NAME _____ DATE _____ PERIOD _____

CHAPTER 15

The rates of chemical reactions

Write the letter of the correct answer in the space provided.

E 1. According to the collision theory, the rate of a chemical reaction is *not* dependent on

a. whether chemical bonds are broken in the reaction
b. the number of successful collisions between molecules per unit of time
c. the kinetic energy of the colliding molecules
d. the relative amounts of surface area in contact between reactants
e. the mass of the colliding molecules

A 2. Raising the temperature of a reacting system increases the rate of the reaction but does *not* increase the

a. activation energy
b. average velocity of the reacting molecules
c. number of collisions
d. number of successful collisions
e. fraction of the reacting molecules that possess energies greater than the activation energy

C 3. Reaction rates are affected by concentration, collision geometry, and the presence of a catalyst. Which one of the following statements is *false*?

a. Increasing the concentration of reacting particles increases the chance for collisions.
b. Poor collision geometry slows the rate of reaction.
c. A catalyst increases the kinetic energy of the reacting molecules.
d. The slowest reaction involved in a reaction mechanism is the rate-determining step.
e. A catalyst lowers the activation energy requirement.

C 4. A match does not ignite spontaneously with the oxygen in the air because

a. the reaction is endothermic
b. the reaction is exothermic
c. very few molecules have acquired sufficient activation energy
d. air is only about 20 percent oxygen
e. the molecules are not spontaneous

A 5. The rate of many reactions is approximately doubled for every 10 °C rise in temperature. If a reaction takes 20 minutes at 100 °C, at 120 °C it should take

a. 5 min
b. 10 min
c. 15 min
d. 20 min
e. impossible to predict

Use the information provided by the following proposed reaction mechanism to answer questions 6 and 7.

1. $BrO_3^- + 2H^+ \longrightarrow H_2BrO_3^+$
2. $Br^- + H_2BrO_3^+ \longrightarrow Br\text{-}BrO_2 + H_2O$
3. $Br\text{-}BrO_2 + 4H^+ + 4Br^- \longrightarrow 3Br_2 + 2H_2O$

D 6. Which one of the following equations could be the overall equation for the proposed reaction mechanism?

a. $Br^- + BrO_3^- + 6H^+ \longrightarrow Br_2 + 3H_2O$
b. $2BrO_3^- + 12H^+ \longrightarrow Br_2 + 6H_2O$
c. $2Br^- + 6H_2O \longrightarrow 2BrO_3^- + 12H^+$
d. $5Br^- + BrO_3^- + 6H^+ \longrightarrow 3Br_2 + 3H_2O$
e. $2H_2BrO_3^+ + 2H^+ \longrightarrow Br_2 + 3H_2O$

E 7. If the rate-determining step in the proposed reaction mechanism is step 2, increasing the concentration of which one of the following species will increase the overall rate of reaction?

a. $Br\text{-}BrO_2$ and H_2O
b. $H_2BrO_3^+$ and H^+
c. BrO_3^- and Br^-
d. $Br\text{-}BrO_2$ and BrO_3^-
e. Br^- and $H_2BrO_3^+$

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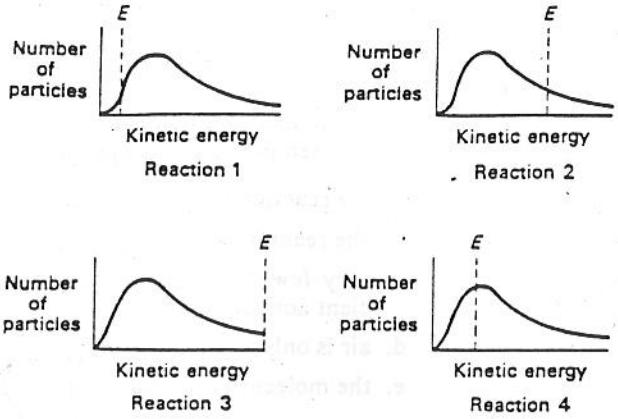
Following are identical kinetic energy distribution curves for four different reactions at the same temperature. Only the threshold energy (E) is different. Use these diagrams to answer questions 8 through 10.



A

___ 8. Under the same conditions, which reaction would occur the fastest?

a. reaction 1
b. reaction 2
c. reaction 3
d. reaction 4
e. All would occur at the same rate.

D

___ 9. If a catalyst were added to reacting system 3, what effect would this have on the system?

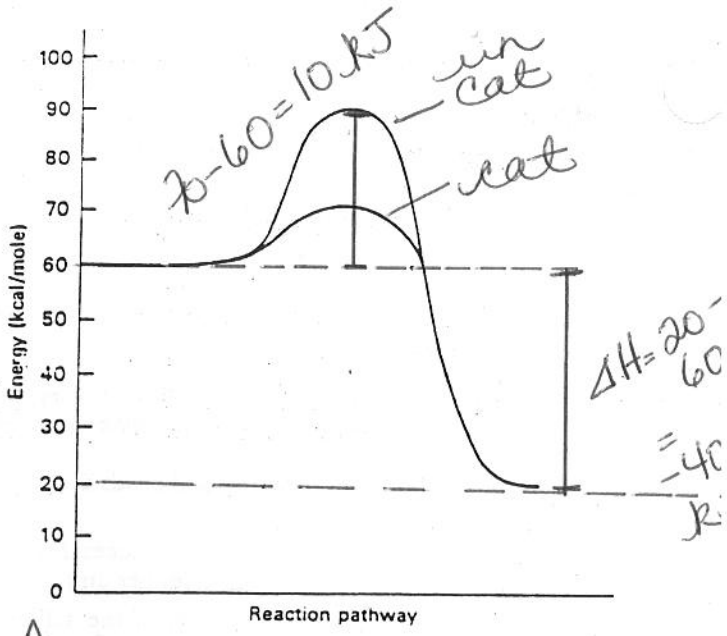
a. The peak kinetic energy distribution curve would be shifted to the left.
b. The peak kinetic energy distribution curve would be shifted to the right.
c. The threshold energy requirement would be raised and thus fewer molecules would collide successfully.
d. The threshold energy requirement would be lowered, and thus more successful molecular collisions would occur.
e. There would be no effect on the reaction.

C

___ 10. In which of the reactions would the reaction rate be increased most by heating the reactants?

a. reaction 1
b. reaction 2
c. reaction 3
d. reaction 4
e. none

Two pathways for a reaction are shown here on a graph. One pathway is for the uncatalyzed reaction, and the other is for the reaction in the presence of a catalyst that is not an inhibitor. Use this graph to answer questions 11 through 14.



A

___ 11. The activation energy for the forward reaction in the presence of the catalyst, in kilocalories per mole, is about

a. 10
b. 30
c. 50
d. 70
e. 90

C

___ 12. For the uncatalyzed reaction, the overall heat of reaction (ΔH), in kilocalories per mole, is about

a. −10
b. −30
c. −40
d. −50
e. −70

E

___ 13. The activation energy for the reverse reaction without a catalyst, in kilocalories per mole, is about

a. 10
b. 30
c. 40
d. 50
e. 70

D

___ 14. Which one of the following statements about the reaction pathway in the presence of a catalyst is *false*?

a. The catalyst increases the rate of reaction of both the forward and the reverse processes.
b. The catalyst enables the reaction to proceed rapidly at a lower temperature.
c. The catalyst involves the formation of an activated complex.
d. The catalyst lowers the ΔH of the reaction.
e. The catalyst is not used up as the reaction proceeds.

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