

ALyl Chem 8 EQ P1 22w to 09s Paper 1 Reaction kinetics 51marks

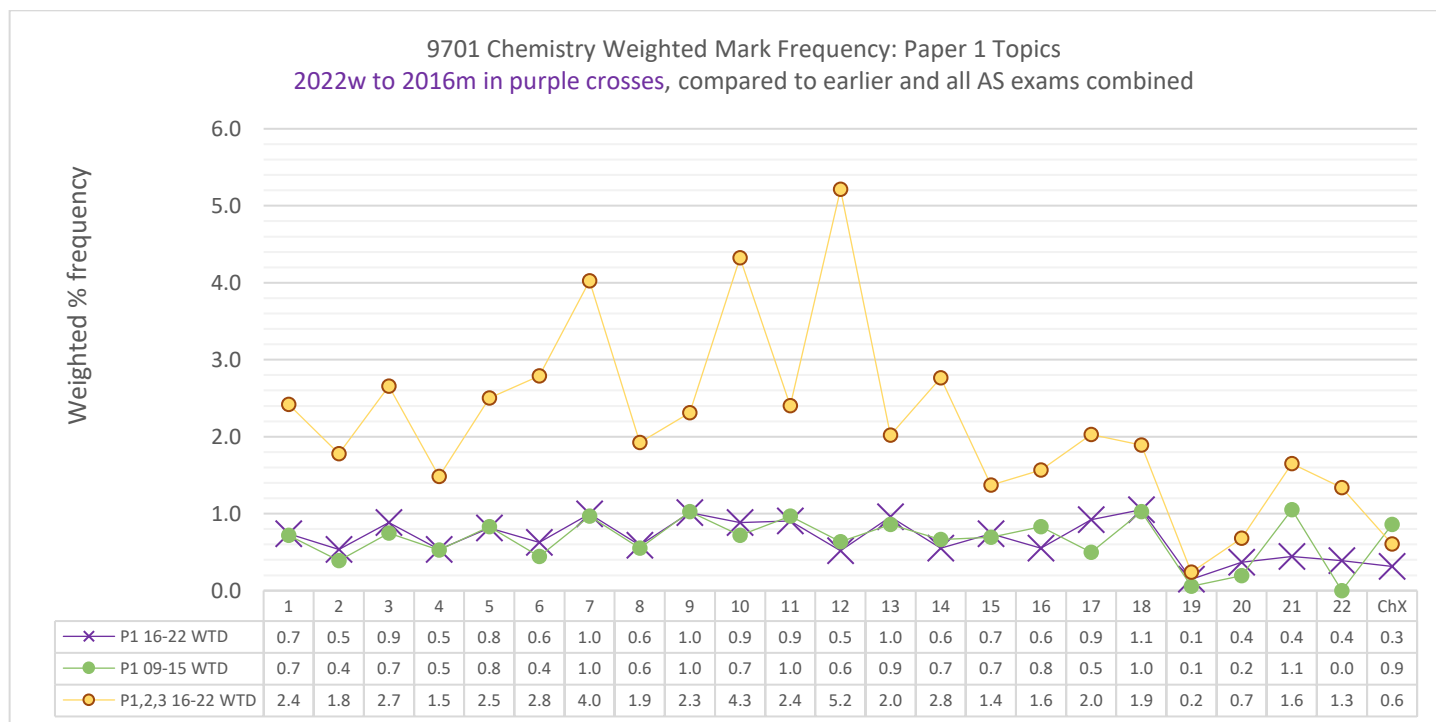
As you start and work through this worksheet you can tick off your progress to show yourself how much you have done, and what you need to do next. The first task is just to read the first question and should take you less than one minutes to complete.

Paper 1 Topic 8

Checklist Tick each task off as you go along

RANK:

P1 Noob	P1 Novice	P1 Bronze	P1 Silver	P1 Gold	P1 ¹ Winner	P1 Hero	P1 Legend
1 Q started	1 Q done	10% of marks	25% of marks	40% of marks	50% of marks	75% of marks	100% of marks
	1	5	13	20	26	38	51
	1	6	16	26	32	48	64



What the most thoughtful students will get out of their extensive studying will be a capacity to do meaningful brain-based work even under stressful conditions, which is a part of the self-mastery skillset that will continue to deliver value for the whole of their lives. Outstanding grades will also happen, but the most important goal from skillful action in study is being better at any important task, even if circumstances do not feel ideal.

As you are moving through your studies you can learn more about yourself by trying out new ways to manage yourself, and analysing how effective those new techniques were. In this reflective process not only will you get better at working positively and productively to deliver ambitious and successful outcomes, but you will be working towards one aspect of life's highest pursuit, summarised and inscribed on the Temple of Apollo at Delphi: "know thyself".

1. To complete these questions, as important as your answer, is checking your answer against the mark scheme.
2. For each page or group of 10 questions, convert your mark score into a percentage. This will allow you to see (and feel) your progress as you get more experience and understanding with each topic.
3. Multiple choice questions, done carefully where you explain and show yourself your thinking using written notes as you move through each question, can be more useful than just Paper 2 for students aiming for a C or B grade. Paper 2 should be the larger focus for students aiming for A and A* grades, however.
4. If you find you get a higher percentage answering short answer questions than multiple choice questions that often means you are NOT using the marking scheme correctly; your correct answer might not be fully complete for all the marks you are awarding. The marks easiest to miss rely on providing the largest amount of detail.

¹ **DO NOT** work on these higher levels of completion in your A2 year unless you have also achieved at least a "Silver" (25%) in the same topic in **Paper 2**, which is **MOST** of your **AS grade**, and Paper 3 which is a smaller part of your year but still important.

8 Reaction kinetics

8.1 Rate of reaction

Learning outcomes

Candidates should be able to:

- 1 explain and use the term rate of reaction, frequency of collisions, effective collisions and non-effective collisions
- 2 explain qualitatively, in terms of frequency of effective collisions, the effect of concentration and pressure changes on the rate of a reaction
- 3 use experimental data to calculate the rate of a reaction

8.2 Effect of temperature on reaction rates and the concept of activation energy

Learning outcomes

Candidates should be able to:

- 1 define activation energy, E_A , as the minimum energy required for a collision to be effective
- 2 sketch and use the Boltzmann distribution to explain the significance of activation energy
- 3 explain qualitatively, in terms both of the Boltzmann distribution and of frequency of effective collisions, the effect of temperature change on the rate of a reaction

8.3 Homogeneous and heterogeneous catalysts

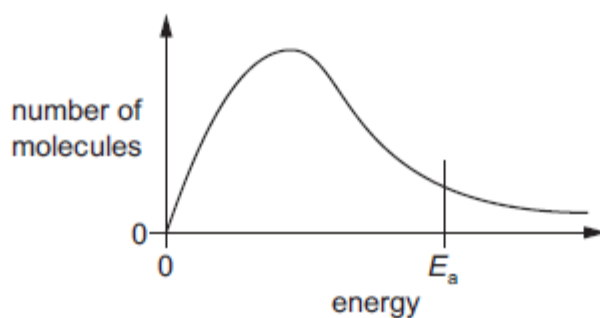
Learning outcomes

Candidates should be able to:

- 1 explain and use the terms catalyst and catalysis
 - (a) explain that, in the presence of a catalyst, a reaction has a different mechanism, i.e. one of lower activation energy
 - (b) explain this catalytic effect in terms of the Boltzmann distribution
 - (c) construct and interpret a reaction pathway diagram, for a reaction in the presence and absence of an effective catalyst

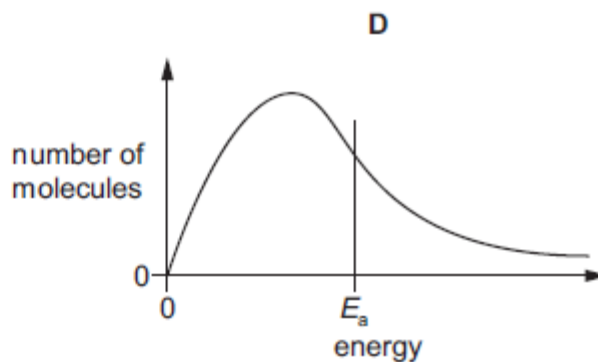
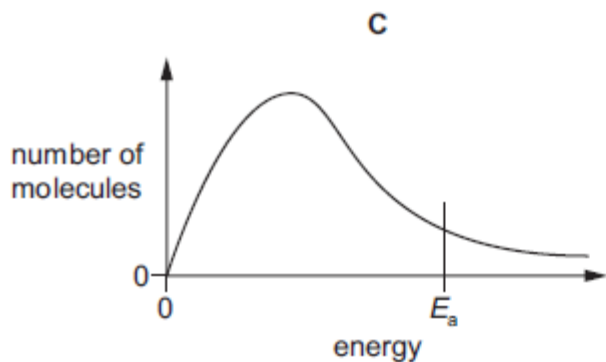
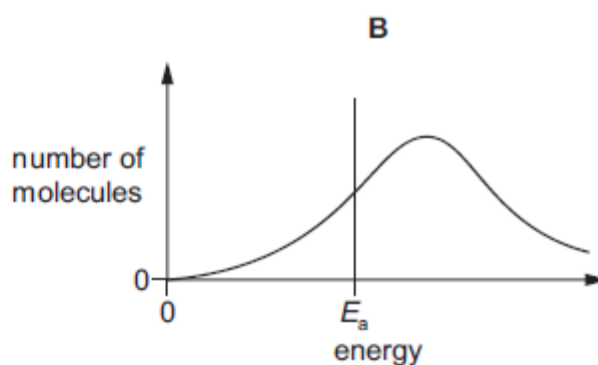
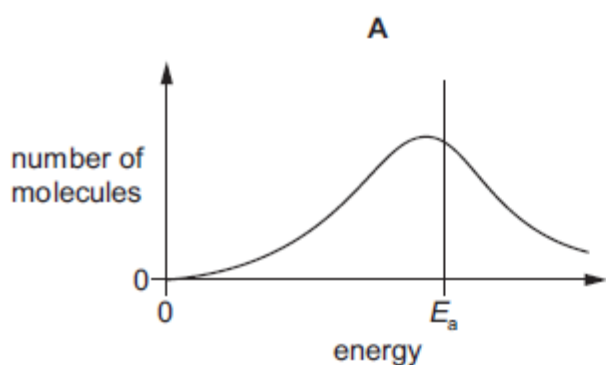
16 Measurements are made to determine the activation energy, E_a , of a reaction.

The diagram shows E_a on the Boltzmann distribution at temperature T_1 .



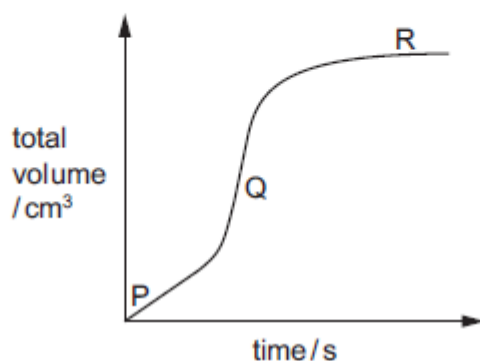
Measurements are then made at a higher temperature, T_2 .

Which diagram correctly shows the Boltzmann distribution and E_a at T_2 ?



- 15 A large excess of magnesium ribbon is added to dilute hydrochloric acid and the volume of hydrogen gas produced is measured as the reaction proceeds. The reaction is exothermic.

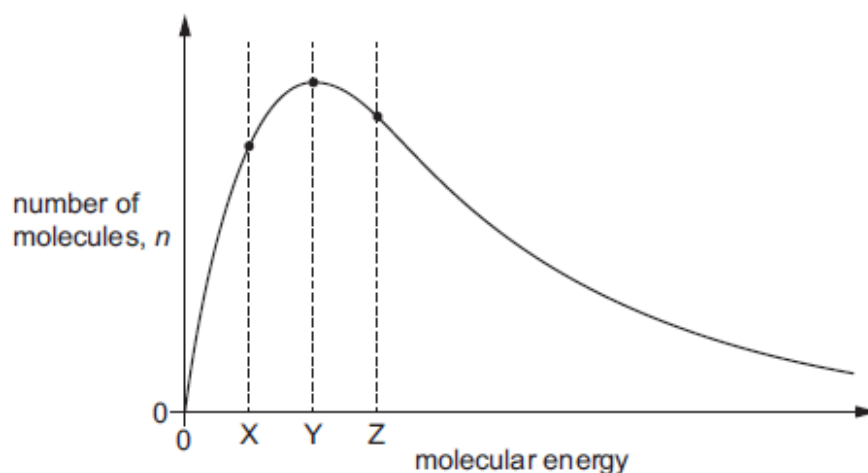
The results are shown.



Which row explains the changes in the rate of reaction between points P and Q and between points Q and R?

	between points P and Q	between points Q and R
A	the reaction temperature is increasing	the acid concentration is falling
B	the reaction temperature is increasing	the magnesium has been used up
C	magnesium's surface area is decreasing	the acid concentration is falling
D	magnesium's surface area is decreasing	the magnesium has been used up

- 15 The Boltzmann distribution for a gas at a constant temperature of 50 °C is shown.



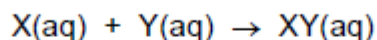
If the temperature of the gas is **reduced** by 10 °C, the graph changes shape.

What happens to the values of n for the molecular energies X, Y and Z?

	X	Y	Z
A	higher	lower	higher
B	higher	lower	lower
C	lower	higher	lower
D	lower	lower	lower



- 16 In the reaction shown, the concentrations of both X and Y are reduced to half of their original values whilst keeping the total volume of the solution constant.

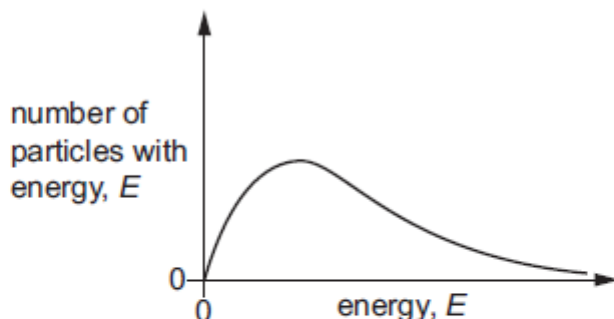


Simultaneously the temperature is increased from 298 K to 348 K.

Which prediction is definitely true?

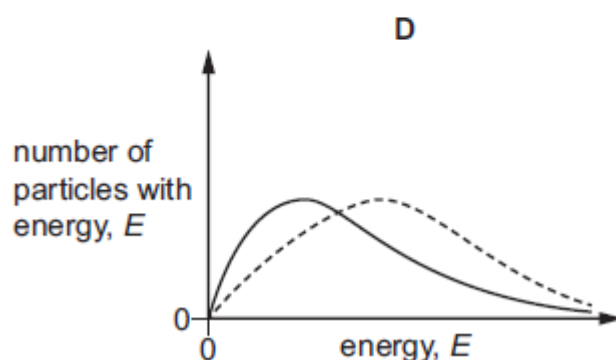
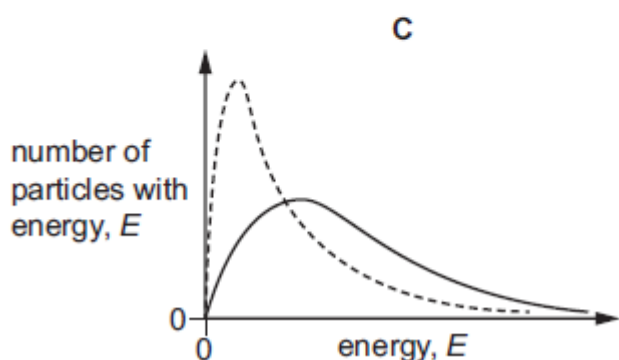
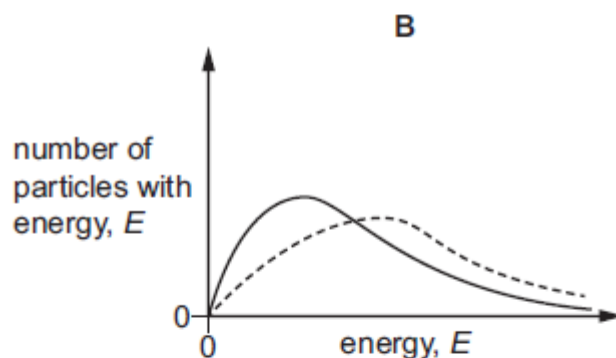
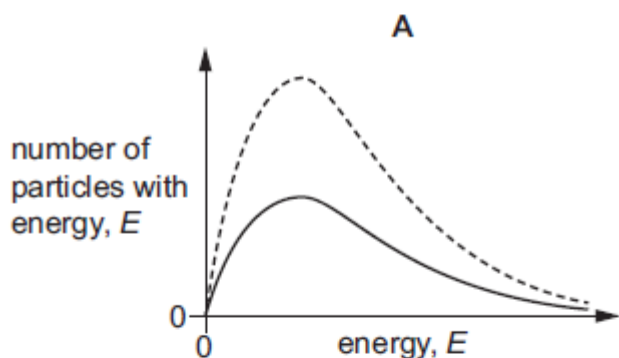
- A A smaller proportion of collisions between particles of X and particles of Y will be successful.
- B The average kinetic energy of particles of X and particles of Y will increase.
- C The rate of the reaction will be unaffected.
- D The frequency of collisions between particles of X and particles of Y will halve.

- 15 The Boltzmann distribution for one mole of a gas at temperature T is shown.



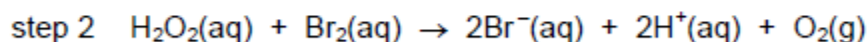
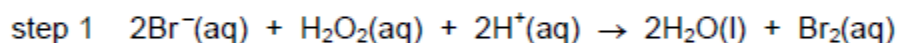
One mole of the same gas is added, and the gas remains at temperature T .

Which dotted curve shows the distribution with the added gas?



11 Hydrogen peroxide, H_2O_2 , decomposes to form water and oxygen.

The reaction is catalysed by bromide ions.



Which row is correct?

	type of catalyst	in step 1
A	heterogeneous	bromide ions are oxidised
B	heterogeneous	bromide ions are reduced
C	homogeneous	bromide ions are oxidised
D	homogeneous	bromide ions are reduced

Q# 451/ AS Chemistry/2021/w/TZ 1/Paper 1/Q# 31//www.SmashingScience.org :o)

The responses **A** to **D** should be selected on the basis of

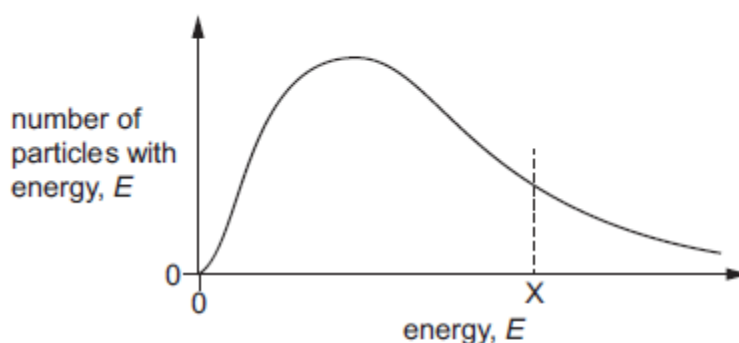
A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

31 Which changes can be used to measure the rates of chemical reactions?

- 1 the decrease in concentration of a reactant per unit time
- 2 the rate of appearance of a product
- 3 the increase in total volume of gas per unit time at constant pressure

Q# 452/ AS Chemistry/2021/w/TZ 1/Paper 1/Q# 11//www.SmashingScience.org :o)

11 The diagram shows the Boltzmann distribution of energies for a reactant gas. For a particular reaction, the activation energy is X.

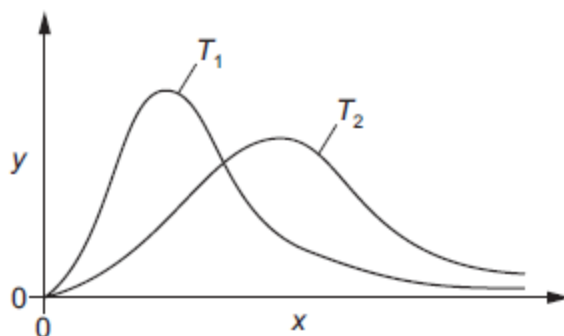


Which change to the diagram occurs if an effective catalyst is added at the same temperature?

- A More particles will possess higher values of E .
- B The peak will move to the left.
- C The peak will move to the right.
- D The value of the activation energy decreases.



- 5 The diagram shows the Boltzmann distribution for the same gas at two different temperatures, T_1 and T_2 .



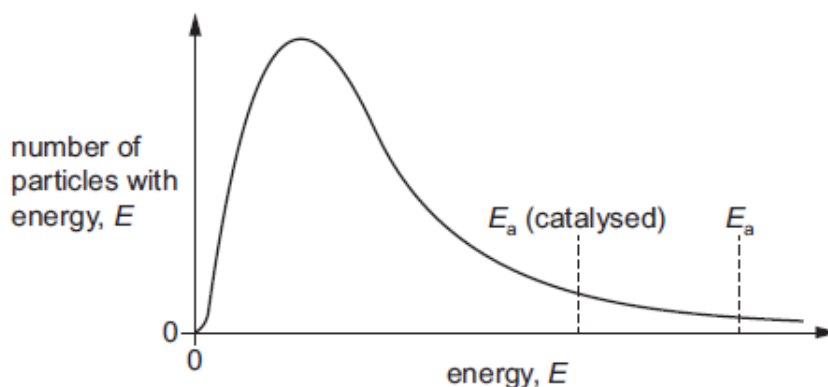
What is plotted on the y-axis and which line represents the higher temperature?

	plotted on y-axis	higher temperature
A	number of molecules	T_1
B	number of molecules	T_2
C	molecular energy	T_1
D	molecular energy	T_2

- 11 Which statement about catalysts is correct?

- A They change the reaction pathway by increasing the activation energy.
- B They increase the rate of reaction by lowering the enthalpy change of the reaction.
- C They increase the number of particles that have sufficient energy to react.
- D Heterogeneous catalysts are in the same state as the reactant.

- 11 The Boltzmann distribution curve for a gaseous mixture of ethene and hydrogen is shown. Nickel is an effective catalyst for the reaction that occurs.



How does the diagram appear if the same reaction mixture is at a higher temperature?

- A The curve is unchanged.
- B The values of both E_a (catalysed) and E_a decrease.
- C The values of both E_a (catalysed) and E_a increase.
- D The values of both E_a (catalysed) and E_a remain the same.

10 A large excess of marble chips is reacted with 25 cm^3 of 1.0 mol dm^{-3} hydrochloric acid at 40°C .

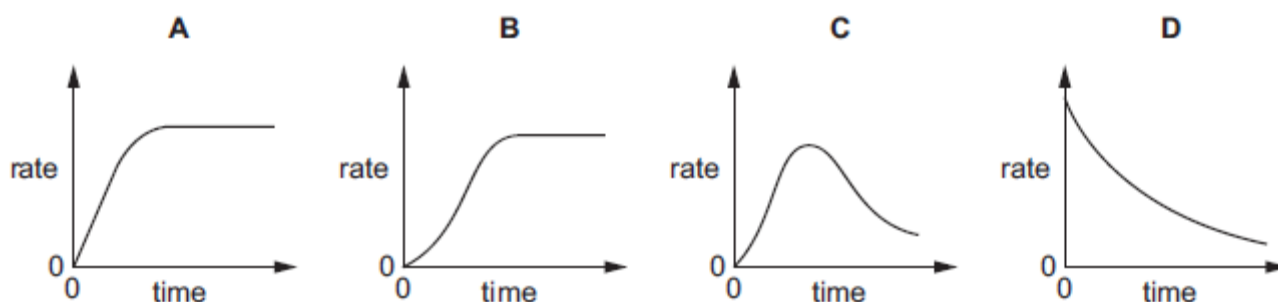
How is the result different when the reaction is repeated with 60 cm^3 of 0.5 mol dm^{-3} hydrochloric acid at 40°C ?

- A The reaction is faster and more of the products are made when the reaction is complete.
- B The reaction is faster and less of the products are made when the reaction is complete.
- C The reaction is slower and more of the products are made when the reaction is complete.
- D The reaction is slower and less of the products are made when the reaction is complete.

Q# 457/ AS Chemistry/2020/w/TZ 1/Paper 1/Q# 11//www.SmashingScience.org :o)

11 An autocatalytic reaction is a reaction in which one of the products catalyses the reaction.

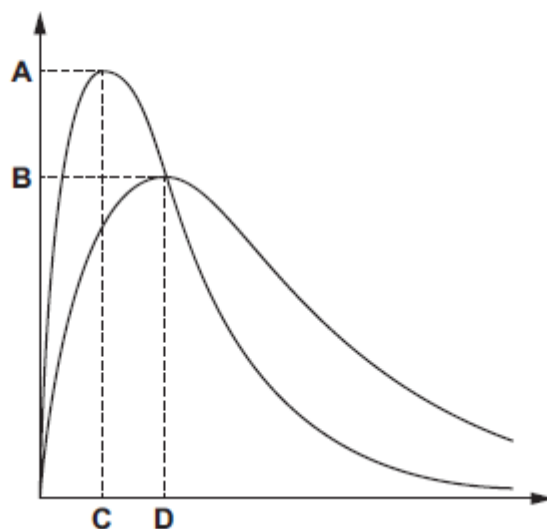
Which curve would be obtained if the rate of an autocatalytic reaction is plotted against time?



Q# 458/ AS Chemistry/2020/s/TZ 1/Paper 1/Q# 6//www.SmashingScience.org :o)

6 The diagram shows the Boltzmann energy distribution curves for molecules of a sample of a gas at two different temperatures.

Which letter on the axes represents the most probable energy for molecules of the same sample of gas at the **lower** temperature?



Q# 459/ AS Chemistry/2020/m/TZ 2/Paper 1/Q# 34//www.SmashingScience.org :o)

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

34 Hydrochloric acid reacts with zinc.

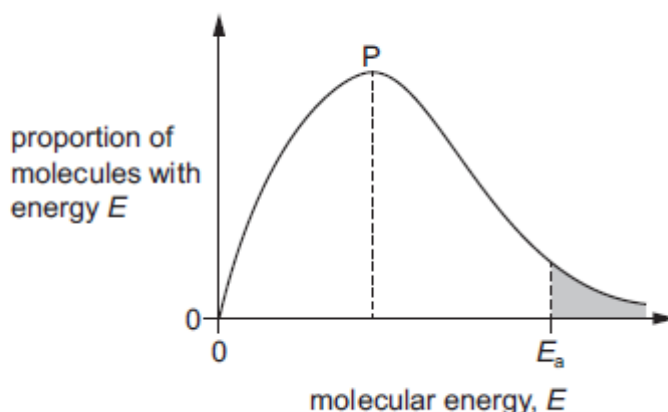


What will increase the rate of this reaction but will **not** change the Boltzmann distribution of molecular energies?

- 1 addition of a suitable catalyst
- 2 an increase in concentration of hydrochloric acid
- 3 an increase in temperature of hydrochloric acid

Q# 460/ AS Chemistry/2019/w/TZ 1/Paper 1/Q# 1//www.SmashingScience.org :o)

- 1 The diagram shows the Boltzmann distribution of energies in a gas. The gas undergoes a reaction with an activation energy, E_a . The peak of the distribution is labelled P.



If the same reaction is carried out in the presence of a catalyst, which statement is correct?

- A The peak P is at a lower height and the position of E_a moves to the left.
- B The peak P is at a lower height and the position of E_a moves to the right.
- C The peak P remains at the same height and the position of E_a moves to the left.
- D The peak P remains at the same height and the position of E_a moves to the right.

Q# 461/ AS Chemistry/2019/s/TZ 1/Paper 1/Q# 1//www.SmashingScience.org :o)

- 1 The temperature of a sample of an inert gas is increased.

What effect does this have on the number of molecules with the most probable energy and on the number of molecules with high energy?

	number of molecules with the most probable energy	number of molecules with high energy
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases



The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

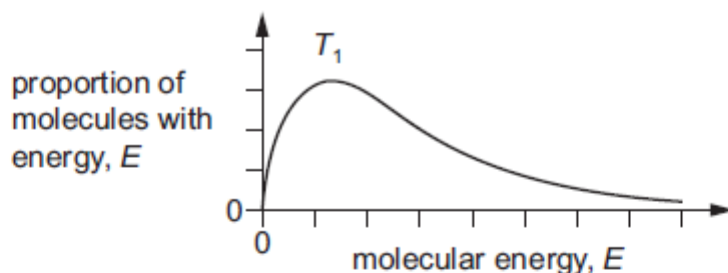
34 Some polluting gases are removed from car exhaust fumes using a catalytic converter.

Platinum or palladium can be used as the catalyst. The reactions are faster when platinum is the catalyst than they are when palladium is the catalyst.

Which statements are correct?

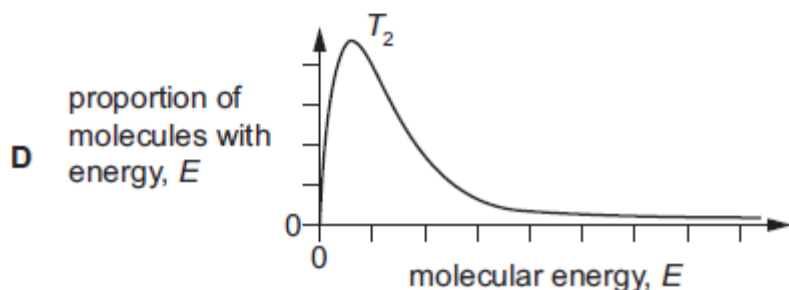
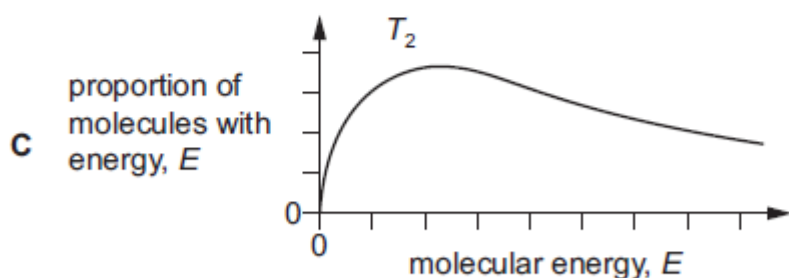
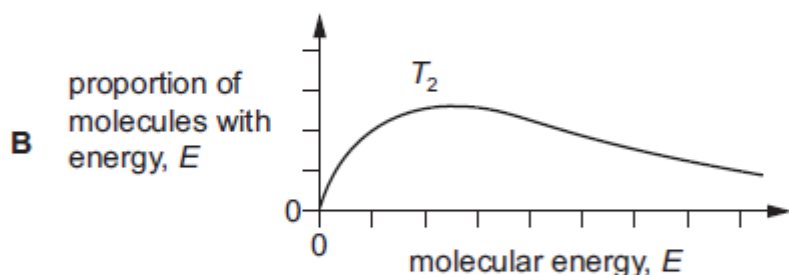
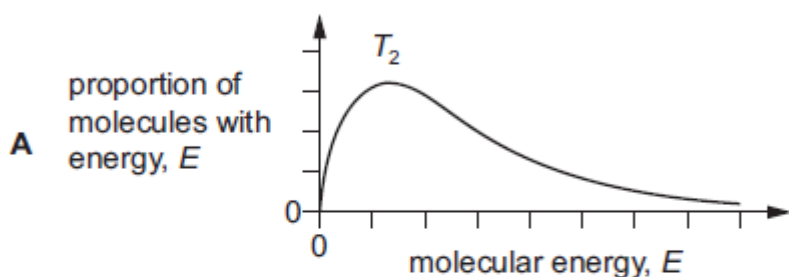
- 1** Platinum acts as a heterogeneous catalyst in these reactions.
- 2** The palladium-catalysed reactions have higher activation energies than the platinum-catalysed reactions.
- 3** The platinum-catalysed reactions are more exothermic than the palladium-catalysed reactions.

1 The Boltzmann distribution is shown for a sample of gas at an initial temperature, T_1 .



The sample of gas was heated to temperature, T_2 .

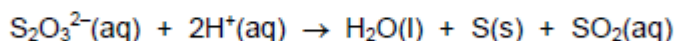
What is the correct distribution for the higher temperature, T_2 ?



The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

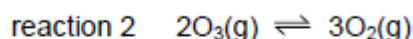
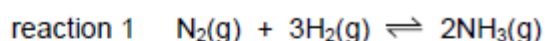
- 34 The factors affecting the rate of reaction between aqueous sodium thiosulfate and hydrochloric acid can be investigated. The ionic equation for the reaction is shown.



Which of the following can be used to investigate the rate of this reaction?

- 1 change of mass
- 2 change of appearance caused by formation of a precipitate
- 3 change of electrical conductivity

- 11 Two reactions are shown.



In reaction 1, a finely powdered iron catalyst is used.

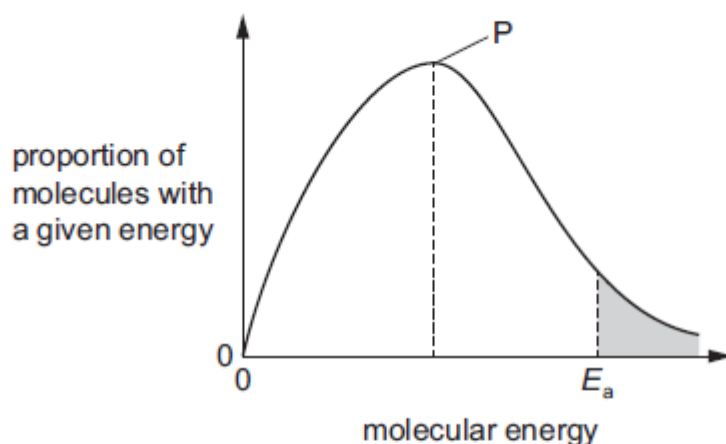
In reaction 2, a vaporised tetrachloromethane catalyst in ultraviolet light is used.

Which statement about the catalysts used is correct?

- A Both reaction 1 and reaction 2 use a heterogeneous catalyst.
- B Both reaction 1 and reaction 2 use a homogeneous catalyst.
- C Reaction 1 uses a heterogeneous catalyst and reaction 2 uses a homogeneous catalyst.
- D Reaction 1 uses a homogeneous catalyst and reaction 2 uses a heterogeneous catalyst.



- 4 The diagram shows the Boltzmann distribution of energies in a gas. The gas can take part in a reaction with an activation energy, E_a . The gas is maintained at a constant temperature.



Which statement is correct?

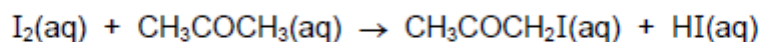
- A If a catalyst is added, peak P will be lower and E_a will move to the left.
- B If a catalyst is added, peak P will be lower and E_a will move to the right.
- C If a catalyst is added, peak P will be the same and E_a will move to the left.
- D If a catalyst is added, peak P will be the same and E_a will move to the right.

- 11 Hydrogen ions catalyse the hydrolysis of esters.

Which statement is correct?

- A The hydrogen ions act as a heterogeneous catalyst.
- B The hydrogen ions are in the same phase as the reactants.
- C The hydrogen ions are used up in the reaction.
- D The hydrogen ions have no effect on the activation energy of the reaction.

- 7 Iodine and propanone react according to the following equation.

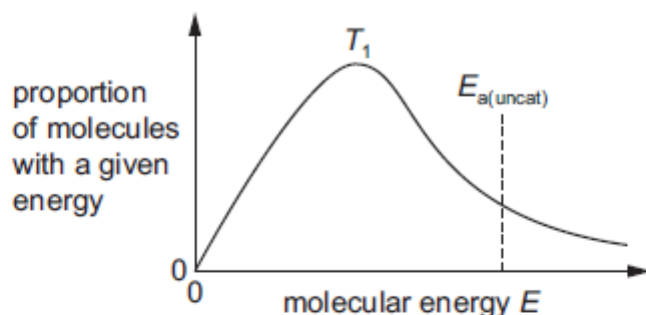


If the concentration of propanone is increased, keeping the total reaction volume constant, the rate of the reaction also increases.

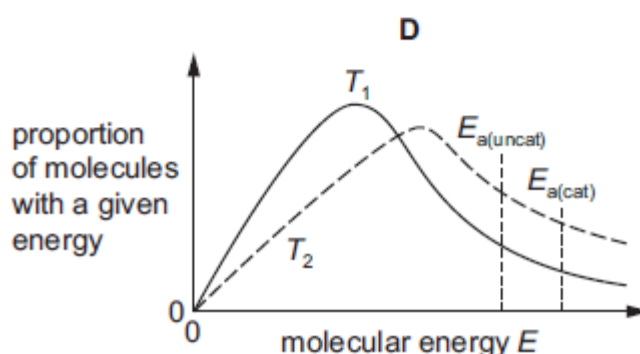
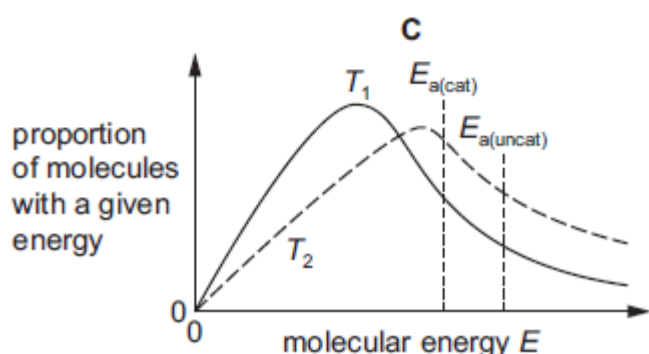
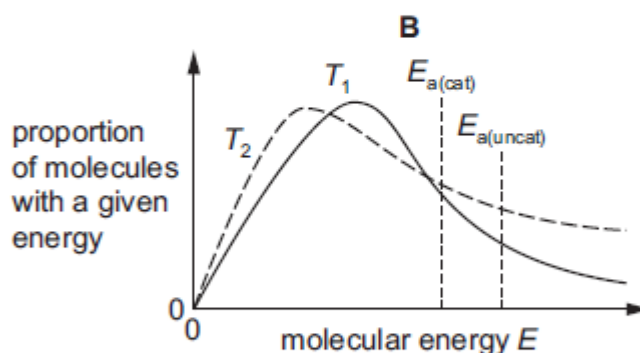
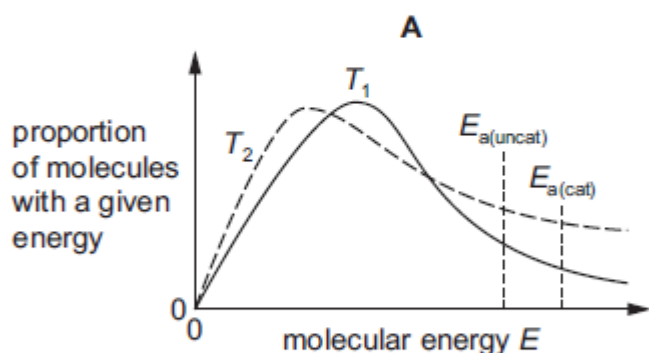
What could be the reason for this?

- A A greater proportion of collisions is successful at the higher concentration.
- B The particles are further apart at the higher concentration.
- C The particles have more energy at the higher concentration.
- D There are more collisions between reactant particles per second at the higher concentration.

- 10 The diagram shows the distribution of molecular energies in a sample of gas at a temperature T_1 . The activation energy for an uncatalysed reaction of this gas, $E_{a(\text{uncat})}$, is shown.



Which diagram correctly shows the new distribution and new activation energy, $E_{a(\text{cat})}$, when the temperature is increased to T_2 , and a catalyst is used that increases the rate of the reaction?



Q# 470/ AS Chemistry/2017/s/TZ 1/Paper 1/Q# 34//www.SmashingScience.org :o)

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

- 34 Which changes can be used to measure the rates of chemical reactions?

- 1 the decrease in concentration of a reactant per unit time
- 2 the rate of appearance of a product
- 3 the increase in total volume per unit time at constant pressure



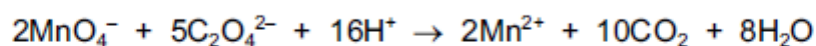
- 11 When 4 g of powdered calcium carbonate, $M_r = 100$, were added to 100 cm^3 of 0.10 mol dm^{-3} hydrochloric acid the volume of carbon dioxide produced was recorded.

time / s	30	60	90	120	150	180	210	240
total volume of carbon dioxide given off / cm^3	40	70	88	101	110	116	120	120

Which row gives the correct explanations about these results?

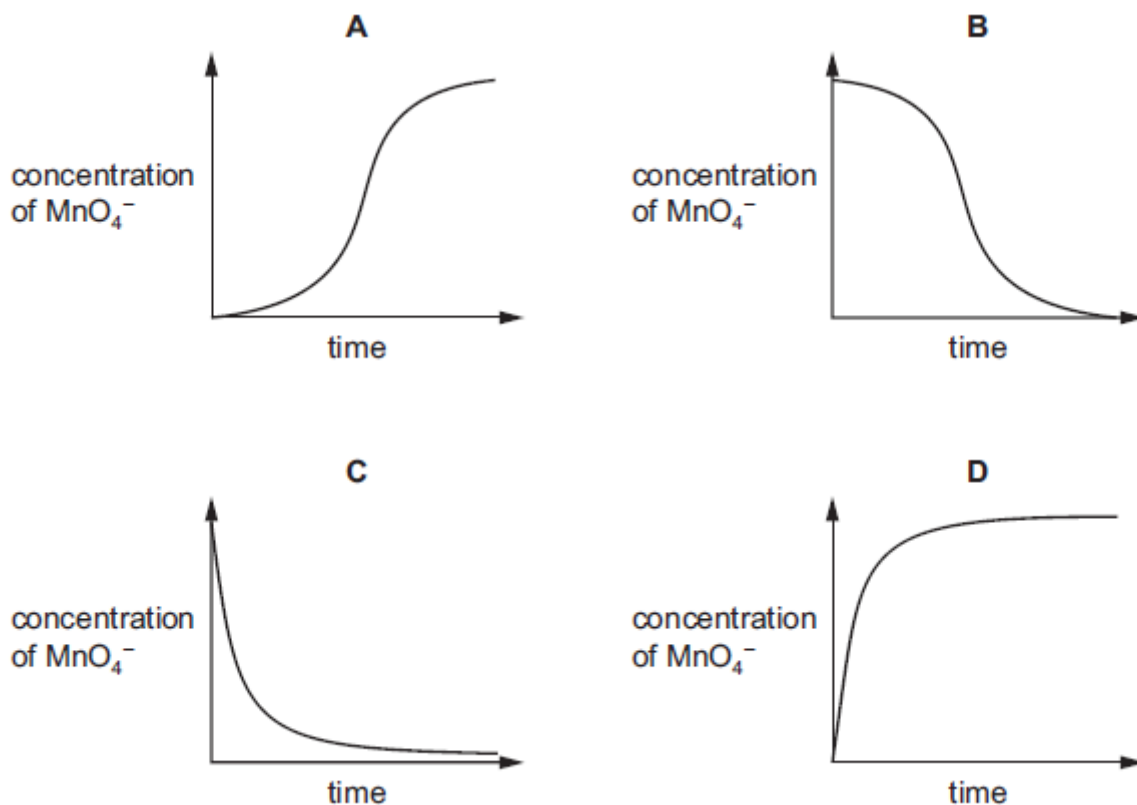
	why the rate of the reaction changes with time	why the reaction stops
A	fewer collisions between reacting molecules occur	the calcium carbonate is used up
B	fewer collisions between reacting molecules occur	the hydrochloric acid is used up
C	more collisions between reacting molecules occur	the calcium carbonate is used up
D	more collisions between reacting molecules occur	the hydrochloric acid is used up

10 Oxidation of ethanedioate ions by acidified manganate(VII) ions is very slow at room temperature.



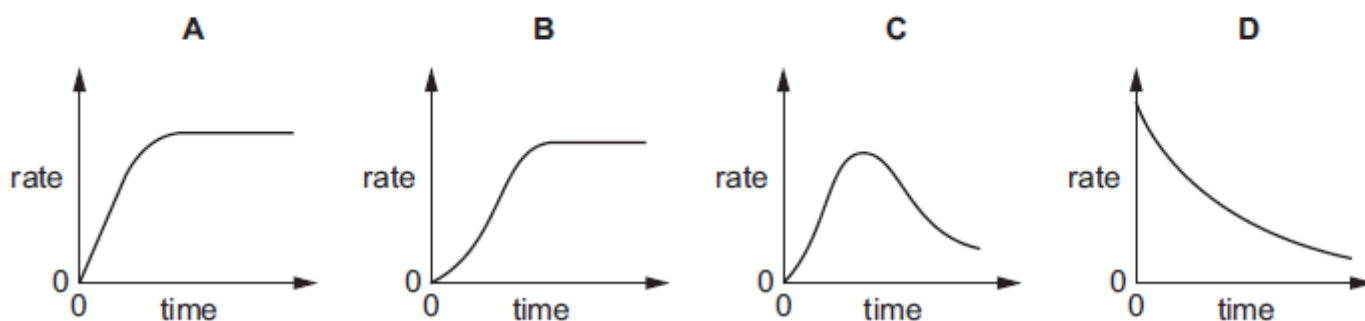
Mn^{2+} ions catalyse this reaction.

Which graph shows how the concentration of acidified manganate(VII) ions varies after ethanedioate ions are added?

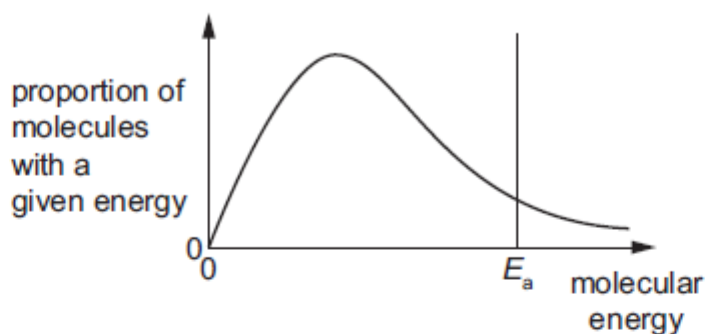


11 An autocatalytic reaction is a reaction in which one of the products catalyses the reaction.

Which curve would be obtained if the rate of an autocatalytic reaction is plotted against time?

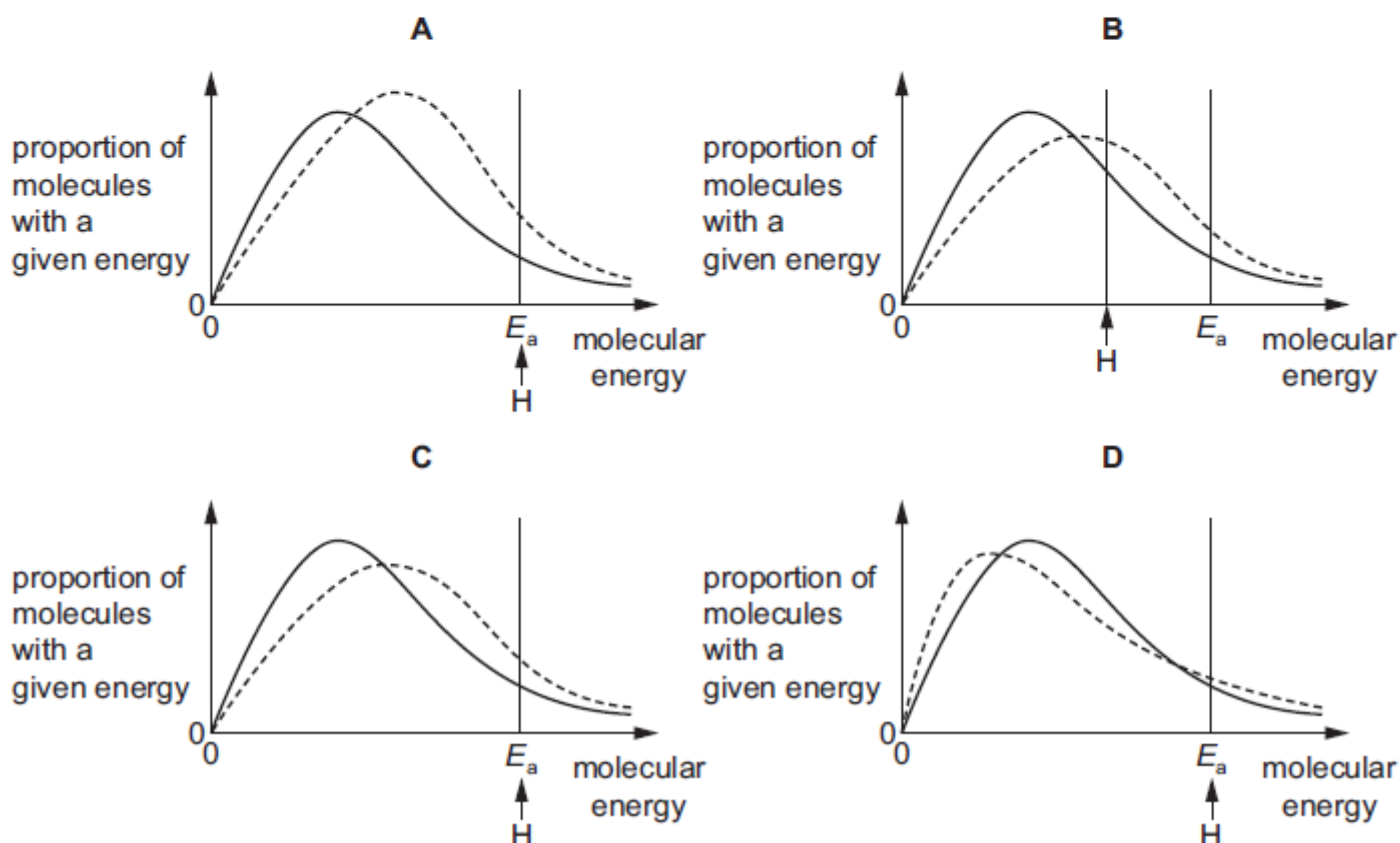


- 1 The diagram represents, for a given temperature, the Boltzmann distribution of the kinetic energies of the molecules in a mixture of two gases that react together. The activation energy for the reaction, E_a , is marked.



The dotted curves below show the Boltzmann distribution for the same reaction at a higher temperature. On these diagrams, H represents the activation energy at the higher temperature.

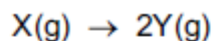
Which diagram is correct?



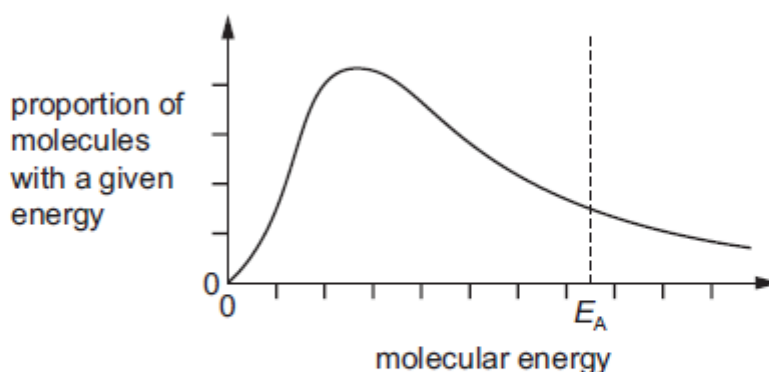
The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

37 The equation shows a gas phase reaction.

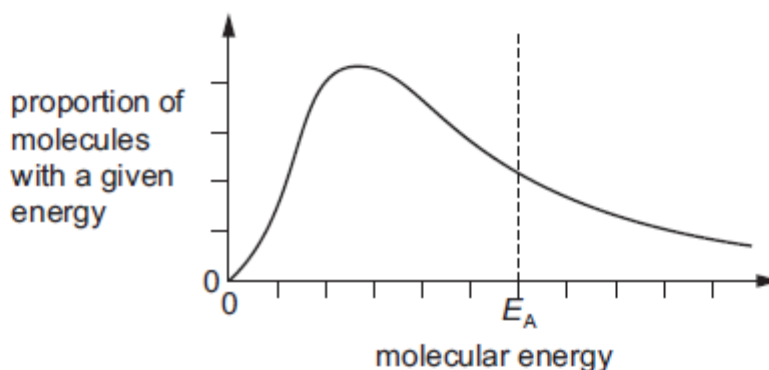


The diagram shows the Boltzmann distribution of a fixed mass of X(g) at temperature T in the absence of a catalyst. The line E_A indicates the activation energy.

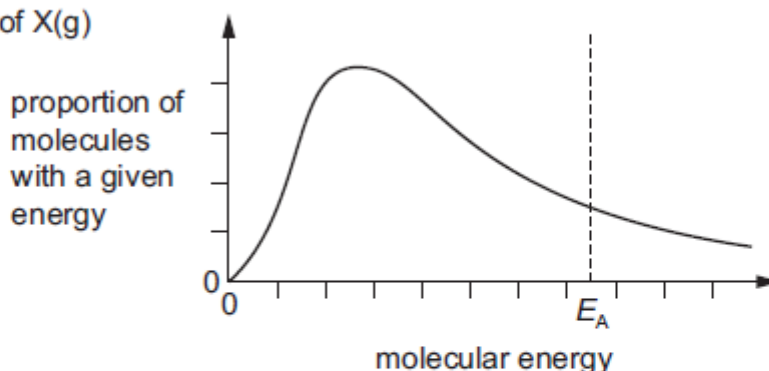


Which diagrams correctly show the effect of the following changes made separately and independently?

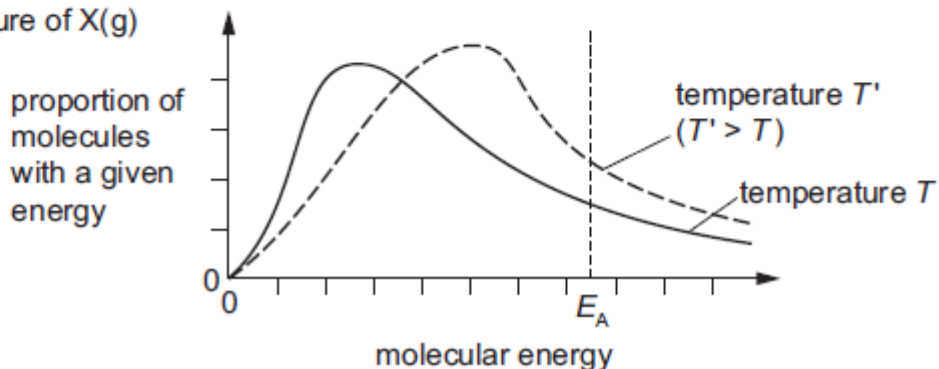
1 adding a catalyst



2 increasing the pressure of X(g)



3 increasing the temperature of X(g)



The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

- 34 A chemist puts a sample of dilute aqueous hydrochloric acid into beaker 1. She adds a sample of zinc and measures the rate of production of hydrogen gas.

She then puts a different sample of dilute aqueous hydrochloric acid into beaker 2. She adds a different sample of zinc and measures the rate of production of hydrogen gas.

The rate of the reaction in beaker 2 is greater than the rate of the reaction in beaker 1.

Which factors **could** help to explain this observation?

- 1 The reaction in beaker 1 has a higher activation energy than the reaction in beaker 2.
- 2 The zinc in beaker 1 is in larger pieces than the zinc in beaker 2.
- 3 The acid in beaker 1 is at a lower concentration than the acid in beaker 2.

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

- 34 Which statements correctly describe an effect of a rise in temperature on a gas-phase reaction?

- 1 More particles now have energies greater than the activation energy.
- 2 The energy distribution profile changes with more particles having the most probable energy.
- 3 The activation energy of the reaction is decreased.

The responses **A** to **D** should be selected on the basis of

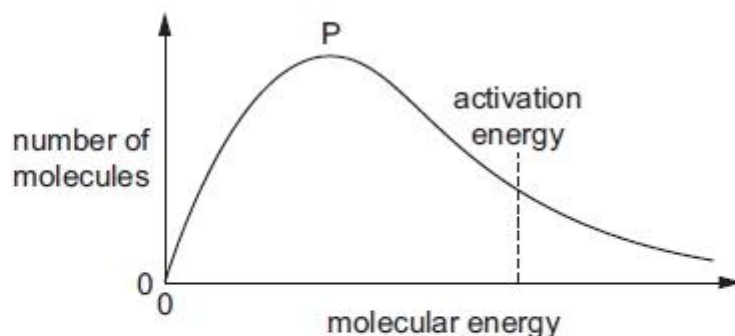
A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

- 34 Why does raising the pressure of a fixed mass of gaseous reactants at a constant temperature cause an increase in the rate of reaction?

- 1 More collisions occur per second when the pressure is increased.
- 2 More molecules have energy greater than the activation energy at the higher pressure.
- 3 Raising the pressure lowers the activation energy.



- 1 The diagram shows a Boltzmann distribution of molecular energies for a gaseous mixture. The distribution has a peak, labelled P on the diagram.



What happens when an effective catalyst is added to the mixture?

- A The height of the peak decreases and the activation energy moves to the right.
- B The height of the peak decreases and the activation energy moves to the left.
- C The height of the peak remains the same and the activation energy moves to the right.
- D The height of the peak remains the same and the activation energy moves to the left.

The responses **A** to **D** should be selected on the basis of

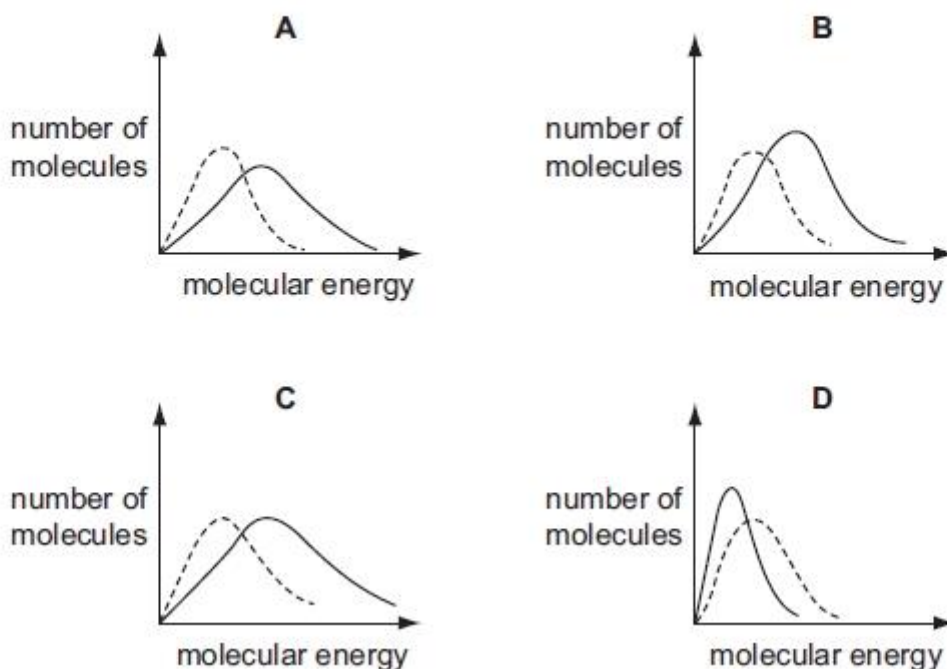
A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

- 33 A reversible reaction is catalysed.

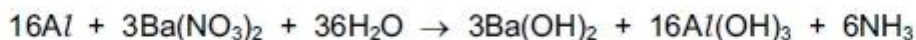
Which statements about the effects of the catalyst on this system are correct?

- 1 The catalyst alters the mechanism of the reaction.
- 2 The catalyst reduces the activation energy for both the forward and the backward reaction.
- 3 The catalyst alters the composition of the equilibrium mixture.

- 1 Which solid-line curve most accurately represents the distribution of molecular energies in a gas at 500K if the dotted-line curve represents the corresponding distribution for the same gas at 300K?



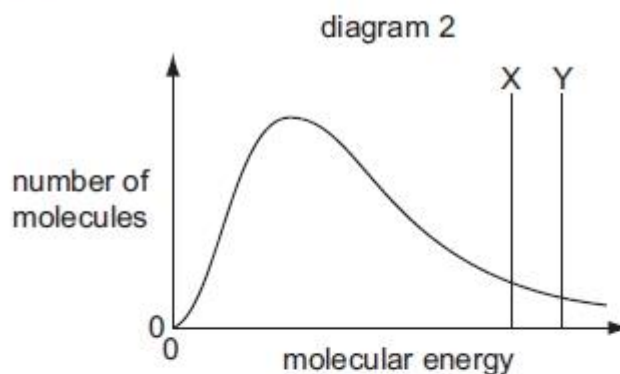
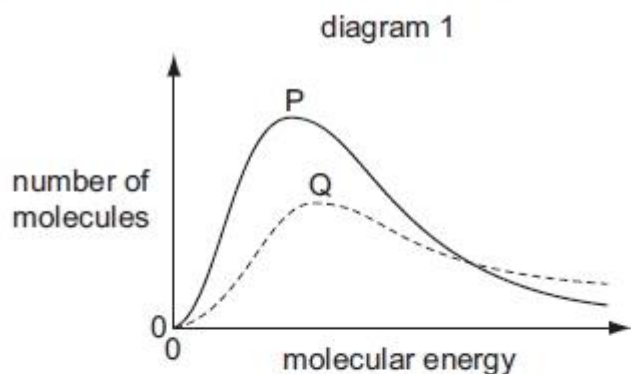
- 8 When making sparkler fireworks, a mixture of barium nitrate powder with aluminium powder, water and glue is coated onto wires and allowed to dry. At this stage, the following exothermic reaction may occur.



Which conditions would be best to reduce the rate of this reaction during the drying process, and would also keep the aluminium and barium nitrate unchanged?

	temperature /K	pH
A	298	7
B	298	14
C	398	7
D	398	14

11 Boltzmann distributions are shown in the diagrams.



In diagram 1, one curve, P or Q, corresponds to a temperature higher than that of the other curve.

In diagram 2, one line, X or Y, 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.

Which combination gives the correct curve and line?

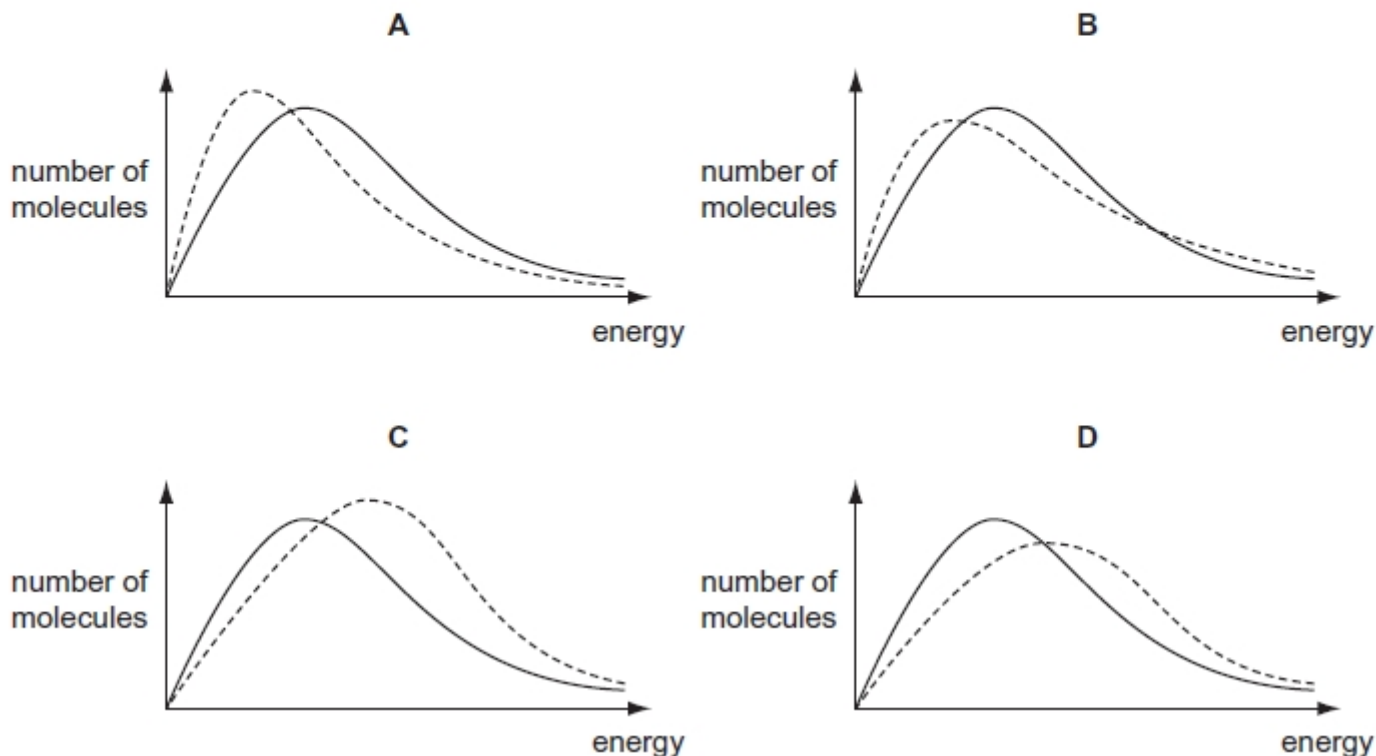
	higher temperature	presence of catalyst
A	P	X
B	P	Y
C	Q	X
D	Q	Y

6 The diagrams below show the Boltzmann distribution for air at two temperatures.

The solid line represents the distribution at -20°C .

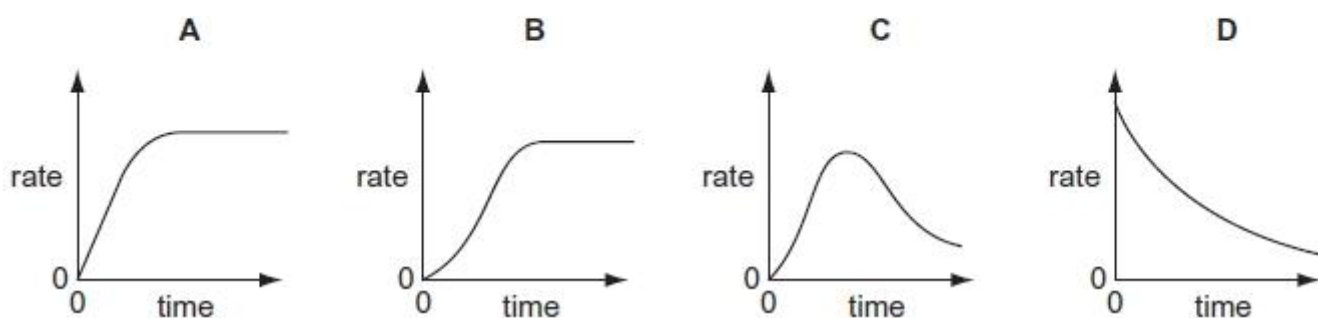
The dotted line represents the distribution at -10°C .

Which diagram is correct?



5 An autocatalytic reaction is a reaction in which one of the products catalyses the reaction.

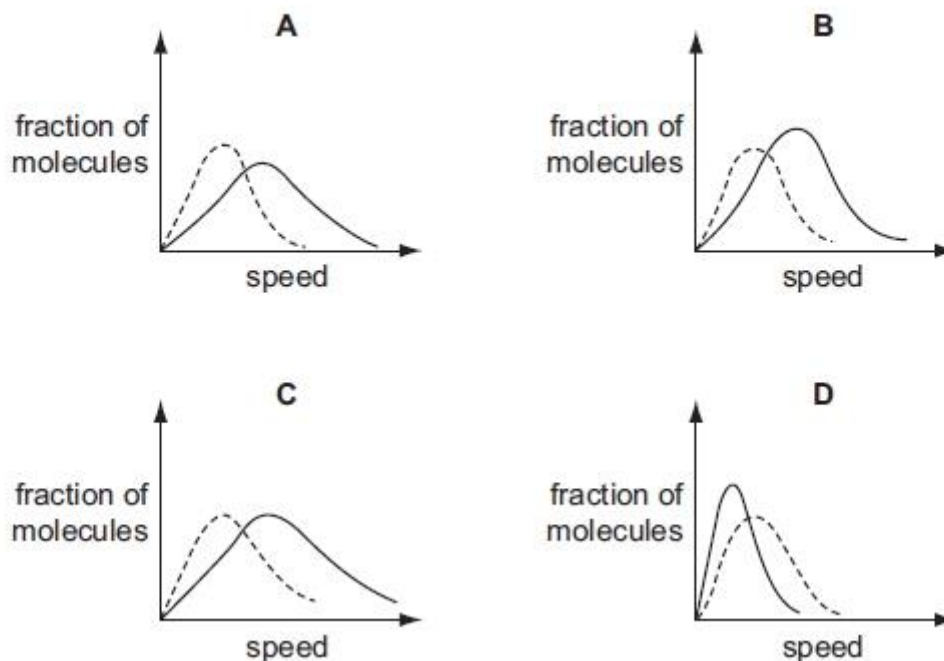
Which curve was obtained if the rate of reaction was plotted against time for an autocatalytic reaction?



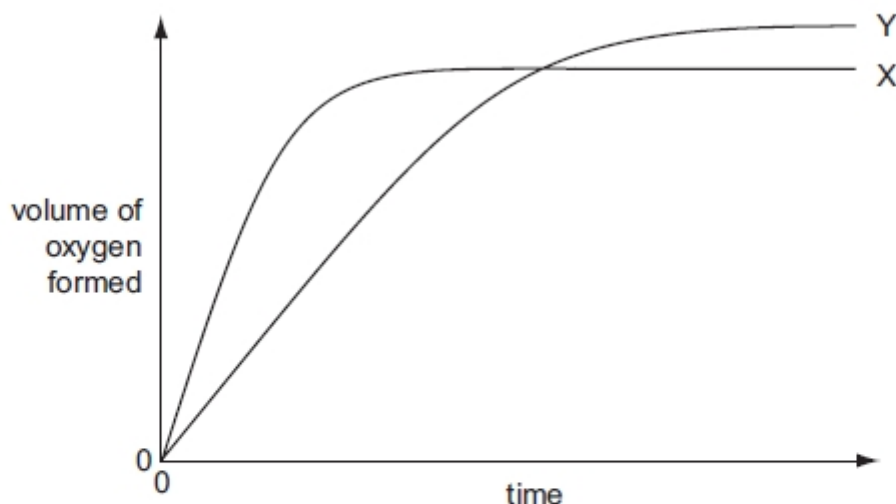
8 Why does the rate of a gaseous reaction increase when the pressure is increased at a constant temperature?

- A More particles have energy that exceeds the activation energy.
- B The particles have more space in which to move.
- C The particles move faster.
- D There are more frequent collisions between particles.

- 11 Which solid-line curve most accurately represents the distribution of molecular speeds in a gas at 500 K if the dotted-line curve represents the corresponding distribution for the same gas at 300 K?



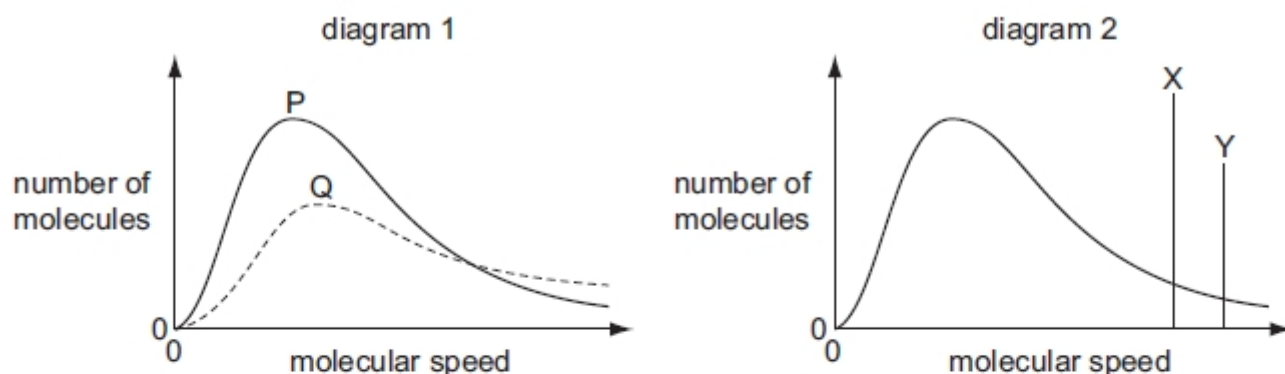
- 6 In the diagram, curve X was obtained by observing the decomposition of 100 cm^3 of 1.0 mol dm^{-3} hydrogen peroxide, catalysed by manganese(IV) oxide.



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

- A adding some 0.1 mol dm^{-3} hydrogen peroxide
- B adding water
- C lowering the temperature
- D using less manganese(IV) oxide

4 Different Boltzmann distributions are shown in the diagrams.



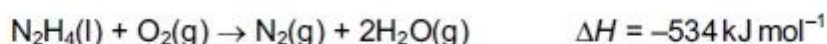
In diagram 1, one curve P or Q corresponds to a temperature higher than that of the other curve.

In diagram 2, one line X or Y corresponds to the activation energy for a catalysed reaction and the other line corresponds to the activation energy of the same reaction when uncatalysed.

Which combination gives the correct curve and line?

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

12 Hydrazine, N_2H_4 , is widely used as a rocket fuel because it reacts with oxygen as shown, producing 'environmentally friendly' gases.



Despite its use as a rocket fuel, hydrazine does not burn spontaneously in oxygen.

Which statement explains why hydrazine does **not** burn spontaneously?

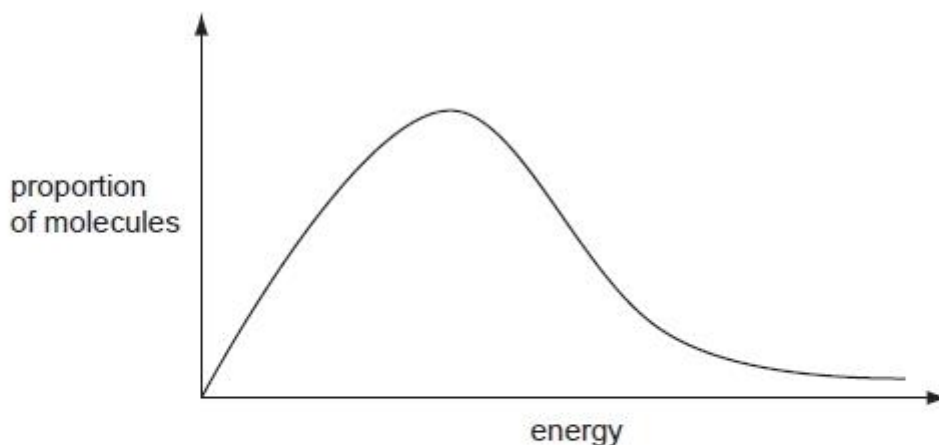
- A** Hydrazine is a liquid.
- B** The activation energy is too high.
- C** The $\text{N}\equiv\text{N}$ bond is very strong.
- D** The reaction is exothermic.

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct



32 The diagram represents the Boltzmann distribution of molecular energies at a given temperature.



Which of the factors that affect the rate of a reaction can be explained using such a Boltzmann distribution?

- 1 increasing the concentration of reactants
- 2 increasing the temperature
- 3 the addition of a catalyst

Q# 492/ AS Chemistry/2010/s/TZ 1/Paper 1/Q# 12//www.SmashingScience.org :o)

12 $\text{Na}_2\text{S}_2\text{O}_3$ reacts with dilute HCl to give a pale yellow precipitate. If 1 cm^3 of 0.1 mol dm^{-3} HCl is added to 10 cm^3 of 0.02 mol dm^{-3} $\text{Na}_2\text{S}_2\text{O}_3$ the precipitate forms slowly.

If 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} $\text{Na}_2\text{S}_2\text{O}_3$ the precipitate forms more quickly.

Why is this?

- A The activation energy of the reaction is lower when 0.05 mol dm^{-3} $\text{Na}_2\text{S}_2\text{O}_3$ is used.
- B The reaction proceeds by a different pathway when 0.05 mol dm^{-3} $\text{Na}_2\text{S}_2\text{O}_3$ is used.
- C The collisions between reactant particles are more violent when 0.05 mol dm^{-3} $\text{Na}_2\text{S}_2\text{O}_3$ is used.
- D The reactant particles collide more frequently when 0.05 mol dm^{-3} $\text{Na}_2\text{S}_2\text{O}_3$ is used.

Q# 493/ AS Chemistry/2009/w/TZ 1/Paper 1/Q# 34//www.SmashingScience.org :o)

The responses A to D should be selected on the basis of

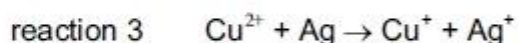
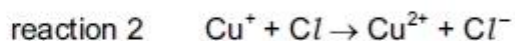
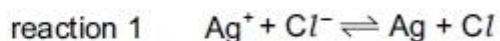
A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

34 Why does a mixture of hydrogen gas and bromine gas react together faster at a temperature of 500 K than it does at a temperature of 400 K ?

- 1 A higher proportion of effective collisions occurs at 500 K .
- 2 Hydrogen molecules and bromine molecules collide more frequently at 500 K .
- 3 The activation energy of the reaction is lower at 500 K .

- 11 Photochromic glass, used for sunglasses, darkens when exposed to bright light and becomes more transparent again when the light is less bright. The depth of colour of the glass is related to the concentration of silver atoms.

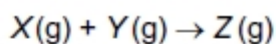
The following reactions are involved.



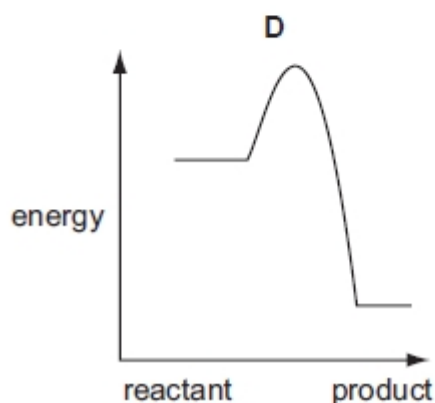
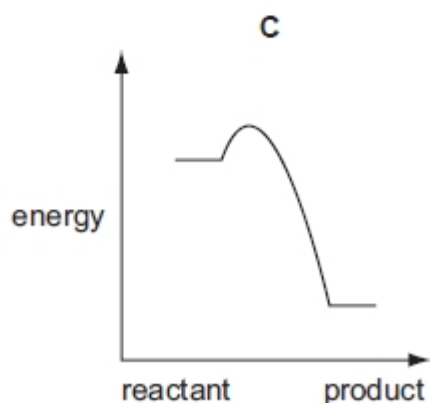
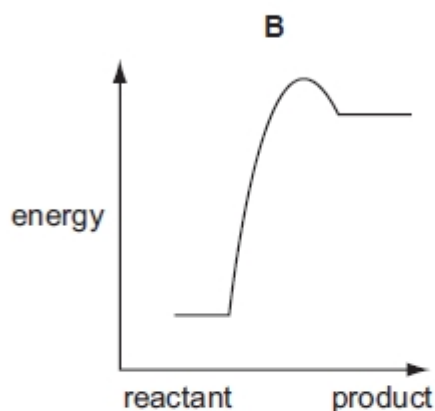
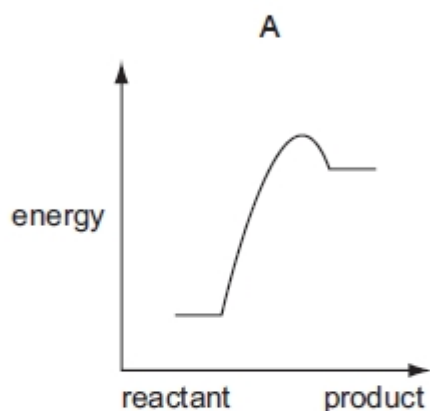
Which statement about these reactions is correct?

- A Cu^+ and Cu^{2+} ions act as catalysts.
- B Cu^+ ions act as an oxidising agent in reaction 2.
- C Reaction 2 is the one in which light is absorbed.
- D Ag^+ ions are oxidised in reaction 1.

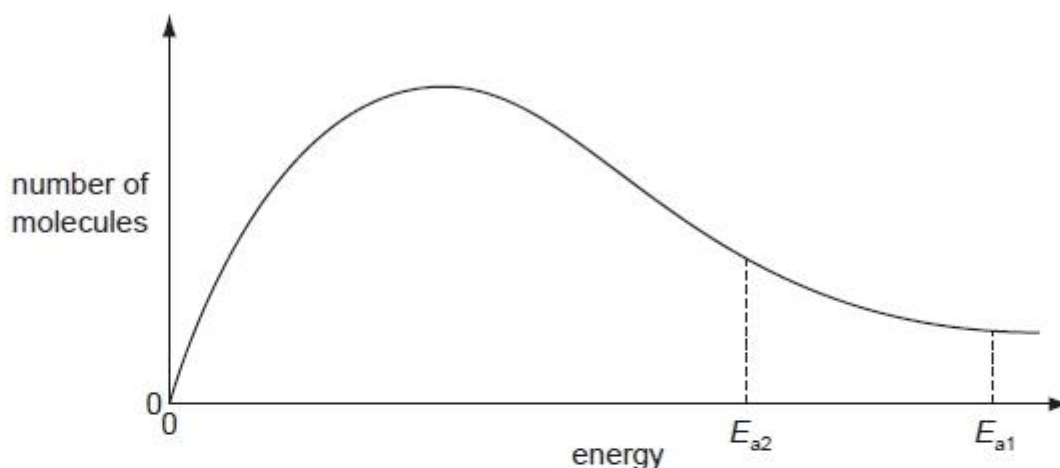
- 10 Four reactions of the type shown are studied at the same temperature.



Which is the correct reaction pathway diagram for the reaction that would proceed **most** rapidly and with the **highest** yield?



- 10 The diagram shows the Maxwell-Boltzmann energy distribution curve for molecules of a mixture of two gases at a given temperature. For a reaction to occur the molecules must collide together with sufficient energy.



E_a is the activation energy for the reaction between the gases. Of the two values shown, one is for a catalysed reaction, the other for an uncatalysed one.

Which pair of statements is correct when a catalyst is used?

A	E_{a1} catalysed reaction fewer effective collisions	E_{a2} uncatalysed reaction more effective collisions
B	E_{a1} uncatalysed reaction fewer effective collisions	E_{a2} catalysed reaction more effective collisions
C	E_{a1} catalysed reaction more effective collisions	E_{a2} uncatalysed reaction fewer effective collisions
D	E_{a1} uncatalysed reaction more effective collisions	E_{a2} catalysed reaction fewer effective collisions

Mark Scheme ALV1 Chem 8 EQ P1 22w to 09s Paper 1 Reaction kinetics 51marks

Q# 445/ AS Chemistry/2022/w/TZ 1/Paper 1/Q# 16//www.SmashingScience.org :o)

16 | A

Q# 446/ AS Chemistry/2022/w/TZ 1/Paper 1/Q# 15//www.SmashingScience.org :o)

15 | A

Q# 447/ AS Chemistry/2022/s/TZ 1/Paper 1/Q# 15//www.SmashingScience.org :o)

15 | B

Q# 448/ AS Chemistry/2022/m/TZ 2/Paper 1/Q# 16//www.SmashingScience.org :o)

16 | B

Q# 449/ AS Chemistry/2022/m/TZ 2/Paper 1/Q# 15//www.SmashingScience.org :o)

15 | A

Q# 450/ AS Chemistry/2022/m/TZ 2/Paper 1/Q# 11//www.SmashingScience.org :o)

11 | C

Q# 451/ AS Chemistry/2021/w/TZ 1/Paper 1/Q# 31//www.SmashingScience.org :o)

31 | A

Q# 452/ AS Chemistry/2021/w/TZ 1/Paper 1/Q# 11//www.SmashingScience.org :o)

11 | D

Q# 453/ AS Chemistry/2021/s/TZ 1/Paper 1/Q# 5//www.SmashingScience.org :o)

5 | B

Q# 454/ AS Chemistry/2021/s/TZ 1/Paper 1/Q# 11//www.SmashingScience.org :o)

11 | C



Q# 455/ AS Chemistry/2021/m/TZ 2/Paper 1/Q# 11//www.SmashingScience.org :o)
11 | D

Q# 456/ AS Chemistry/2021/m/TZ 2/Paper 1/Q# 10//www.SmashingScience.org :o)
10 | C

Q# 457/ AS Chemistry/2020/w/TZ 1/Paper 1/Q# 11//www.SmashingScience.org :o)
11 | C

Q# 458/ AS Chemistry/2020/s/TZ 1/Paper 1/Q# 6//www.SmashingScience.org :o)
6 | C

Q# 459/ AS Chemistry/2020/m/TZ 2/Paper 1/Q# 34//www.SmashingScience.org :o)
34 | B

Q# 460/ AS Chemistry/2019/w/TZ 1/Paper 1/Q# 1//www.SmashingScience.org :o)
1 | C

Q# 461/ AS Chemistry/2019/s/TZ 1/Paper 1/Q# 1//www.SmashingScience.org :o)
1 | B

Q# 462/ AS Chemistry/2019/m/TZ 2/Paper 1/Q# 34//www.SmashingScience.org :o)
34 | B

Q# 463/ AS Chemistry/2019/m/TZ 2/Paper 1/Q# 1//www.SmashingScience.org :o)
1 | B

Q# 464/ AS Chemistry/2018/w/TZ 1/Paper 1/Q# 34//www.SmashingScience.org :o)
34 | C

Q# 465/ AS Chemistry/2018/w/TZ 1/Paper 1/Q# 11//www.SmashingScience.org :o)
11 | C

Q# 466/ AS Chemistry/2018/s/TZ 1/Paper 1/Q# 4//
4 | C

Q# 467/ AS Chemistry/2018/s/TZ 1/Paper 1/Q# 11//www.SmashingScience.org :o)
11 | B

Q# 468/ AS Chemistry/2017/w/TZ 1/Paper 1/Q# 7//
7 | D

Q# 469/ AS Chemistry/2017/w/TZ 1/Paper 1/Q# 10//
10 | C

Q# 470/ AS Chemistry/2017/s/TZ 1/Paper 1/Q# 34//www.SmashingScience.org :o)
34 | A

Q# 471/ AS Chemistry/2017/s/TZ 1/Paper 1/Q# 11//
11 | B

Q# 472/ AS Chemistry/2017/m/TZ 2/Paper 1/Q# 10//:o)
10 | B

Q# 473/ AS Chemistry/2016/w/TZ 1/Paper 1/Q# 11//:o)
11 | C

Q# 474/ AS Chemistry/2016/w/TZ 1/Paper 1/Q# 1//:o)
1 | C

Q# 475/ AS Chemistry/2016/s/TZ 1/Paper 1/Q# 37//:o)
37 | B

Q# 476/ AS Chemistry/2016/m/TZ 2/Paper 1/Q# 34//:o)
34 | C

Q# 477/ AS Chemistry/2015/w/TZ 1/Paper 1/Q# 34//:o)
34 | D

Q# 478/ AS Chemistry/2015/s/TZ 1/Paper 1/Q# 34//:o)
34 | D

Q# 479/ AS Chemistry/2015/s/TZ 1/Paper 1/Q# 1//:o)
1 | D

Q# 480/ AS Chemistry/2014/w/TZ 1/Paper 1/Q# 33//:o)
33 | B

Q# 481/ AS Chemistry/2014/w/TZ 1/Paper 1/Q# 1//:o)
1 | A

Q# 482/ AS Chemistry/2014/s/TZ 1/Paper 1/Q# 8//:o)
8 | A

Q# 483/ AS Chemistry/2014/s/TZ 1/Paper 1/Q# 11//:o)
11 | C

Q# 484/ AS Chemistry/2013/w/TZ 1/Paper 1/Q# 6//:o)
6 | D

Q# 485/ AS Chemistry/2013/w/TZ 1/Paper 1/Q# 5//:o)
5 | C

Q# 486/ AS Chemistry/2013/s/TZ 1/Paper 1/Q# 8//:o)
8 | D

Q# 487/ AS Chemistry/2011/w/TZ 1/Paper 1/Q# 11//:o)
11 | A

Q# 488/ AS Chemistry/2011/s/TZ 1/Paper 1/Q# 6//:o)
6 | A

Q# 489/ AS Chemistry/2011/s/TZ 1/Paper 1/Q# 4//:o)
4 | C

Q# 490/ AS Chemistry/2011/s/TZ 1/Paper 1/Q# 12//:o)
12 | B

Q# 491/ AS Chemistry/2010/w/TZ 1/Paper 1/Q# 32//:o)
32 | C

Q# 492/ AS Chemistry/2010/s/TZ 1/Paper 1/Q# 12//:o)
12 | D

Q# 493/ AS Chemistry/2009/w/TZ 1/Paper 1/Q# 34//:o)
34 | B

Q# 494/ AS Chemistry/2009/w/TZ 1/Paper 1/Q# 11//:o)
11 | A

Q# 495/ AS Chemistry/2009/w/TZ 1/Paper 1/Q# 10//:o)
10 | C

Q# 496/ AS Chemistry/2009/s/TZ 1/Paper 1/Q# 10//:o)
10 | B

