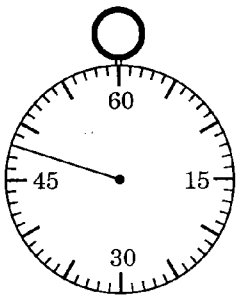
[SBPmidyearF508-01]

An experiment was conducted to find out the effect of temperature on the rate of reaction. 50 cm^3 of sodium thiosulphate solution 0.2 mol dm^{-3} at 30 °C was put into a 150 cm^3 conical flask. Then the conical flask was placed on an "X" sign on a piece of white paper. 5 cm^3 of sulphuric acid 1.0 mol dm^{-3} was added to the sodium thiosulphate solution and shaken. At the same time, the stop watch was started. The stop watch was stopped as soon as the "X" sign was no longer visible. The same steps of the experiment were repeated for sodium thiosulphate solution which was heated to 35 °C, 40 °C, 45 °C and 50 °C.

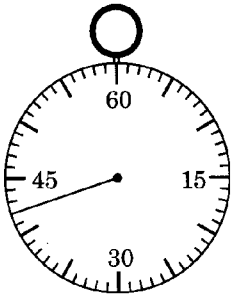
Diagram 1 shows the reading of the stop watch for each of the reaction at different temperatures.



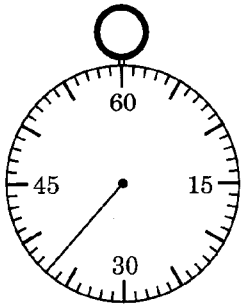
Time, t_1 ..... at 30 °C



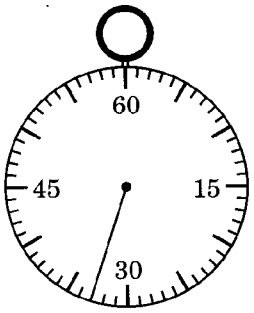
Time, t_2 ..... at 35 °C



Time, t_3 ..... at 40 °C



Time, t_4 ..... at 45 °C



Time, t_5 ..... at 50 °C

Diagram 1

(a) Record the time for each reaction in the spaces provided in Diagram 1. [3M]

(b) State one observation in this experiment. [3M]

.....

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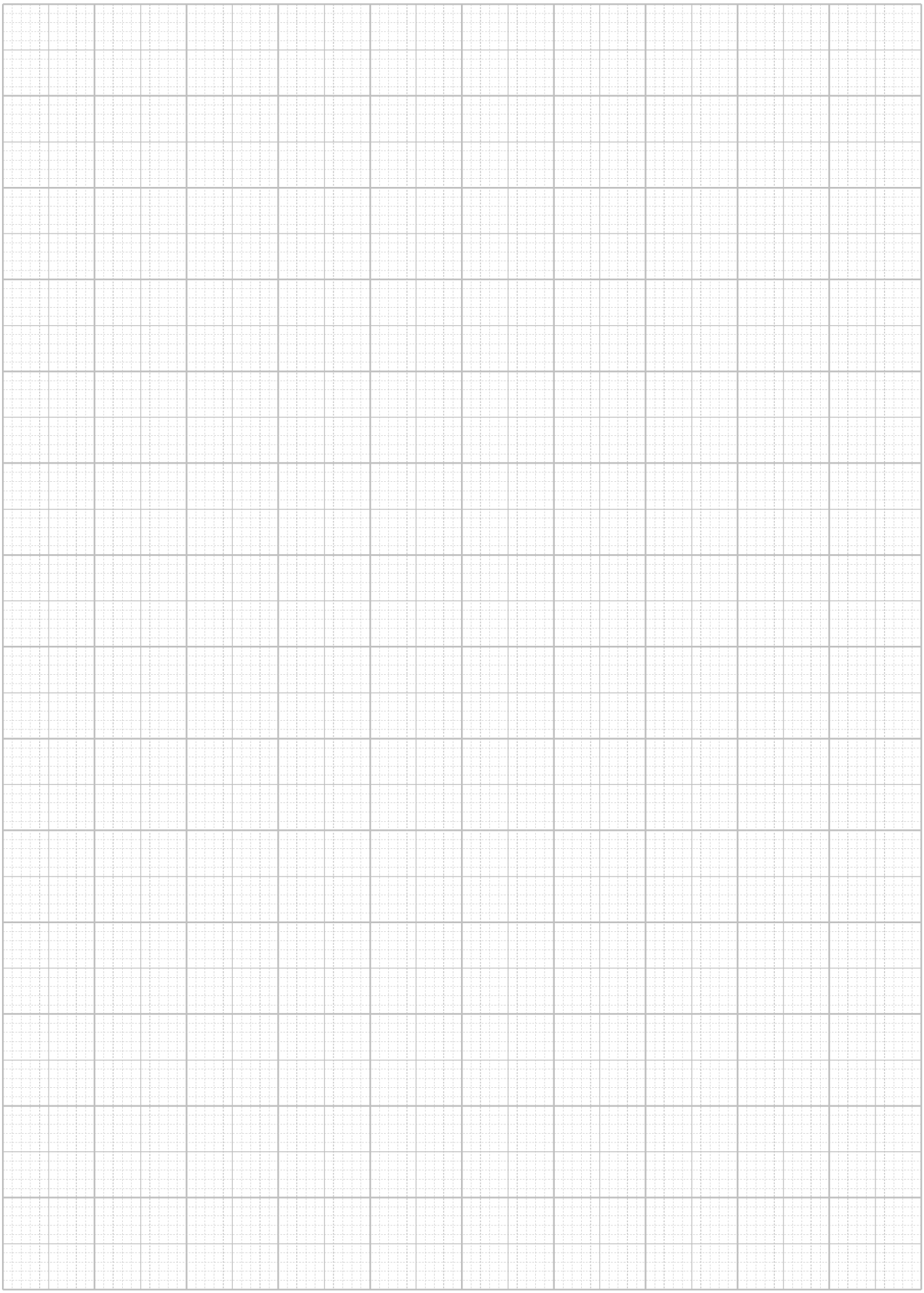
.....

(c) Construct a table and record temperature, time, and 1/ time for this experiment. [3M]

(d) (i) Plot a graph of temperature of sodium thiosulphate solutions against 1/time. [3M]



(ii) Based on the graph in (d) (i), state the relationship between the rate of reaction and temperature. [3M]

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.....

.....

(e) Complete the Table 1.1 based on the above experiment. [3M]

Type of variable	**Action that needs to be taken**
(i) Manipulated variable:	The way to manipulate the variable: ....
(ii) Responding variable:	What to observe in the responding variable: ....
(iii) Fixed variable:	The way to maintain the fixed variable: ....

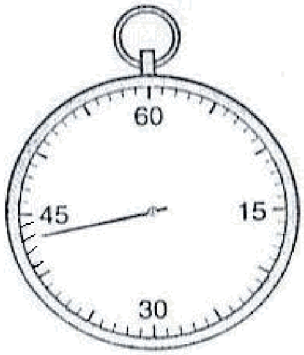
Table 1.1

[SBP07 F5midyear-01]

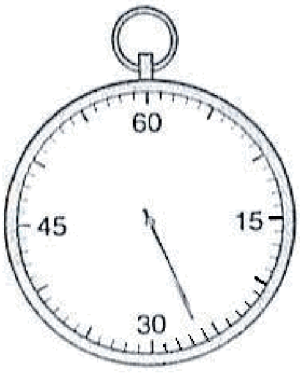
An experiment was conducted to study the effect of temperature on the rate of reaction. 30 cm^3 of 1.0 mol dm^{-3} hydrochloric acid at 30°C was poured into a 150 cm^3 conical flask. Magnesium strip of 2 cm long was added to the hydrochloric acid.

The stopwatch was immediately started. The conical flask was shaken for a few seconds. As soon as the magnesium ribbon disappears, the stopwatch was stopped.

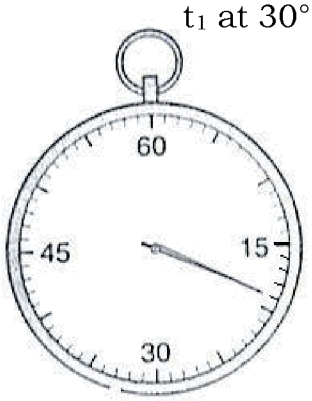
The time taken was recorded. The steps were repeated for 30 cm^3 of 1.0 mol dm^{-3} hydrochloric acid at 35°C, 40°C, 45°C and 50°C respectively. The figure below shows the readings of the stopwatch for each set of the experiment.



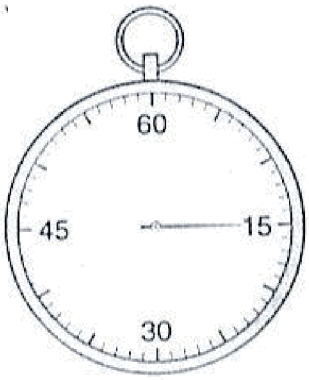
t_1 at 30°C = _____s



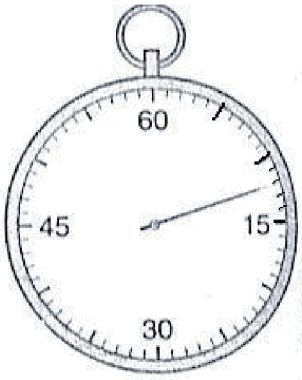
t_2 at 35°C = _____s



t_3 at 40°C = _____s



t_4 at 45°C = _____s

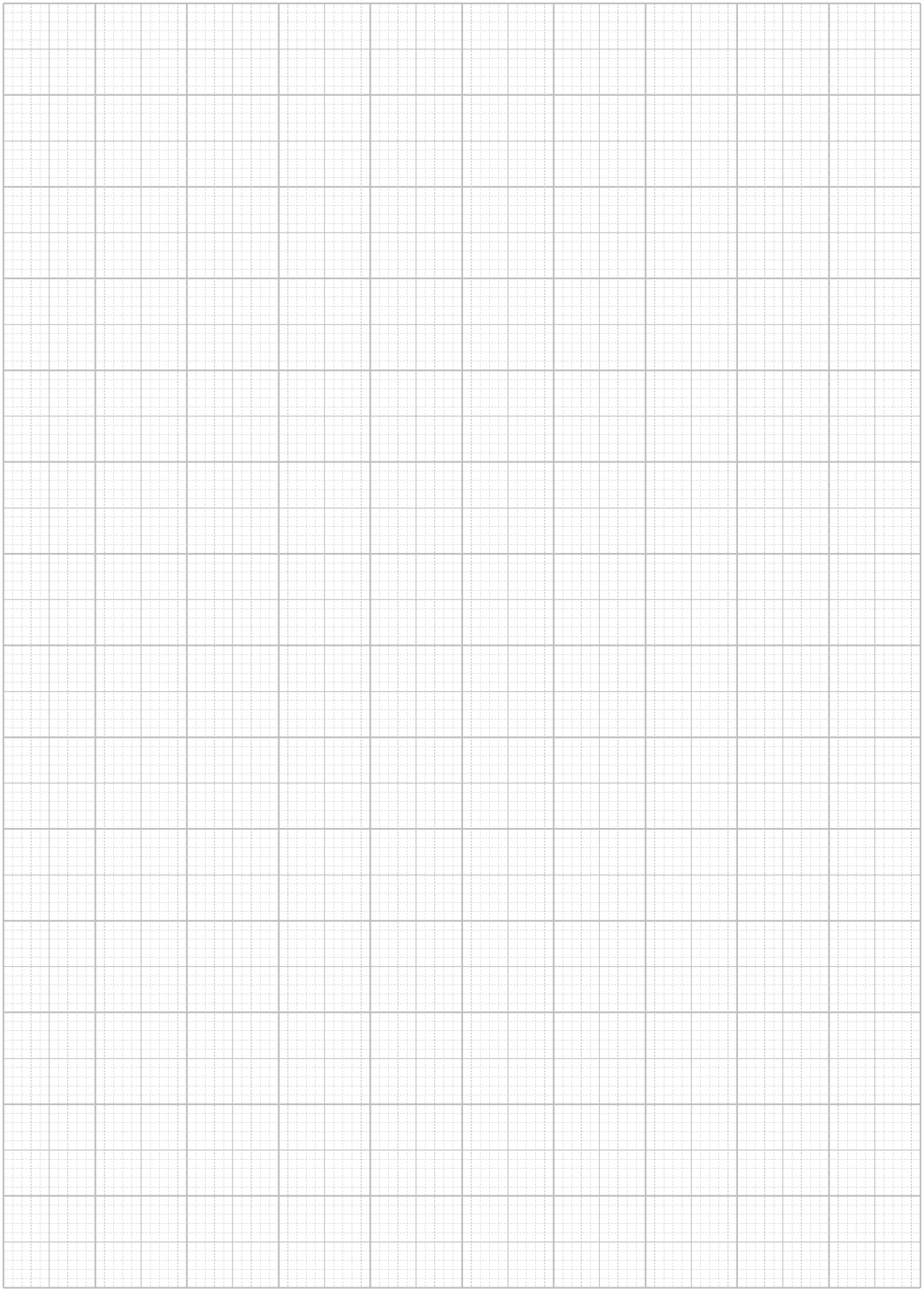


t_5 at 50°C = _____s

(a) Record the time taken for each reaction in the spaces provided. [3M]

(b) Design a table and record the temperature, time and 1/time for this experiment. [3M]

(c) Plot a graph of temperature against 1/time on the graph paper provided. [3M]



(d) Based on the graph in (c), deduce the relationship between the rate of reaction and temperature. [3M]

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(e) Predict the time taken if the experiment is repeated at 44°C. [3M]

.....

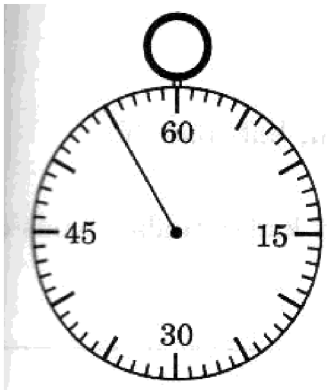
[SPM03-01]

An experiment was conducted to find out the effects of temperature on the rate of reaction. 50 cm^3 of sodium thiosulphate solution 0.05 mol dm^{-3} at 30 °C was put in into 250 cm^3 conical flask. Then the conical flask was placed on an 'X' sign on a piece of white paper.

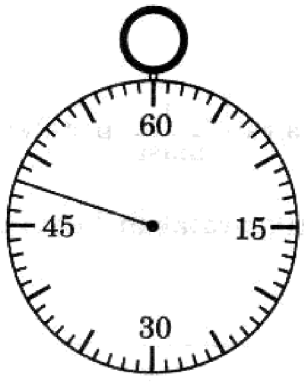
10 cm^3 of hydrochloric acid 1.0 mol dm^{-3} was added to the sodium thiosulphate solution and shaken. At the same time, the stop watch was started. The stop watch was stopped as soon as the 'X' sign was no longer visible.

The same steps of the experiment were repeated for sodium thiosulphate solution which was heated to 35 °C, 40 °C and 50 °C.

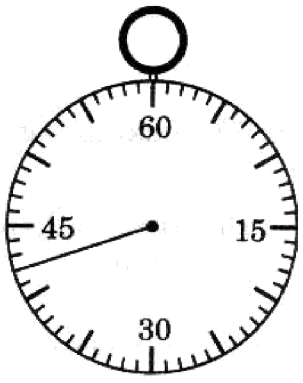
Diagram 1 shows the readings of the stop watch for each of the reaction at different temperature.



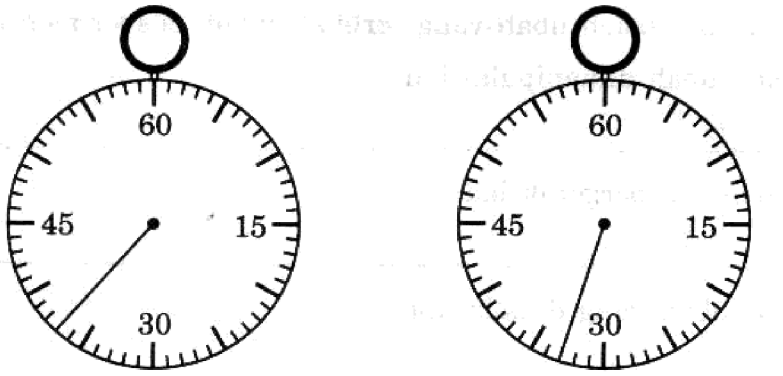
Time, t_1 _____ s
at 30°C



Time, t_2 _____ s
at 35°C



Time, t_3 _____ s
at 40°C



Time, t_4 _____ s at 45°C

Time, t_5 _____ s at 50°C

Diagram 1

(a) Record the time for each reaction in the spaces provided in Diagram 1.

(b) Construct a table and record temperature, time and 1/time for this experiment.

(c) (i) Draw a graph of temperature against 1/time on the graph paper.

(ii) Based on the graph in (c) (i), state the relationship between the rate of reaction and temperature.

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.....

(d) Predict the time taken as soon as the sign 'X' to be no longer visible if this experiment is repeated at 55 C.

.....

(e) (i) State the variable involved in this experiment.

Manipulated : .....

Responding variable : .....

Constant variable : .....

(ii) State how you would manipulate one variable while keeping the other variables constant.

.....

.....

.....

(f) State the hypothesis for this experiment

.....

.....

.....

(g) From the above experiment, the student found a relationship between temperature and rate of reaction. The same situation can be applied in our daily lives, for example, keeping food that is easily spoiled in the refrigerator.

Using your knowledge of chemistry, state the relationship between temperature and the rate at which food turns bad.

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[SBPtrial05-02] {Translate}

Table below show result of two experiments was done to study the effect of quantity of manganate(IV) oxide, MnO_2 in decompose of hydrogen peroxide, H_2O_2. Oxygen gas released was collected by water displacement technique.

Time/s / Volume of oxygen gas/cm^3	0	30	60	90	120	150	180	210	240
Experiment I (Using 1 g of MnO_2)	0.0	6.0	11.5	16.0	20.0	24.0	28.0	31.5	34.0
Experiment II (Using 2 g of MnO_2)	0.0	11.0	20.0	28.0	34.0	38.5	42.0	44.5	46.5

(a) State the hypothesis for this experiment. [3M]

.....

.....

.....

(b) With the same axis, draw a graph volume of oxygen gas versus time for experiment I and experiment II. [3M]

(c)(i) From graph at (b), calculate the rate of reaction at 120 second for

Experiment I	**Experiment II**

(ii) Based on the answer at (c) (i), state the relationship between rate of reaction with catalyst. [3M]

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.....

.....

(iii) Predict the rate of reaction at 120 seconds if hydrogen peroxide decompose without catalyst. [3M]

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(d) Why the rate of decompose hydrogen peroxide for both experiment I and experiment II decreases with time? [3M]

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.....

Essay {Paper03}

[SBPtrial10-03]

The reaction between zinc and sulphuric acid will produce zinc sulphate and hydrogen gas. The chemical equation for the reaction is shown below:

$$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$$

Referring to the information above, plan a laboratory experiment to investigate the effect of size of zinc on the rate of reaction.

Your planning should include the following aspects: [17M]

(a) Problem statement
(b) Hypothesis
(c) All the variables
(d) List of materials and apparatus
(e) Procedure
(f) Tabulation of data

----------oooOO aĎaŽ OOooo----------

[MRSMtrial08-02]

Diagram 2.1 shows two types of bonfire using sticks and logs.

During camping, a group of students discovered that it is easier to start a bonfire using sticks rather than logs. This is due to the differences in the size

Bonfire using sticks

Bonfire using logs

Diagram 2.1

Referring to the above situation, plan a laboratory experiment to investigate the effect of size of reactant on the rate of reaction between calcium carbonate and an acid.

Your planning should include the following: [17M]

(a) Statement of Problem
(b) All the variables
(c) Statement of hypothesis
(d) List of substances and apparatus
(e) Procedure of the experiment
(f) Tabulation of data

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[SPM05-03]

Tasks 2

Buildings in industrial areas are more corroded than those in housing areas. This is because the concentration of acid in rain water is higher in industrial areas.

Referring to the situation above, plan a laboratory experiment to investigate the effect of concentration on the rate of reaction between a named acid and a named metal.

Your planning must include the following items: [17M]

(a) Statements of the problem
(b) All the variables
(c) Lists of substances and apparatus
(d) Produce
(e) Tabulation of data

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[SBPtrial09-03-P3]

Diagram 2.1 shows two methods of dissolving sugar cubes to make sugar solution.

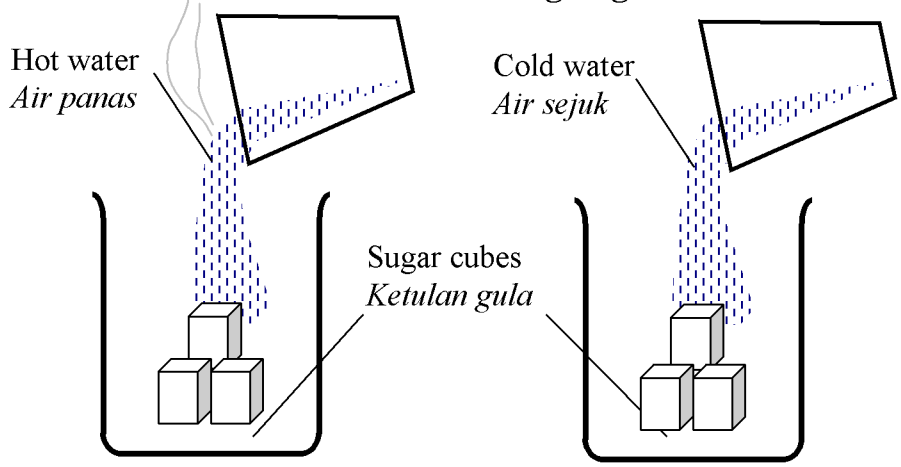

Diagram 2.1

A group of students discovered that it is faster to dissolve the sugar cubes to make sugar solution by using hot water rather than cold water. This is due to the difference in the temperature of the water.

Referring to the situation above, plan a laboratory experiment to investigate the effect of temperature on the rate of reaction between sulphuric acid and sodium thiosulphate solution.

Your planning should include the following aspects. [17M]

(a) Statement of the problem
(b) All the variables
(c) Statement of the hypothesis
(d) Lists of substances and apparatus
(e) Procedure
(e) Tabulation of data

[SPM2010-03]

Diagram 3 shows the productions of fuel during the launching of a space shuttle by using a catalyst.

Diagram 3

The catalyst is used to speed up the production of fuel. Based on this idea, plan one laboratory experiment to investigate the effect of a catalyst on the rate of reaction between metal and acid. Use copper(II) sulphate solution as the catalyst.

Your planning should include the following aspects:

(a) Aim of the experiment
(b) All the variables
(c) Statement of the hypothesis
(d) List of substances and apparatus
(e) Procedure for the experiment
(f) Tabulation of data
[17M]

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[MRSMtrial09-03]

Diagram 3 shows a reaction between dilute acid and metal in Test tube I and Test tube II.

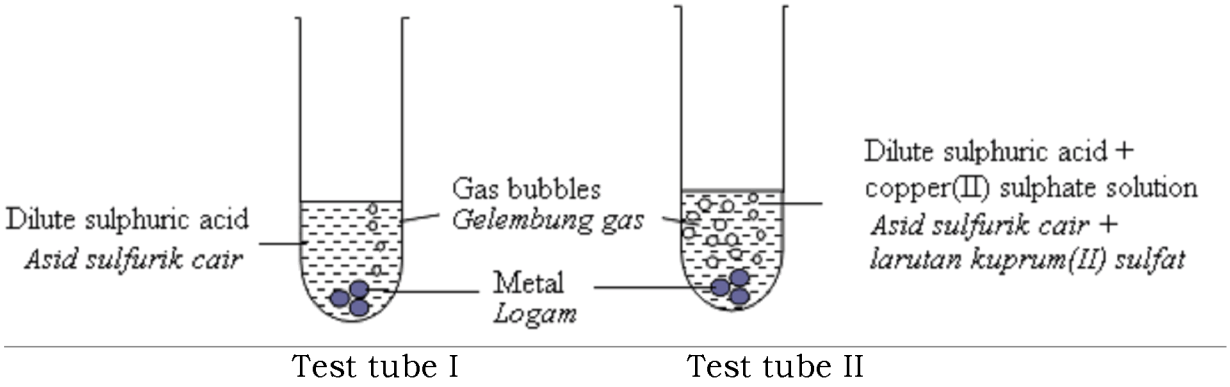

Diagram 3

The time taken for the reaction in Test tube II to complete is shorter than in Test tube I.

Identify the factor that influences the difference in the observation between Test tube I and Test tube II.

Referring to Diagram 3, plan a laboratory experiment to investigate the factor that influences the difference in the rate of reaction.

Your planning should include the following aspects: [17M]

(a) Aim of the experiment
(b) All the variables
(c) Statement of the hypothesis
(d) List of substances and apparatus
(e) Procedure of the experiment
(f) Tabulation of data

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[MRSMtrial03-03-P3]

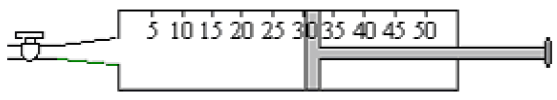

FIGURE 3 (a)

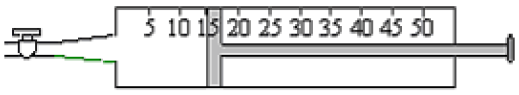

FIGURE 3 (b)

Experiment I

Figure 3(a) shows a syringe containing oxygen gas produced from the decomposition of 10-volume hydrogen peroxide with the presence of substance X after 90 seconds.

Experiment II

Figure 3(b) shows a syringe containing oxygen gas produced from the decomposition of 10-volume hydrogen peroxide without the presence of substance X after 90 seconds.

You are required to plan an experiment based on the above observations.

Your description should include the following: [17M]

(a) Aim of experiment
(b) All the variables involved
(c) List of materials and apparatus
(d) Experimental method
(e) Data tabulation

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