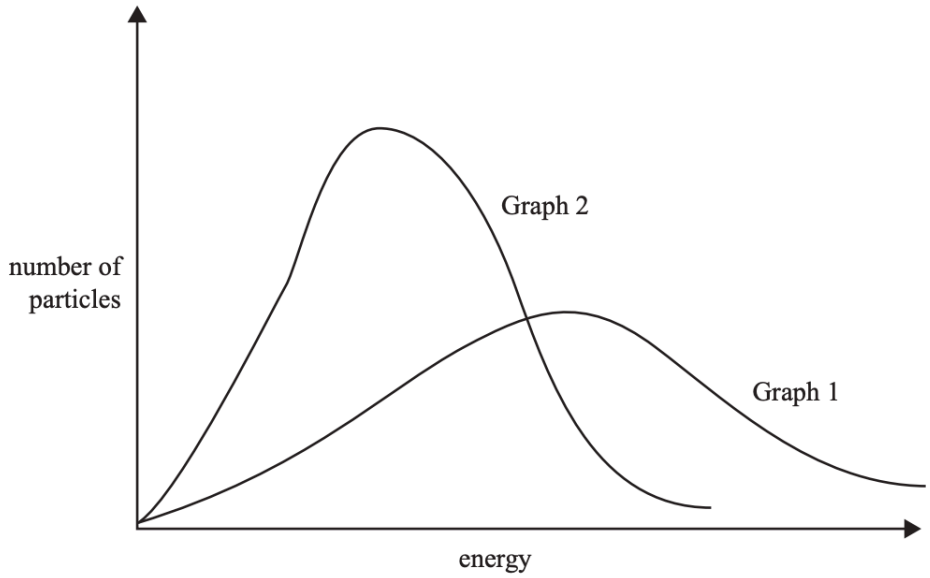
1. VCE 2018 Q20

The kinetic energy of a sample of gas in a container of fixed volume is represented by the distribution curve shown in Graph 1 below.

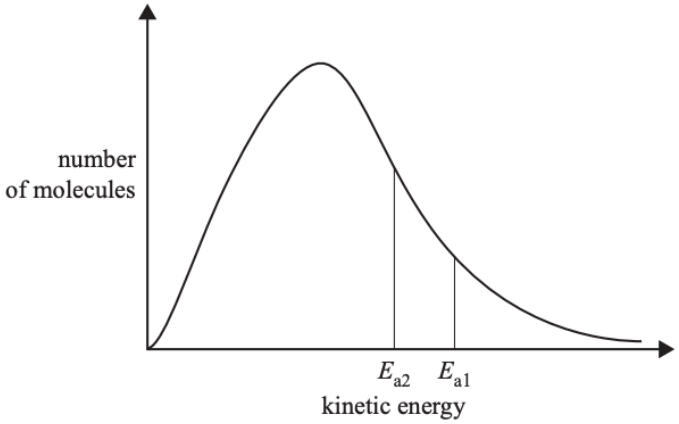
One change was made to the sample and the resulting distribution curve of kinetic energy is shown in Graph 2.



Which one of the following statements explains the change from Graph 1 to Graph 2?

(A) The average kinetic energy of the gas molecules decreased.
(B) More gas, at the same temperature, was added to the container.
(C) More collisions occurred between gas particles.
(D) The temperature of the gas was increased.

2. VCE 2018(2) Q10



The diagram above represents the distribution of kinetic energy in a sample of gaseous reactant molecules. Activation energy E_{a1} can be changed to activation energy E_{a2}. This change increases the reaction rate.

Which of the following gives the most likely cause of the change from E_{a1} to E_{a2} and explains why the reaction rate would increase?

	Cause	Why the reaction rate increases
A.	catalyst added	molecules move faster, resulting in more successful collisions
B.	catalyst added	greater proportion of reactants collide with sufficient energy to react
C.	temperature increased	greater proportion of reactants collide with the correct orientation to react
D.	concentration of reactants increased	greater frequency of collisions, resulting in more successful collisions

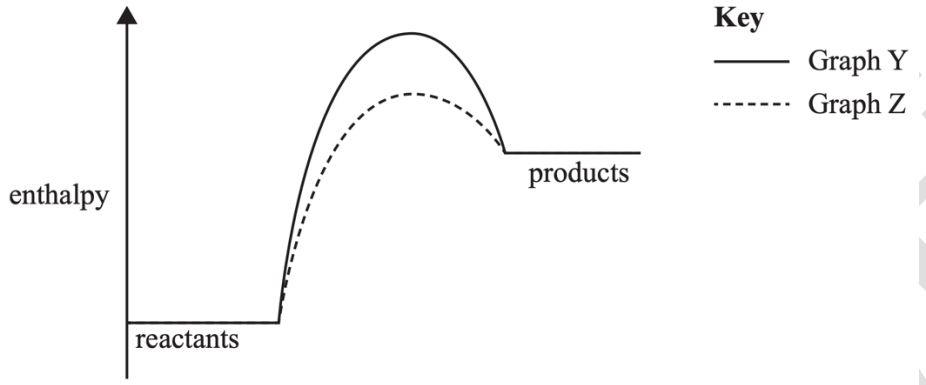
3. VCE 2017 Q1

A catalyst

(A) slows the rate of reaction.
(B) ensures that a reaction is exothermic.
(C) moves the chemical equilibrium of a reaction in the forward direction.
(D) provides an alternative pathway for the reaction with a lower activation energy.

4. VCE 2017(2) Q6

In the diagram below, Graph Y represents the energy profile for the reaction between two gases in a sealed container. The experiment was repeated and one change was made to the reaction conditions. Graph Z represents the energy profile under the new conditions.



Which one of the following possible changes to the reaction conditions would result in the change in the energy profile from Graph Y to Graph Z?

(A) The initial temperature of the gases was higher.
(B) An inert gas was added to the reaction container.
(C) The volume of the reaction container was decreased.
(D) A catalyst was added to the reaction container with the gases.

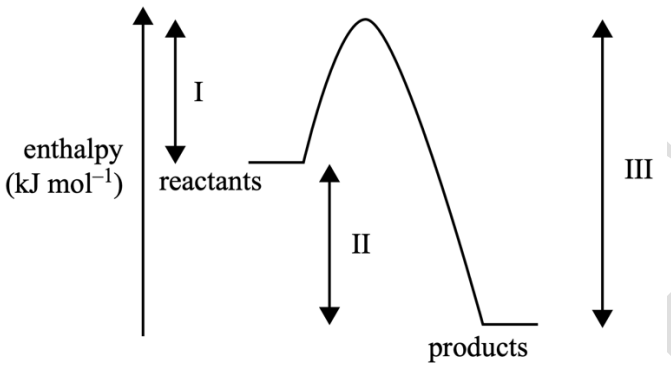
5. VCE 2017(2) Q7

Which one of the following statements is correct for an exothermic reaction?

(A) The enthalpy change is positive.
(B) The activation energy is negative.
(C) Heat energy is absorbed from the environment.
(D) The enthalpy of the reactants is higher than that of the products.

6. VCE 2015 Q16

Consider the following energy profile for a particular chemical reaction, where I, II and III represent enthalpy changes during the reaction.

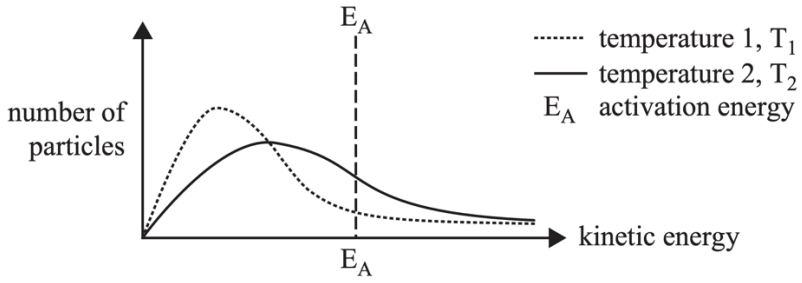


Which one of the following statements is correct?

(A) The activation energy for the reverse reaction is (III–II).
(B) The net energy released for the forward reaction is represented by II.
(C) The energy required to break the reactant bonds is represented by II.
(D) The energy released by the formation of new bonds is represented by I.

7. VCE 2012(2) Q3

The diagram below represents the distribution of the kinetic energy of reactant particles at two different temperatures. Assume that the areas under the curves are equal.



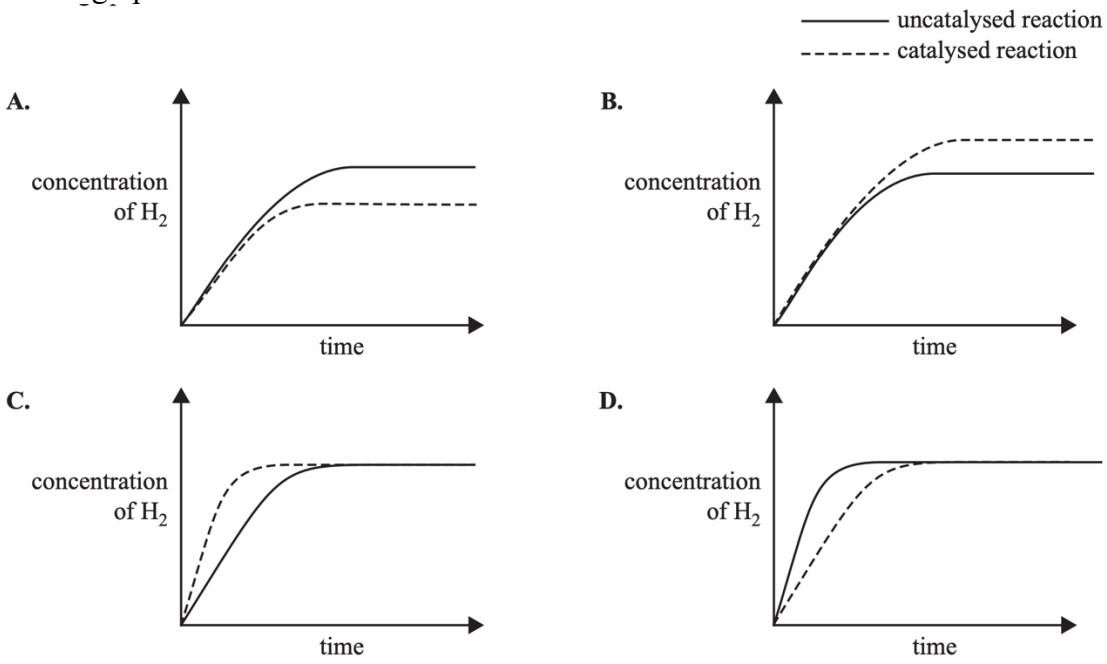
From this diagram it can be concluded that

(A) at T_1 a greater number of particles have sufficient energy to react. T_1 is greater than T_2.
(B) at T_1 a greater number of particles have sufficient energy to react. T_2 is greater than T_1.
(C) at T_2 a greater number of particles have sufficient energy to react. T_1 is greater than T_2.
(D) at T_2 a greater number of particles have sufficient energy to react. T_2 is greater than T_1.

8. VCE 2012(2) Q11

In trials, the reaction is carried out with and without a catalyst in the sealed container. All other conditions are unchanged. The change in hydrogen concentration with time between an uncatalysed and a catalysed reaction is represented by a graph.

Which graph is correct?

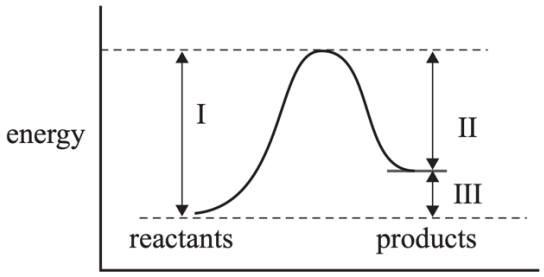


9. VCE 2010(2) Q2

For an endothermic reaction

(A) the enthalpy change is negative.
(B) equilibrium can never be achieved.
(C) the reaction absorbs energy from its surroundings.
(D) the enthalpy of the reactants is higher than the enthalpy of the products.

10. VCE 2010(2) Q3



For a gas phase reaction, which of the quantities (I, II and III) in the energy profile diagram above are affected by decreasing the volume of the reaction vessel at constant temperature?

(A) I and II only
(B) I and III only
(C) I, II and III
(D) none of the quantities

11. VCE 2009(2) Q1

The addition of a catalyst to a chemical reaction

(A) lowers the activation energy required for the reaction to occur.
(B) lowers the chemical energy of the products.
(C) lowers the chemical energy of the reactants.
(D) lowers the value of the enthalpy change for the reaction.

12. VCE 2009(2) Q2

The two statements below give possible explanations for changes that occur when the temperature of a reaction mixture is increased.

I. At a higher temperature, particles move faster and the reactant particles collide more frequently.

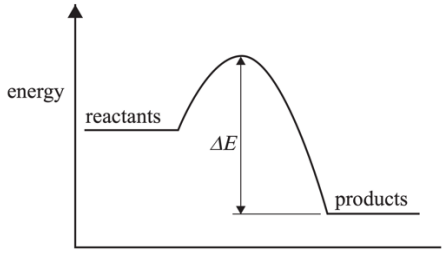
II. At a higher temperature, more particles have energy greater than the activation energy.

Which alternative below best explains why the observed reaction rate is greater at higher temperatures?

(A) **I** only
(B) **II** only
(C) **I** and **II** to an equal extent
(D) **I** and **II**, but **II** to a greater extent than **I**

13. VCE 2009(2) Q3

The change in energy during a reaction is represented in the following energy profile diagram.



The change in energy labelled ΔE above is

(A) the energy absorbed when bonds in the reactants break.
(B) the activation energy of the forward reaction.
(C) the activation energy for the reverse reaction.
(D) the heat of reaction.

14. VCE 2008(2) Q2

This reaction occurs at a measurable rate only when the finely divided catalyst is present. This catalyst increases the reaction rate because

(A) it strongly attracts the reaction products, driving the reaction to the right.
(B) the reactants can become attached to its surface where they can meet and undergo reaction.
(C) it provides energy to the reactants when their molecules bounce off it, increasing the proportion of molecules in the gas state with the required activation energy.
(D) it increases the equilibrium constant of the reaction, causing an increase in the proportion of products at equilibrium.

15. VCE 2008(2) Q4

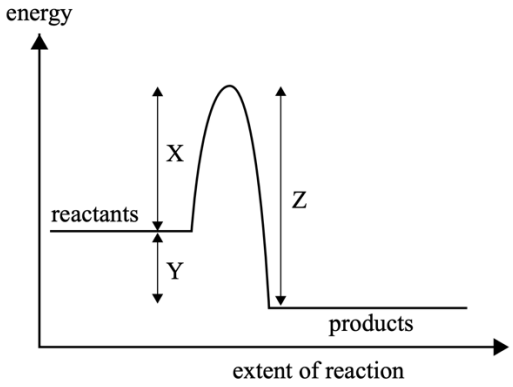
The rate of a reaction generally increases with temperature. The factor that has the biggest effect on the increase in reaction rate is that with increasing temperature

(A) the activation energy of the reaction increases.
(B) the activation energy of the reaction decreases.
(C) the number of collisions between particles increases.
(D) the proportion of particles with high kinetic energy increases.

Questions 5 and 6 refer to the following information.
The following reaction can occur to completion in aqueous solution.

$$CH_3Cl(aq) + OH^-(aq) \rightarrow CH_3OH(aq) + Cl^-(aq)$$

The energy change during this process is illustrated by



16. VCE 2008(2) Q5

A reaction can occur between a CH_3Cl molecule and a hydroxide ion

(A) every time they collide.
(B) only when they collide with exactly the energy X.
(C) only when they collide with an energy equal to Y–Z.
(D) only when they collide with an energy greater than or equal to energy X.

17. VCE 2008(2) Q6

A catalyst appropriate for this reaction will affect the value of

(A) X only.
(B) Y only.
(C) X and Z only.
(D) X, Y and Z.

18. VCE 2007(1) Q8

A chemical reaction has a ΔH of –150 kJ mol^{-1} and the activation energy for its **reverse** reaction is 350 kJ mol^{-1}. The activation energy, in kJ mol^{-1}, of the **forward** reaction is

(A) +500
(B) +200
(C) +150
(D) –200

19. VCE 2006(1) Q3

Zinc metal reacts with 0.1 M hydrochloric acid to form hydrogen gas and zinc chloride solution. The production of hydrogen gas is more vigorous if the zinc is powdered, rather than in large pieces, because the

(A) activation energy of the reaction is lower.
(B) activation energy of the reaction is higher.
(C) frequency of collisions between zinc metal and hydrogen ions is higher.
(D) fraction of reactant particles with sufficient energy to react is higher

20. VCE 2006(1) Q18

Consider the following information for the reaction A + B → C.

heat of reaction: –120 kJ mol^{-1}

activation energy: +200 kJ mol^{-1}

The activation energy, in kJ mol^{-1}, for the reaction C → A + B, is

A. –320
B. –80
C. +80
D. +320

21. VCE 2003(1) Q2

The rate of decomposition of hydrogen peroxide is increased by the presence of a catalyst. The catalyst

(A) increases the equilibrium constant for the reaction.
(B) provides a reaction pathway with a lower activation energy.
(C) provides a reaction pathway with a greater activation energy.
(D) increases the average kinetic energy of the hydrogen peroxide molecules.

22. VCE 2002(1) Q5

The best description of the effect of a catalyst on a chemical reaction is that it

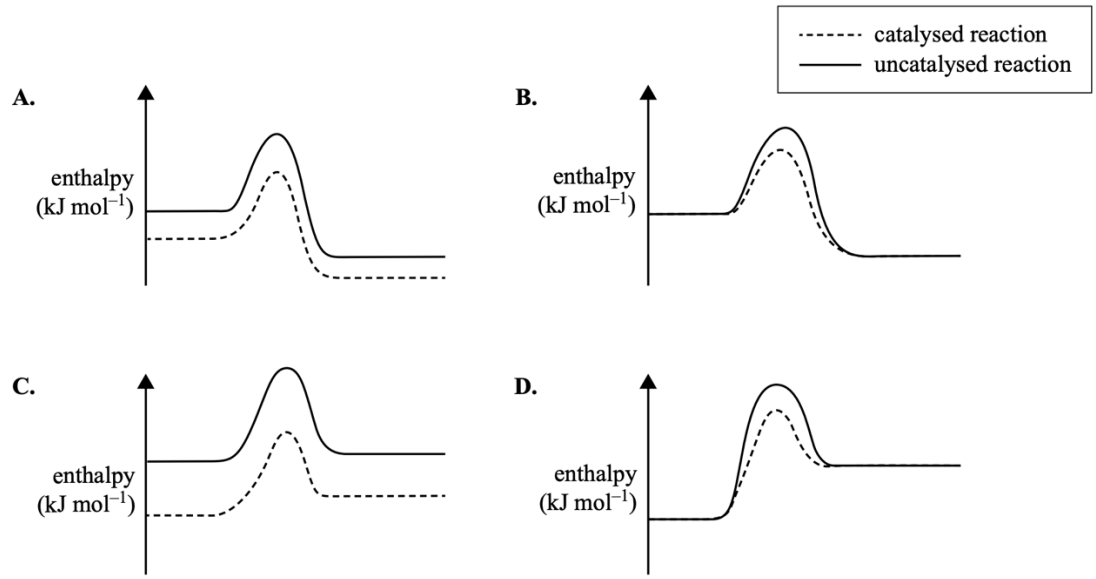
(A) lowers the activation energy of the forward reaction without changing the activation energy of the reverse reaction.
(B) lowers the activation energy of the forward reaction and raises the activation energy of the reverse reaction.
(C) lowers the activation energy of both forward and reverse reactions by the same amount.
(D) lowers the activation energy of the reverse reaction without changing the activation energy of the forward reaction.

23. VCE 2015 Q17

The oxidation of sulfur dioxide is an exothermic reaction. The reaction is catalysed by vanadium(V) oxide.

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$$

Which one of the following energy profile diagrams correctly represents both the catalysed and the uncatalysed reaction? B



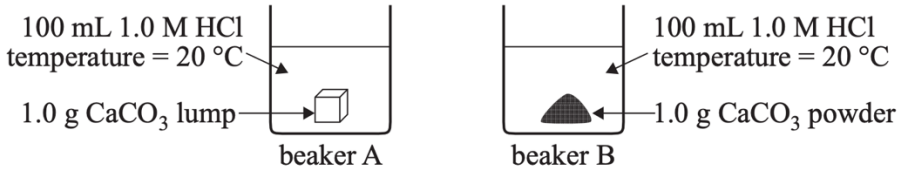
VCE 2012(2) Q1 (6 marks) **Mark**

Two experiments were conducted to investigate various factors that affect the rate of reaction between calcium carbonate and dilute hydrochloric acid.

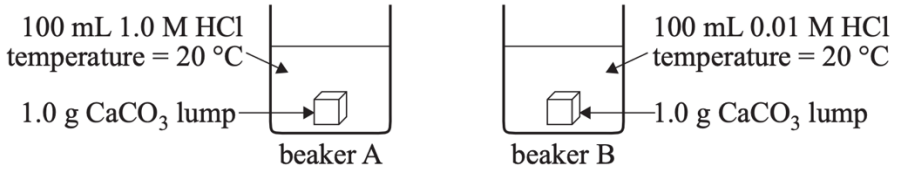
$$CaCO_3(s) + 2HCl(aq) \rightleftharpoons CO_2(g) + CaCl_2(aq) + H_2O(l)$$

The two experiments are summarised in the diagrams below.

experiment 1



experiment 2



(a) How could the rate of this reaction be measured in these experiments? **1**

……

……

……

VCE 2012(2) Q1 (continued) **1**

(a) (i) Identify the rate determining factor that is investigated in experiment 1.

……

……

(ii) In experiment 2, will the rate of reaction be faster in beaker A or beaker B? Explain your selection in terms of collision theory. **2**

……

……

……

……

(b) Why is the following statement incorrect? **2**

'Collision theory states that all collisions between reactant particles will result in a chemical reaction.'

……

……

……

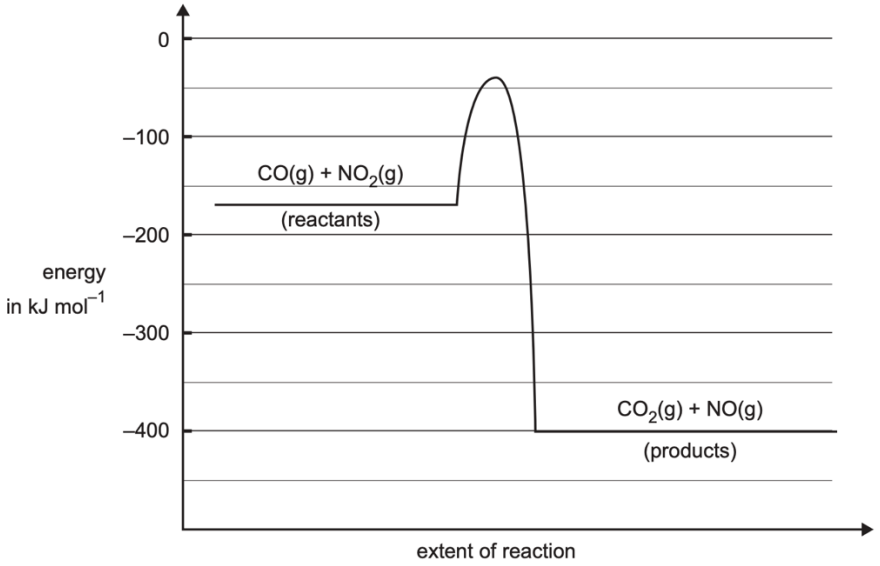
……

……

VCE 2005(1) Q4 (6 marks) **Mark**

The graph below represents the energy changes over the course of a chemical reaction

$$CO(g) + NO_2(g) \rightarrow CO_2(g) + NO(g)$$



(a) Give the magnitude and sign of the ΔH for the forward reaction in kJ mol^{-1}. **1**

……

……

(b) Give the activation energy for the reverse reaction in kJ mol^{-1}. **1**

……

……

……

VCE 2005(1) Q4 (continued) **2**

(c) Give two reasons explaining why the rate of this reaction increases with increasing temperature.

……

……

……

……

(d) A suitable catalyst is discovered for the reaction. What would be the likely effect of the catalyst on:

i. the activation energy? Explain your answer. **1**

……

……

……

ii. the ΔH? Explain your answer. **1**

……

……