6.1 Chemical Kinetics

Question Paper

Course	DP IB Chemistry
Section	6. Chemical Kinetics
Topic	6.1 Chemical Kinetics
Difficulty	Hard

Time allowed: 20

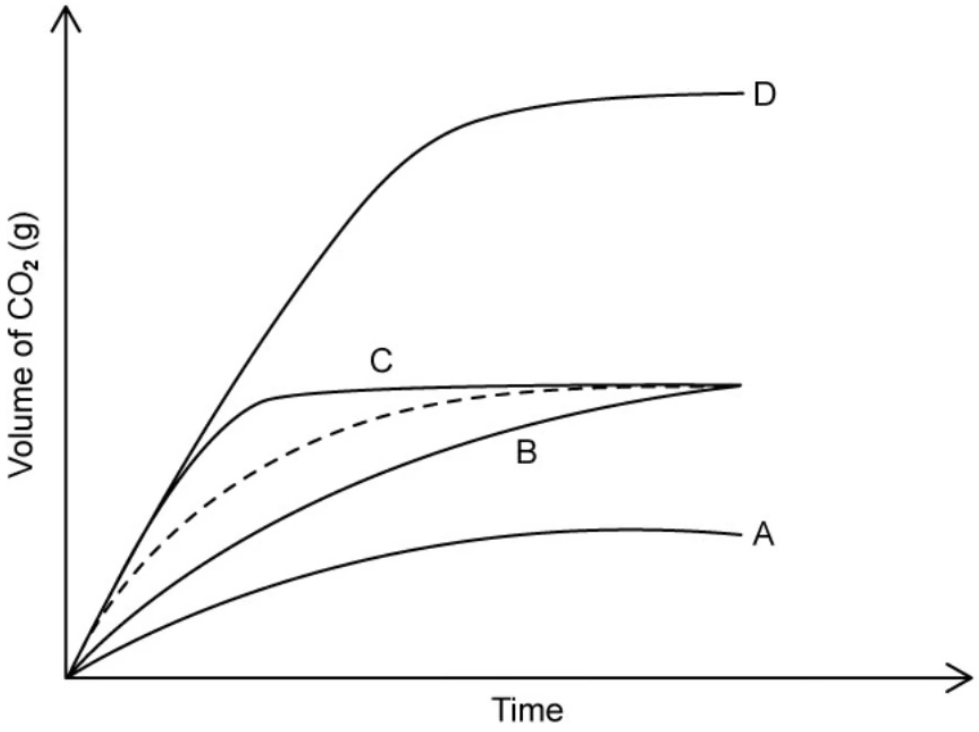
Score: /10

Percentage: /100

Question 1

In a reaction between 1M hydrochloric acid and an excess of marble chips (calcium carbonate) the volume of gas produced was measured against time. This is shown on the dotted line in the graph below.

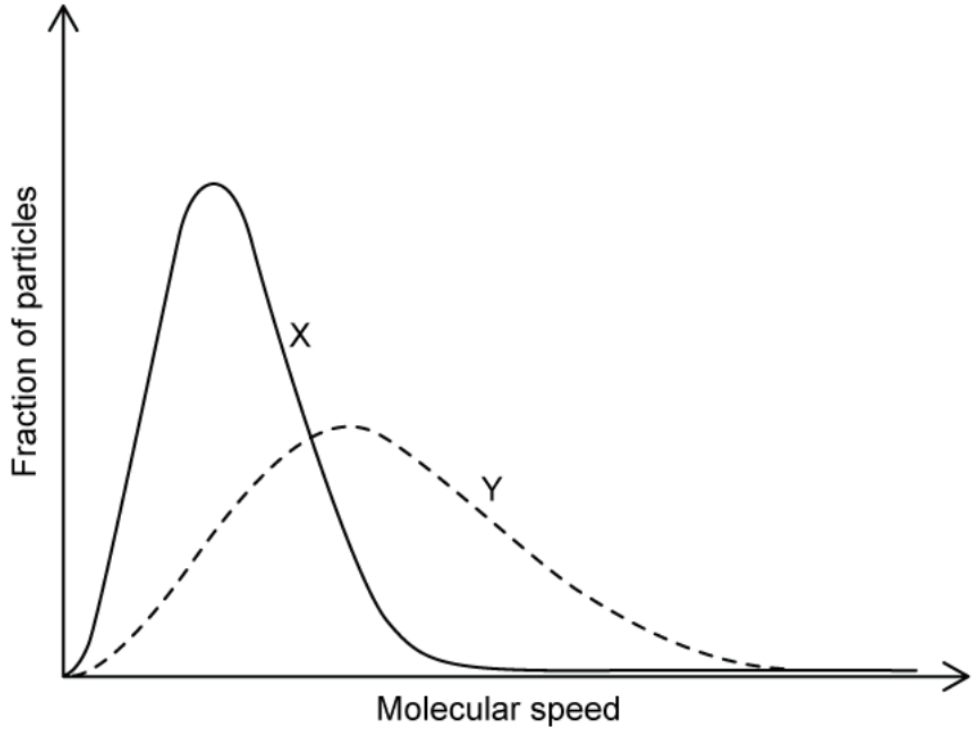
The experiment was repeated, but this time using the same volume of 2M hydrochloric acid. Which line on the graph represents this experiment?



[1 mark]

Question 2

1 dm^3 of gas **X** and 1 dm^3 of gas **Y** are kept at the same temperature and pressure. The speed of the molecules is plotted against the fraction of molecules with that speed. From the graph what can be said about the two gases?



A The molar mass of **X** is larger than the molar mass of **Y**

B The molar mass of **Y** is larger than the molar mass of **X**

C The average kinetic energy of **X** is higher than that of **Y**

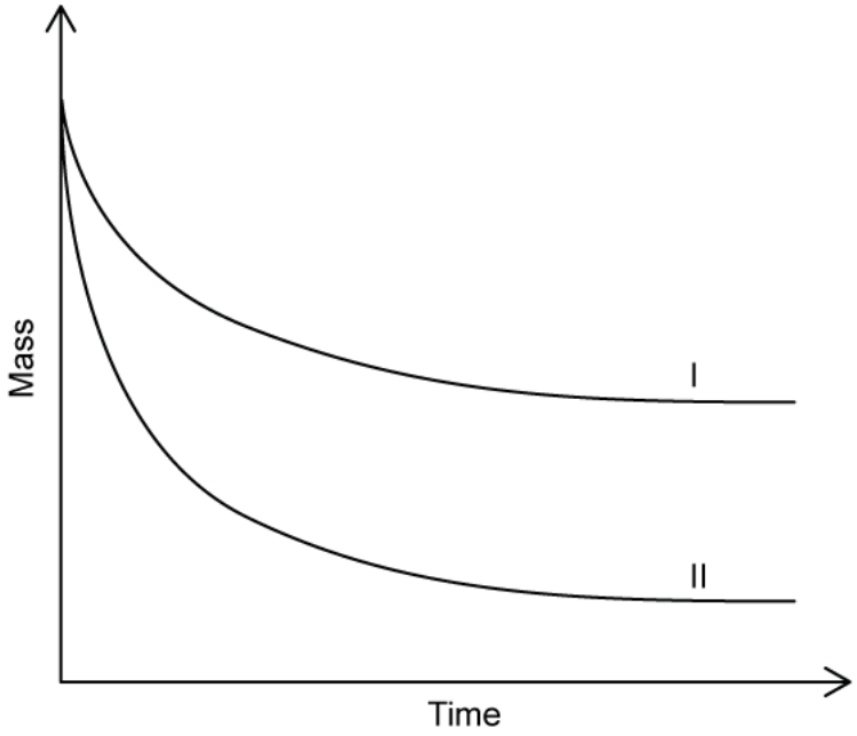
D The average kinetic energy of **Y** is higher than that of **X**

[1 mark]

Question 3

A beaker containing 100 cm^3 of 2M sulfuric acid, $H_2SO_4(aq)$, was placed on a balance and then an excess of powdered zinc was added. The change in mass was recorded against time and the results plotted on a graph as shown in line I below.

What change in conditions could result in line II shown on the graph?



A Using twice as much powdered Zn

B Using pieces of zinc that have the same mass as the powder

C Raising the temperature of the sulfuric acid, $H_2SO_4(aq)$

D Using more concentrated $H_2SO_4(aq)$, but keeping the volume the same

[1 mark]

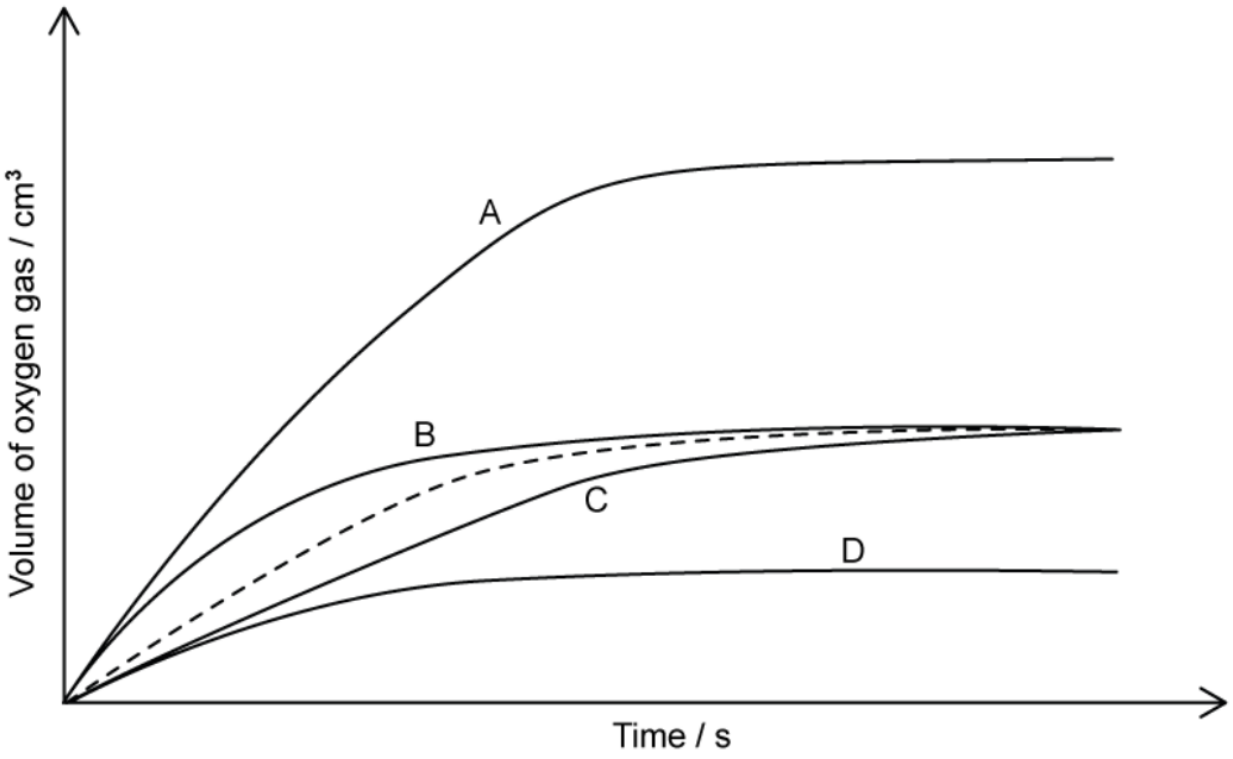
Question 4

Bleach solution contains sodium chlorate(I) which naturally decomposes according to the equation below:

$$2NaClO(aq) \rightarrow 2NaCl(aq) + O_2(g)$$

The bleach decomposes faster as the temperature increases. A 100 cm^3 sample of 10% bleach was heated to 40 °C and the amount of oxygen evolved was measured against time.

The experiment was repeated under the same conditions, but this time using a 100 cm^3 sample of 20% bleach. If the first experiment produces the dotted line, which line is produced by the second experiment?

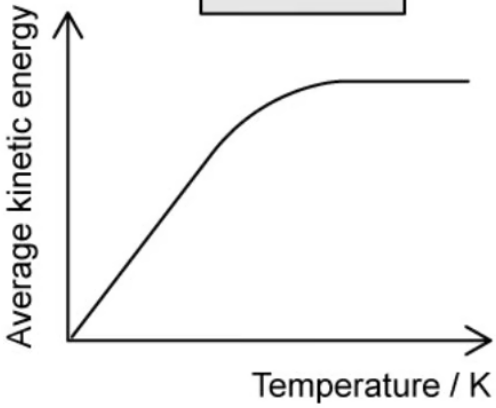


[1 mark]

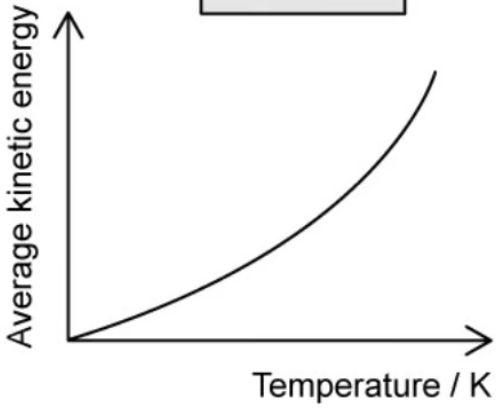
Question 5

How does the average kinetic energy of a gas vary with temperature?

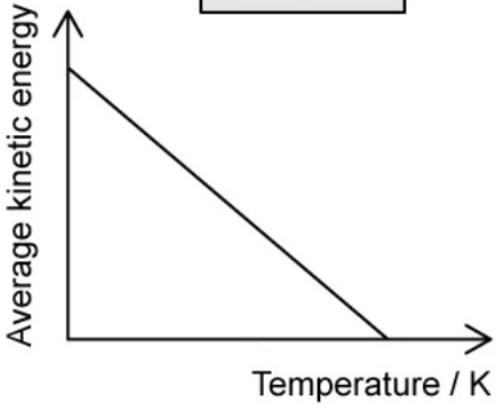
A



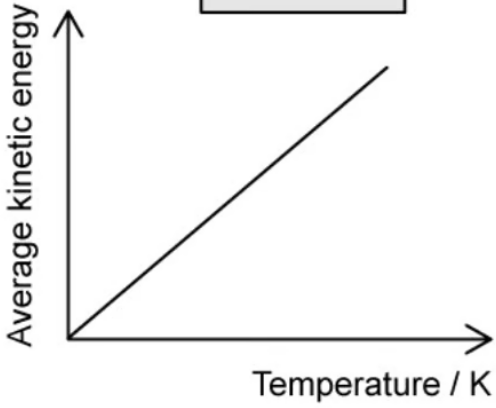
B



C



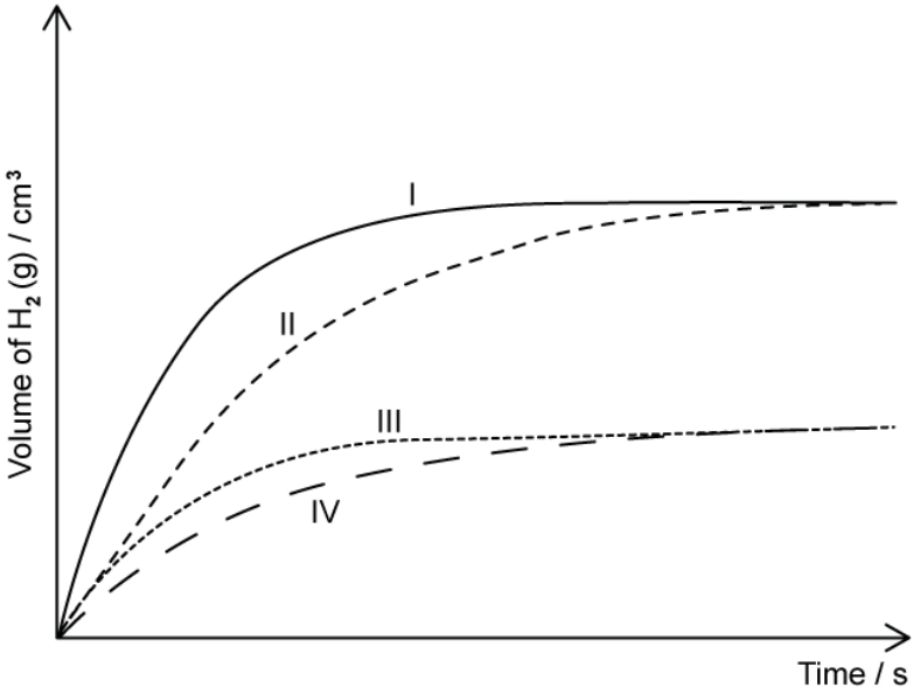
D



[1 mark]

Question 6

Three batches of sulfuric acid containing different volumes and concentrations were reacted with an excess of zinc powder. The hydrogen evolved was measured against time and the results were plotted on a graph. Which lines on the graph could correspond to the specified volumes and concentrations of the sulfuric acid shown in the table?



	$25cm^3$ of 1.0 M H_2SO_4	$50cm^3$ of 0.5 M H_2SO_4	$25cm^3$ of 0.5 M H_2SO_4
A	I	III	IV
B	I	IV	III
C	I	II	III
D	II	I	III

[1 mark]

Question 7

When 1 cm^3 of 0.1 mol dm^{-3} HCl is added to 10 cm^3 of 0.02 mol dm^{-3} $Na_2S_2O_3$ solution, a pale yellow precipitate forms slowly.

When the experiment is repeated with 1 cm^3 of 0.1 mol dm^{-3} HCl and 10 cm^3 of 0.05 mol dm^{-3} $Na_2S_2O_3$ the precipitate forms more quickly.

Why is this?

A when 0.05 mol dm^{-3} $Na_2S_2O_3$ is used the reactant particles collide more frequently

B when 0.05 mol dm^{-3} $Na_2S_2O_3$ is used the collisions between reactant particles are more violent

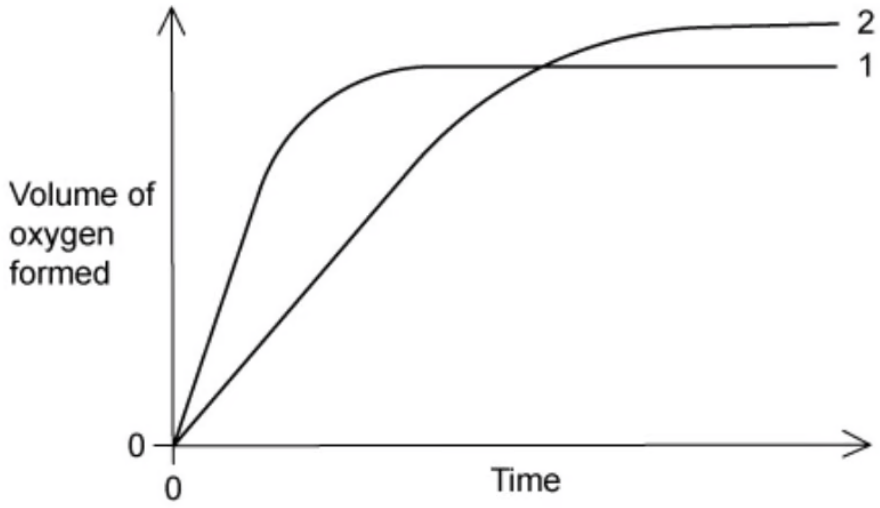
C when 0.05 mol dm^{-3} $Na_2S_2O_3$ is used the activation energy of the reaction is lower

D when 0.05 mol dm^{-3} $Na_2S_2O_3$ is used the reaction proceeds by a different pathway

[1 mark]

Question 8

On the graph, curve 1 was produced from measuring the decomposition of 100 cm^3 of 1.0 mol dm^{-3} hydrogen peroxide in the presence of a manganese(IV) oxide catalyst.



Which alteration to the original experimental conditions would produce curve 2?

A raising the temperature

B adding more manganese(IV) oxide

C using more concentrated hydrogen peroxide

D add some 0.1 mol dm^{-3} hydrogen peroxide

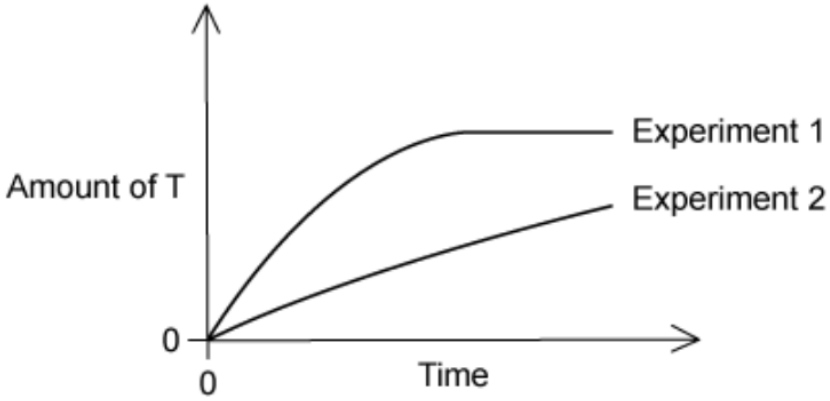
[1 mark]

Question 9

The stoichiometry of a catalysed reaction is shown by the equation below.

$$R(g) + S(g) \rightleftharpoons T(g) + U(g)$$

Two experiments were carried out in which the amount of product *T* was measured against time. The results are shown in the diagram below.



Which changes in the conditions from experiment 1 to experiment 2 might explain the results shown?

1 product *U* was continuously removed from the equilibrium mixture

2 a different catalyst was used

3 less of reactant *R* was used

A 1 only **B** 1 and 3 only **C** 2 and 3 only **D** 1, 2 and 3

[1 mark]

Question 10

Boltzmann distributions are shown in the two diagrams below.

Diagram 1

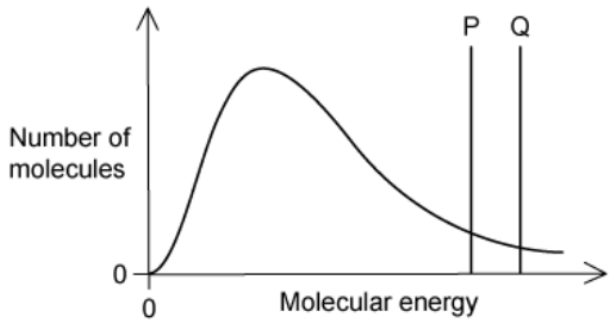
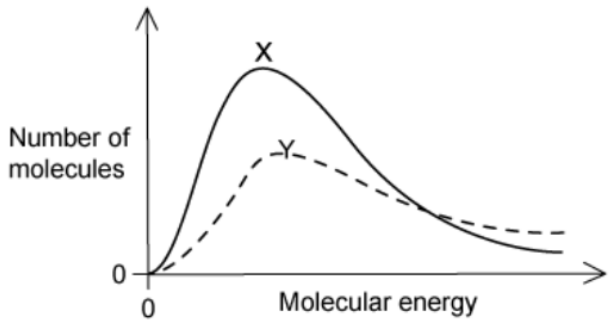


Diagram 2



In diagram 1, one line, P or Q, corresponds to the activation energy in the presence of a catalyst and the other line corresponds to the activation energy of the same reaction in the absence of a catalyst.

In diagram 2, one curve, X or Y, corresponds to a temperature higher than that of the other curve.

Which combination gives the correct curve and line?

	presence of catalyst	higher temperature
A	P	X
B	P	Y
C	Q	X
D	Q	Y

[1 mark]