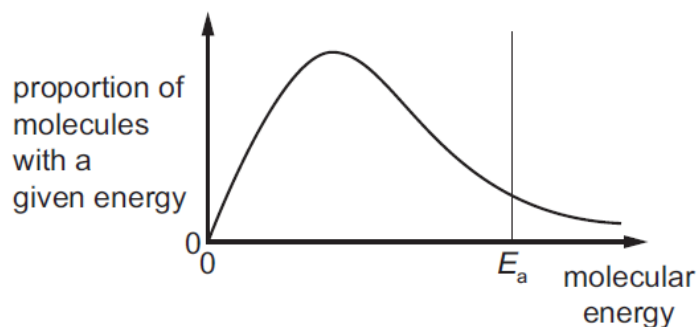


Reaction Kinetics – 2016

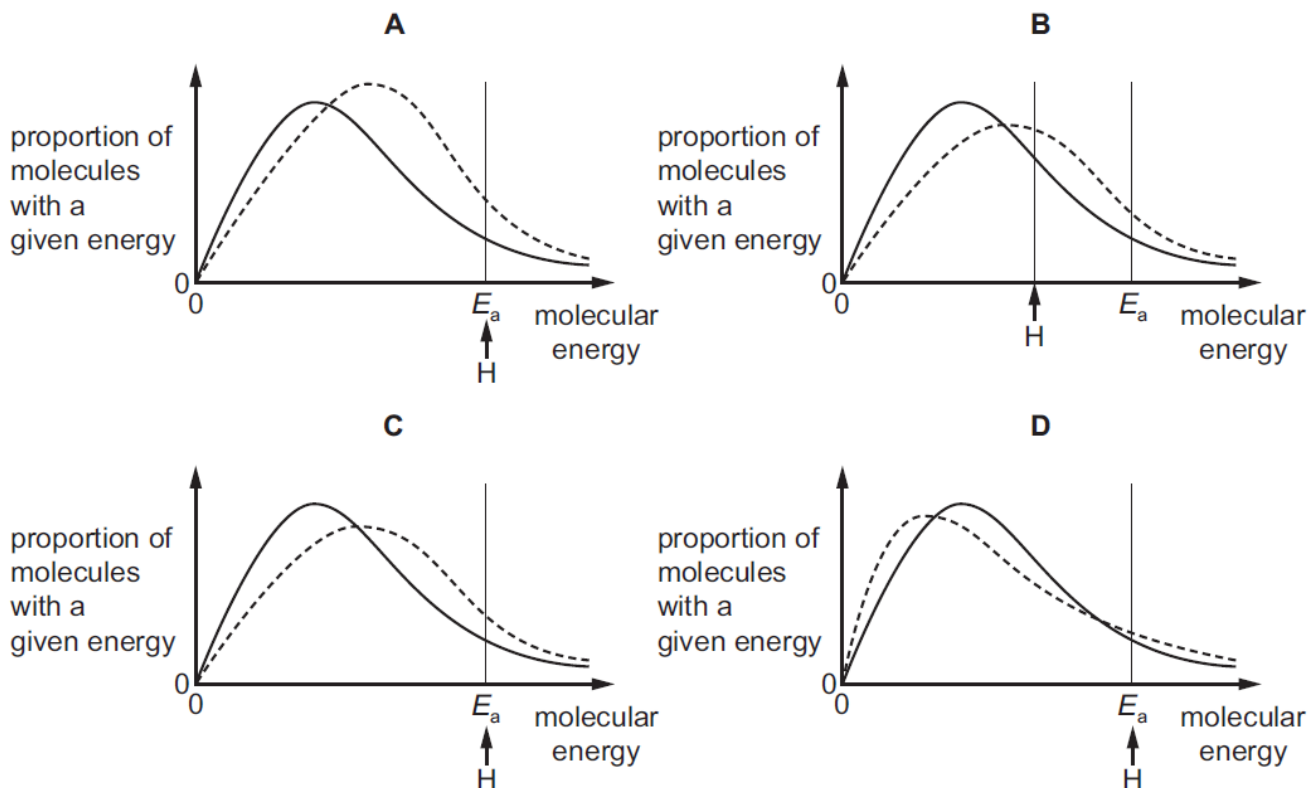
1. 9701/11/O/N/16/1

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.

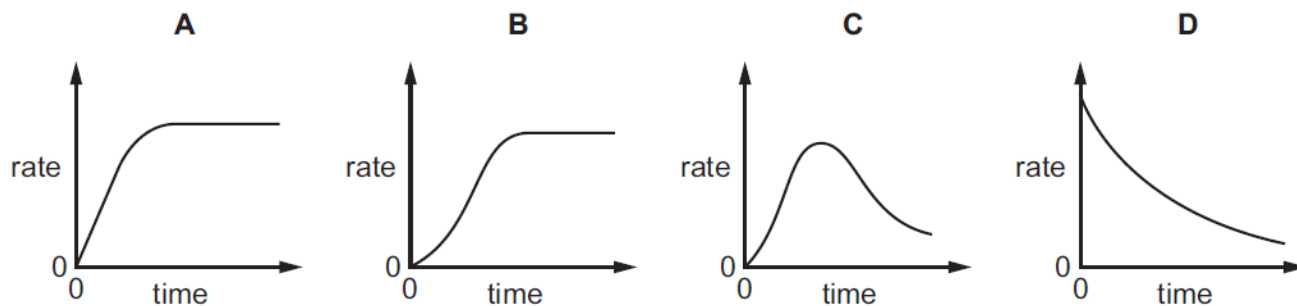
Which diagram is correct?



2. 9701/11/O/N/16/11

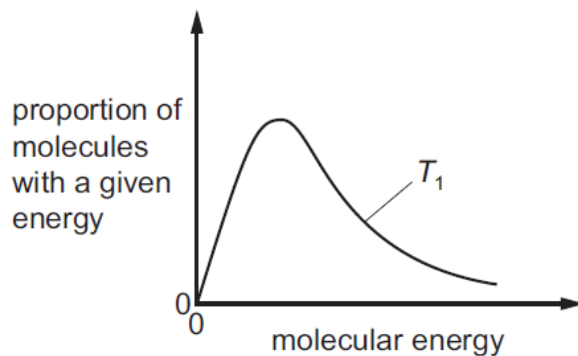
An autocatalytic reaction is a reaction in which one of the products catalyses the reaction.

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



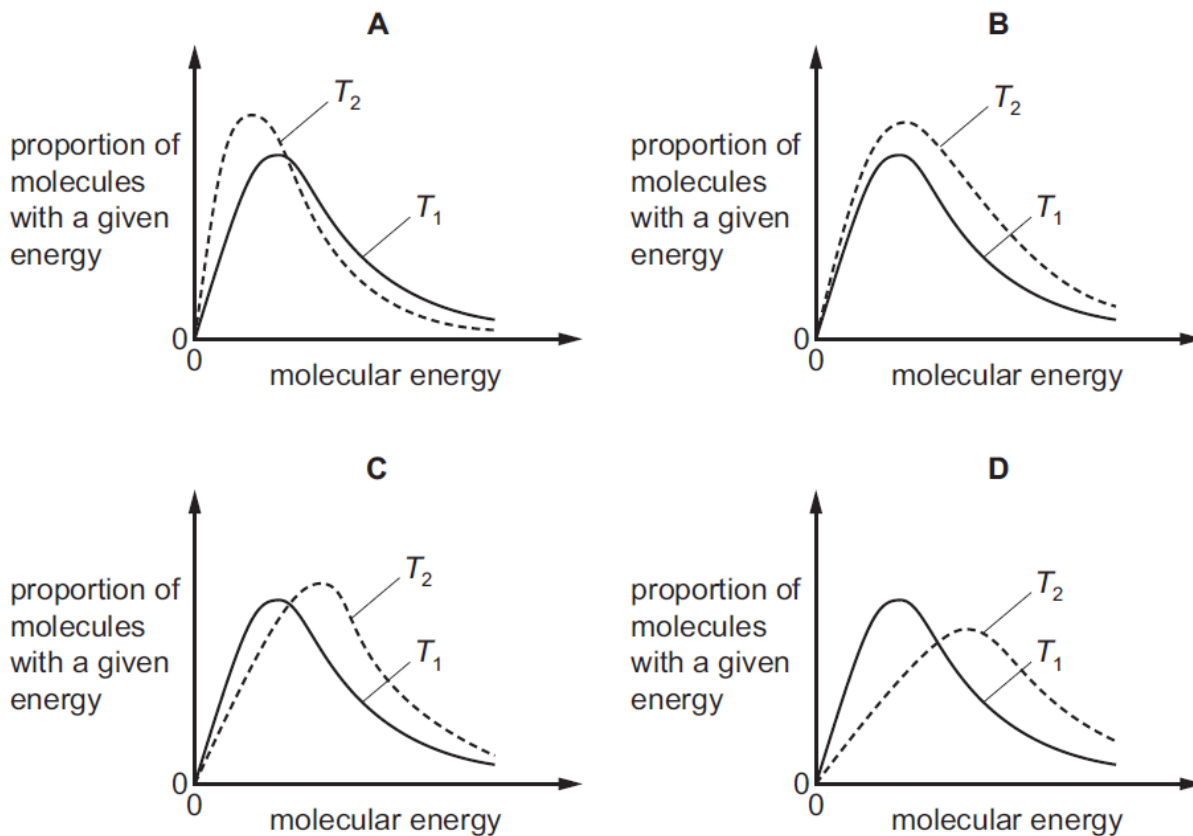
3. 9701/12/O/N/16/1

The molecules of a gas at a constant temperature, T_1 , have the distribution of molecular energies shown in the diagram.



When the temperature is **increased** to T_2 , the distribution of molecular energies changes.

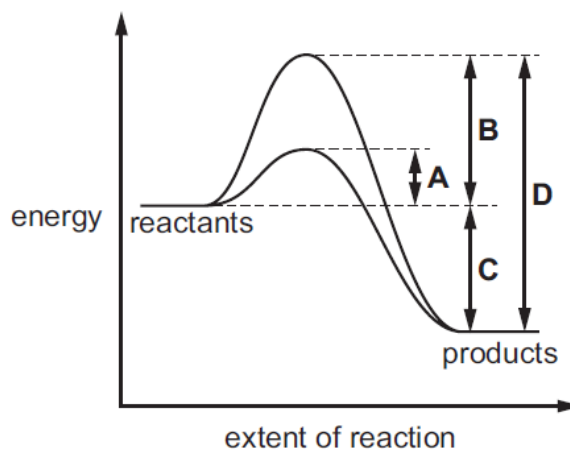
Which diagram correctly shows this change?



4. 9701/12/O/N/16/2

The diagram shows the pathways of a reaction, with and without a catalyst.

Which letter represents the overall energy change for the reaction?



5. 9701/12/F/M/16/34

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.

6. 9701/11/M/J/16/11

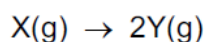
Enzymes are biological catalysts. Many enzymes show specificity. An example of an enzyme which shows specificity is glucokinase. Glucokinase is involved in the metabolism of glucose.

What does specificity mean in this context?

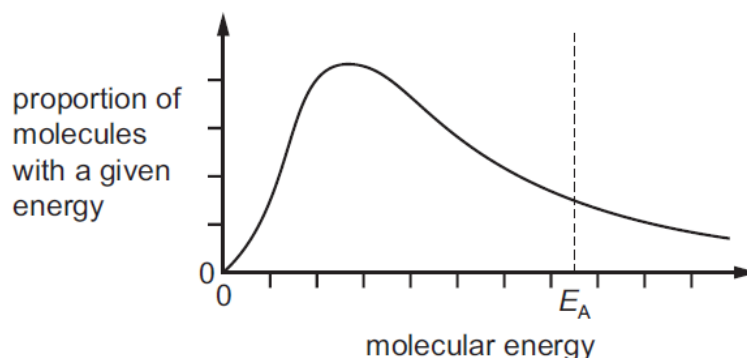
- A Glucokinase is most effective as a catalyst over a narrow pH range.
- B Glucokinase is most effective as a catalyst over a narrow range of temperatures.
- C Glucokinase only operates on a narrow range of substrate molecules.
- D Glucokinase provides an alternative route for the reactions it catalyses.

7. 9701/11/M/J/16/37

The equation shows a gas phase reaction.

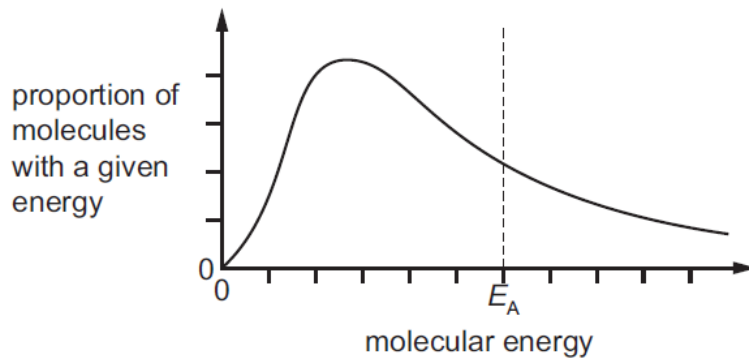


The diagram shows the Boltzmann distribution of a fixed mass of X(g) at temperature T in the absence of a catalyst. The line E_A indicates the activation energy.

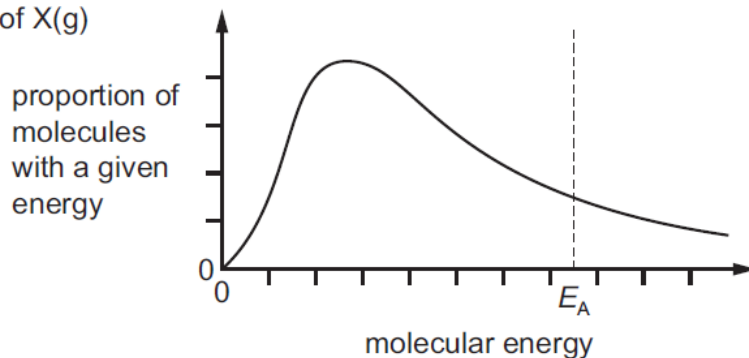


Which diagrams correctly show the effect of the following changes made separately and independently?

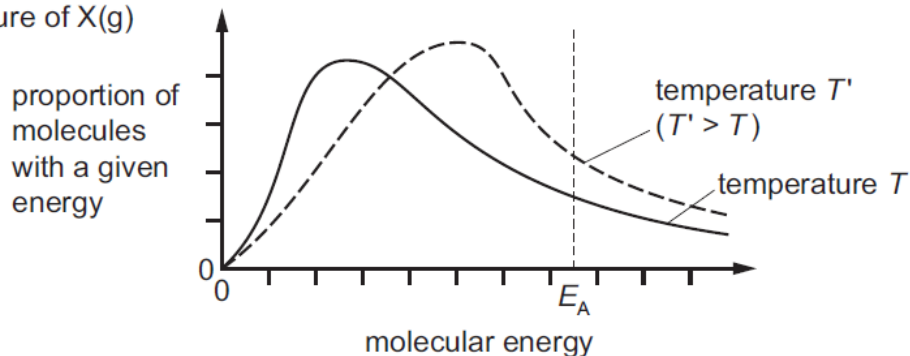
1 adding a catalyst



2 increasing the pressure of X(g)

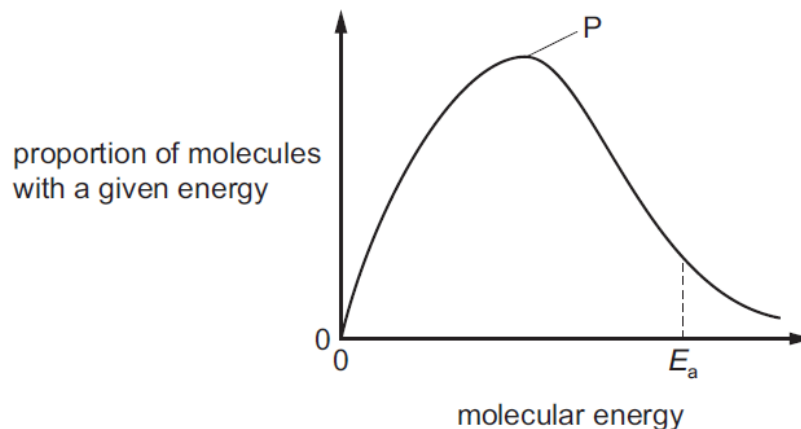


3 increasing the temperature of X(g)



8. 9701/12/M/J/16/1

The diagram shows the Boltzmann distribution of energies in 1 mole of a gas. The gas can take part in a reaction with an activation energy, E_a .



Which statement correctly describes the effect of an increase in temperature?

- A Peak P will be higher and fewer molecules will have energy $> E_a$.
- B Peak P will be higher and more molecules will have energy $> E_a$.
- C Peak P will be lower and fewer molecules will have energy $> E_a$.
- D Peak P will be lower and more molecules will have energy $> E_a$.

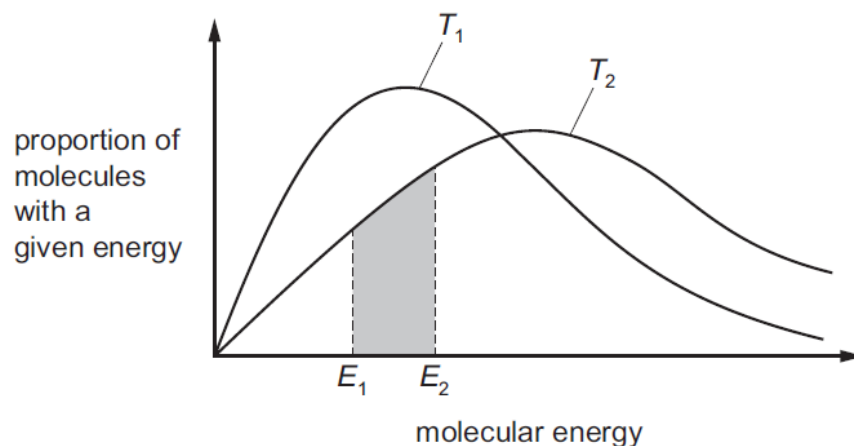
9. 9701/12/M/J/16/11

Which stage in the free radical substitution of ethane by chlorine has the lowest activation energy?

- A $Cl_2 \rightarrow 2Cl\cdot$
- B $Cl\cdot + C_2H_6 \rightarrow C_2H_5\cdot + HCl$
- C $C_2H_5\cdot + Cl_2 \rightarrow C_2H_5Cl + Cl\cdot$
- D $Cl\cdot + C_2H_5\cdot \rightarrow C_2H_5Cl$

10. 9701/13/M/J/16/33

The diagram shows the Boltzmann distribution of molecular energies in one mole of a gas at two temperatures, T_1 and T_2 .



Which statements are correct?

- 1 The shaded area represents the proportion of molecules with energies between E_1 and E_2 at temperature T_2 .
- 2 No particles have zero energy at either temperature.
- 3 T_2 is a lower temperature than T_1 .