

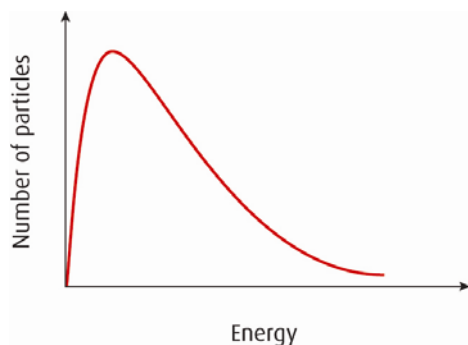
Core Worksheet – Chapter 6

- 1 The following data is for the reaction between 0.25 g of small marble chips and 10 cm³ of 0.5 mol dm⁻³ hydrochloric acid. The volume of carbon dioxide produced was recorded every 10 s.



Time / s	Volume of CO ₂ / cm ³
0	0
10	19
20	33
30	44
40	51
50	54
60	56
70	57
80	57

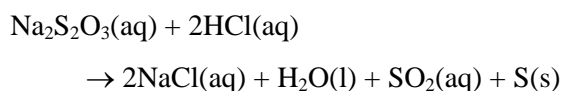
- a Draw a labelled diagram of apparatus that would be suitable for obtaining this data. [2]
- b Plot the data and draw a line of best fit – mark this line **A**. [2]
- c Describe how and why the rate of reaction varies during this reaction. [5]
- d An identical experiment is carried out, except that half the volume of hydrochloric acid is used. Sketch a line on your graph to represent this experiment – label this line **B**. [2]
- e A third experiment is carried out, using 0.25 g of calcium carbonate powder and 10 cm³ of 0.5 mol dm⁻³ hydrochloric acid. Sketch a line on your graph to represent this experiment – label this line **C**. [2]
- f A fourth experiment is carried out, using 0.25 g of small marble chips and 20 cm³ of 0.25 mol dm⁻³ hydrochloric acid. Sketch a line on your graph to represent this experiment – label this line **D**. [2]
- 2 The diagram below shows the distribution of the energies of particles in a sample of gas:



Use the diagram to explain why increasing the temperature causes the rate of reaction to increase. [7]

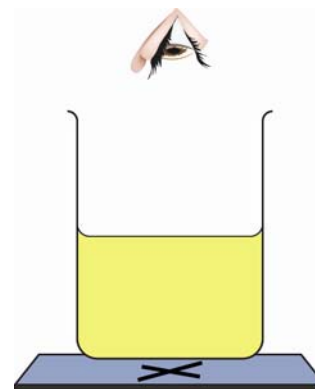
- 3 In the decomposition of hydrogen peroxide solution ($\text{H}_2\text{O}_2(\text{aq})$) to form oxygen and water, manganese(IV) oxide ($\text{MnO}_2(\text{s})$) is a catalyst.
- Write an equation for the reaction. [1]
 - Suggest a method that could be used to follow the rate of this reaction. [1]
 - Explain what is meant by the word **catalyst**. [2]
 - Explain, with the aid of an energy level diagram, how MnO_2 acts as a catalyst in this exothermic reaction. [6]

- 4 The rate of the reaction between sodium thiosulfate and hydrochloric acid can be determined by observing how long it takes to produce sufficient sulfur to obscure a cross drawn on a piece of paper. The equation for the reaction is:



A series of experiments was carried out to investigate the effect of changing the temperature on the rate of this reaction. The results of the experiments are shown below:

Temperature / °C	Time / s	1/time (\propto rate) / s^{-1}
21	151	0.00662
28	104	
37	66	
46	34	
50	27	
61	15	0.067



The rate of reaction is proportional to $1/(\text{reaction time})$.

- Complete the table. [2]
- Plot a graph of the rate against temperature for this reaction. [3]
- Determine from your graph the rate of reaction at the following temperatures:

Temperature / °C	1/time (\propto rate) / s^{-1}
21	0.00662
31	
41	
51	
61	0.067

Use these data to investigate to what extent the rule of thumb 'increasing the temperature by 10°C causes the rate of reaction to double' holds in this case. [5]