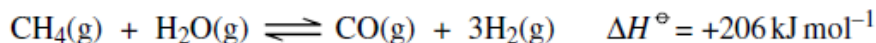


1

The hydrogen used in the Haber process is made by the following reaction.



- (a) Explain why the concentrations of the reactants and the products remain constant when equilibrium is established.

.....

(1 mark)

- (b) A high temperature of over 1000°C is used in the production of hydrogen by this reaction.

- (b) (i) Explain why a high temperature is needed to produce a high equilibrium yield of hydrogen.

.....

(2 marks)

- (b) (ii) Give one disadvantage of using temperatures much higher than 1000°C.

.....

(1 mark)

- (c) State and explain how the overall pressure must be changed to produce an increase in the equilibrium yield of hydrogen.

Change in pressure

Explanation

.....
 (3 marks)

- (d) Explain why the addition of a catalyst has no effect on the equilibrium yield of hydrogen in the reaction.

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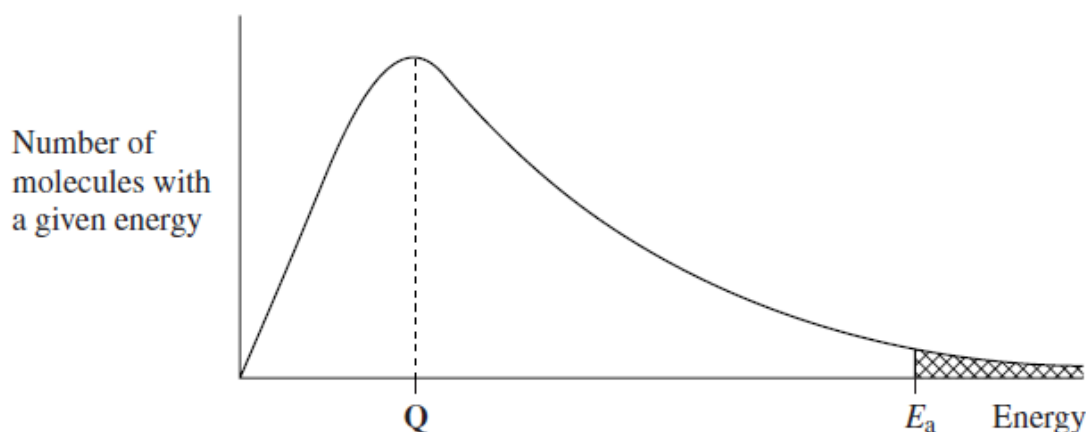
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(2 marks)

2

The curve shows the distribution of molecular energies for a mixture of gases which react together. The activation energy for the reaction is E_a



- (a) Explain what is meant by the term *activation energy*.
(2 marks)
- (b) State what Q represents and what the total area under the curve represents. Explain why the curve starts at the origin and why the shaded area is very small.
(4 marks)
- (c) Describe how the shape of the curve, the area under the curve, the value of E_a and the value of Q change if the temperature is increased. Explain why a small increase in temperature results in a large increase in the rate of a reaction.
(7 marks)
- (d) Explain why a catalyst increases the rate of a reaction.
(2 marks)