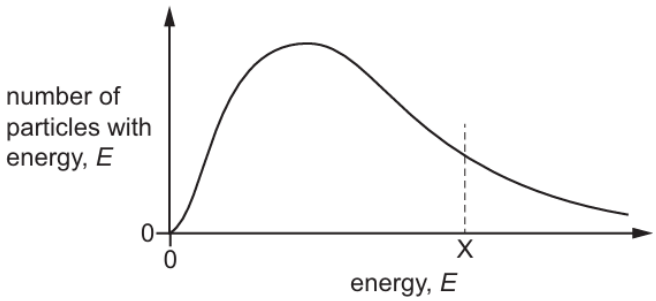
8. Reaction kinetics

8.3 Catalysts

Paper 1

Question Paper

1 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.

2 Which statement about catalysts is correct?

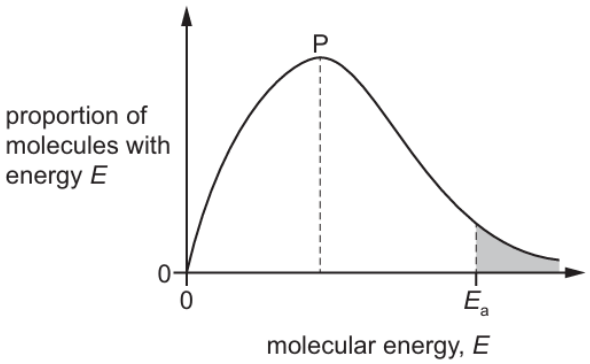
A They change the reaction pathway by increasing the activation energy.

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.

3 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?

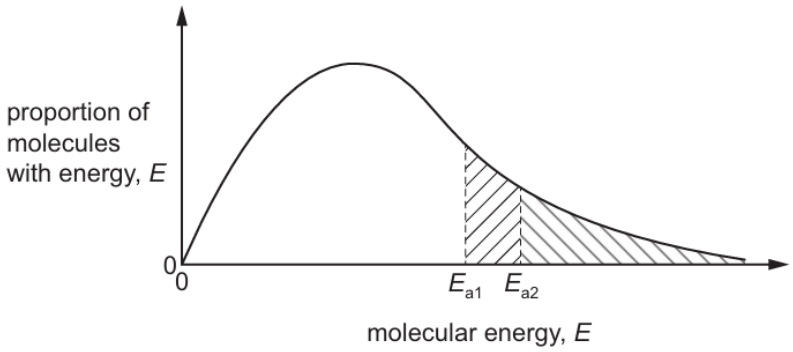
A The peak P is at a lower height and the position of E_a moves to the left.

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.

4 The diagram shows a Boltzmann distribution of the energies of gaseous molecules and the activation energies, E_a, of a reaction with and without a catalyst.



Which statement about this distribution curve is correct?

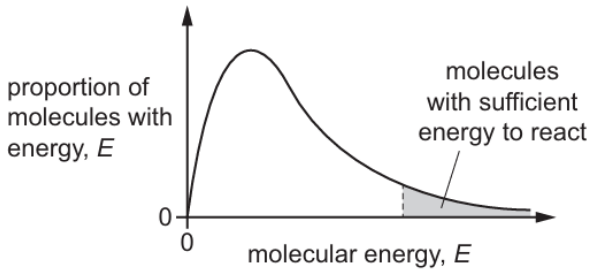
A If the temperature of the gas is increased, the maximum of the curve becomes higher.

B If the temperature of the gas is increased, the maximum of the curve moves to the left.

C The fraction of molecules that react in the presence of a catalyst is shown by  .

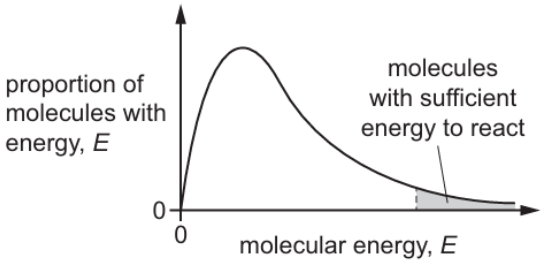
D The fraction of molecules that react in the absence of a catalyst is shown by  .

5 The Boltzmann distribution of molecular energies in a sample of aqueous hydrogen peroxide at room temperature is shown.



Which diagram shows the Boltzmann distribution of molecular energies of aqueous hydrogen peroxide maintained at room temperature when a catalyst, manganese(IV) oxide, is added?

A



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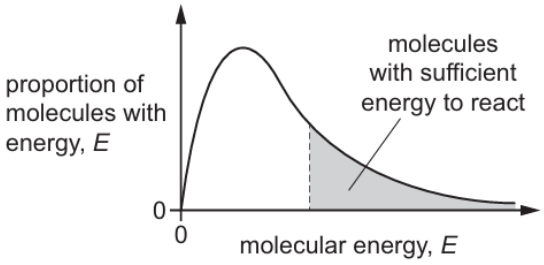

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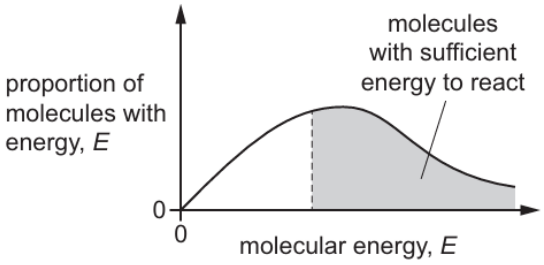

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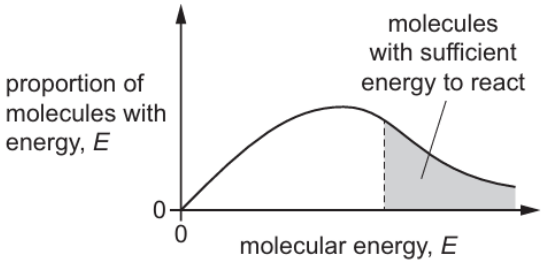

6 Which row is an example of heterogeneous catalysis?

	reaction	catalyst
A	esterification	sulfuric acid
B	the Contact process	divanadium pentoxide
C	destruction of the ozone layer	chlorine radicals
D	atmospheric formation of sulfur trioxide	nitrogen dioxide

7 Two reactions are shown.

reaction 1 $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

reaction 2 $2O_3(g) \rightleftharpoons 3O_2(g)$

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.

8 In a chemical system the particles involved have a range of energies. This can be shown on a graph called the Boltzmann distribution.

Which statement correctly explains the effect of a catalyst on the particles in a chemical system?

A A catalyst enables particles with a lower energy to collide successfully.

B A catalyst increases the number of particles with higher energies.

C A catalyst increases the number of particles with the most probable energy value.

D A catalyst increases the value of the most probable particle energy.

9 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.