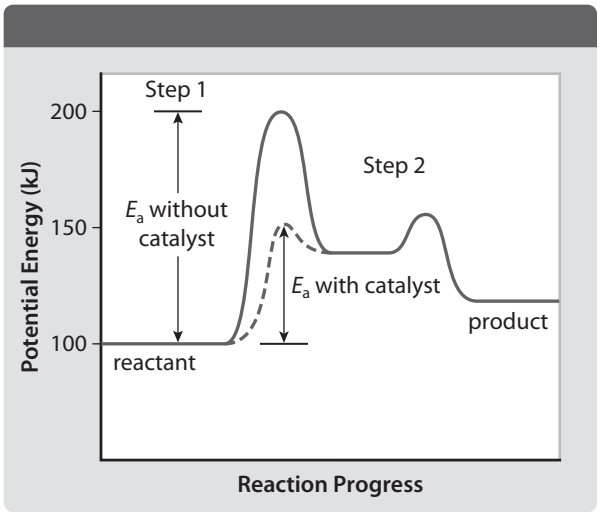
4. Initial rate is the rate of change in the concentration of the reactants at time zero, or the instant when reactants are mixed.

5. Because the rate depends only on the concentration of A, according to the rate law, doubling the surface area of reactant B (all other factors remaining the same) would be expected to have no effect on the rate of the reaction.

6.



7. The rate-determining step is the slowest elementary step in the reaction mechanism. This step determines the overall rate of the reaction.

8. An activated complex cannot be an intermediate. The activated complex is a highly unstable species that exists for only femtoseconds before it decomposes into products or reactants. An intermediate is a more stable species that is formed as a product from one step but is then consumed in a subsequent step in the reaction. In some cases, the intermediate can be isolated but this is not possible for an activated complex.

9. The collision of two particles is the simplest and the most likely event to occur in a reaction. More than two particles colliding with sufficient energy and the correct orientation for a reaction to occur is far less probable. A chemist is unlikely to propose as an elementary step a collision that is highly unlikely to take place.

10. a. The overall equation can be determined by adding the elementary steps together:

Step 1: $Cl_2(g) \rightarrow \cancel{2Cl(g)}$

Step 2 : $\cancel{2Cl(g)} + CHCl_3(g) \rightarrow HCl(g) + \cancel{CCl_3(g)}$

Step 3: $\cancel{Cl(g)} + \cancel{CCl_3(g)} \rightarrow CCl_4(g)$

$$Cl_2(g) + CHCl_3(g) \rightarrow CCl_4(g) + HCl(g)$$

b. There is no catalyst in this reaction; it would be shown as a reactant in one of the steps and a product in a subsequent step.

c. There are two intermediates, Cl(g) and $CCl_3(g)$, since both are produced in one step and consumed in a subsequent step.

d. Step 2 is the rate-determining step since it is the only step that includes $CHCl_3$ as a reactant.

11. a. B, D and F represent activated complexes.

b. +80.0 kJ

c. C and E represent reaction intermediates.

d. +60.0 kJ

e. +20.0 kJ

f. −30.0 kJ

Answers to Practice Problems

For full solutions to Practice Problems, see Part B of this Solutions Manual.

(Student textbook pages 360-1)

1. The average rate of consumption of B is -4.74×10^{-5} mol/L·s.

2. -7.0×10^{-4} mol/L·s

3. a. 0.165 mol

b. 0.165 mol $Br_2(aq)$

4. 1.4 mol/L

5. 5.0×10^{-4} L/s

6. rate of formation of $BrO_3^-(aq)$ = 0.060 mol/L·s; rate of consumption of $BrO^-(aq)$ = 0.18 mol/L·s

7. a. The average rate of consumption of HBr(g) over 50.0 s is 0.0032 mol/L·s.

b. 0.080 mol/L

8. 1.40×10^2 mol/L

9. a. 2.42×10^{-4} mol/s

b. 2.98×10^{-3} L/s

10. 0.70 mol/L·s $Cl_2(g)$ consumption; NOCl(g) is produced at a rate of 1.4 mol/L·s

(Student textbook page 371)

11. Diagrams should contain the following: "Potential Energy" on *y*-axis; "Reaction Progress" on *x*-axis; $E_{a(fwd)}$ is the energy between the reactants and the transition state; $E_{a(rev)}$ is the energy between the transition state and the products; ΔH_r is the energy between the reactants and the products.

a. Endothermic

b. Products