

Rates of Reaction: Chemical Kinetics

I. Multiple Choice

1. The rate determining step for a complex reaction is the one which is
 - A. fastest
 - B. last in the sequence
 - C. slowest
 - D. first in the sequence

2. Which one of the following is **NOT** a key concept of the collision theory:
 - A. particles must collide in order to react
 - B. particles must move slowly when they collide, otherwise they simply "bounce off" one another
 - C. particles must collide with the proper orientation
 - D. particles must collide with sufficient energy to reach the activated complex in order to react

3. Which one of the following factors does *not* affect the rate of a chemical reaction:
 - A. humidity
 - B. concentration
 - C. temperature
 - D. nature of the reactants

4. Activation energy is the amount of energy required to
 - A. break the bonds between the reacting molecules
 - B. convert the reactants into the activated complex
 - C. make the reacting particles collide
 - D. form the bonds between the product molecules

5. The rate of a chemical reaction normally
 - A. increases as temperature decreases.
 - B. decreases when a catalyst is added.
 - C. increases as reactant concentration increases.
 - D. decreases as reactant concentration increases.

6. Crushing a solid into a powder will increase reaction rate because:
 - A. the particles will collide with more energy
 - B. the orientation of colliding particles will be improved
 - C. the activation energy barrier will be lowered
 - D. the powdered form has more surface area.

7. The series of steps that most reactions undergo, from initial reactants to final products, is called the:

- A. catalytic conversion
- B. entropy of reaction
- C. activation energy
- D. reaction mechanism

8. Reaction rates generally increase with an increase in temperature. Four suggested reasons are:

- I. Molecules collide more frequently at higher temperatures.
- II. As the temperature of a reaction increases, the activation energy for the reaction decreases.
- III. The concentration of reactants will be greater at a higher temperature.
- IV. The fraction of high energy molecules is greater at higher temperatures.

The correct statements are:

- A. II and IV only
- B. I and IV only
- C. I, II and IV only
- D. I, III, and IV only

9. A lump of ignited charcoal which is glowing in air burns more vigorously when lowered into a bottle of pure oxygen. This is due to an increase in

- A. surface area
- B. temperature
- C. concentration
- D. volume

10. What happens to a catalyst in a reaction?

- A. It remains unchanged.
- B. It is incorporated into the reactants.
- C. It is incorporated into the products.
- D. It evaporates.

11. It is generally believed that catalysts increase reaction rates by:

- A. removing the activation energy barrier
- B. providing an alternate activation energy barrier that is lower than the original barrier
- C. lowering the activation energy barrier
- D. giving the reacting particles more energy, thus there will be more successful collisions

12. Which one of the following statements concerning rates of reactions is FALSE?

- A. The higher the activation energy barrier, the faster the reaction.
- B. Increasing the concentration of a reactant may increase the rate of a reaction.
- C. Adding a catalyst speeds up the rate of reaction for both the forward and reverse reactions.
- D. Increasing the concentration increases the rate of a reaction, because it increases the number of collisions.

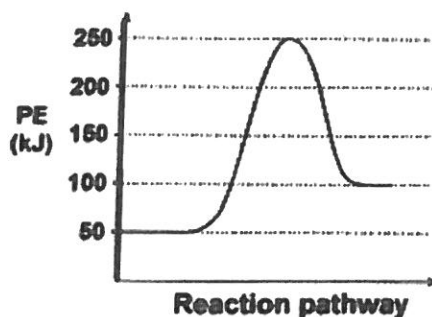
13. Which of the following reactions is likely to have the fastest reaction rate:

- A. $\text{Mg(s)} + 2\text{H}^+(\text{aq}) \rightarrow \text{Mg}^{2+}(\text{aq}) + \text{H}_2(\text{g})$
- B. $\text{Zn(s)} + \text{S(s)} \rightarrow \text{ZnS(s)}$
- C. $2\text{Ag}^+(\text{aq}) + \text{CrO}_4^{2-}(\text{aq}) \rightarrow \text{Ag}_2\text{CrO}_4^{2-}(\text{aq})$
- D. $3\text{Fe}^{2+}(\text{aq}) + \text{NO}_3^-(\text{aq}) + 4\text{H}^+(\text{aq}) \rightarrow 3\text{Fe}^{3+}(\text{aq}) + \text{NO(g)} + 2\text{H}_2\text{O(l)}$

14. In general, an increase in temperature of 10°C will have what effect on reaction rate:

- A. double the rate
- B. triple the rate
- C. half the rate
- D. increase the rate but not by a specific amount

USE THE FOLLOWING POTENTIAL ENERGY CURVE FOR QUESTIONS 15 and 16



15. The heat of reaction, ΔH , for the forward reaction is

- A. +200 kJ
- B. - 50 kJ
- C. +150 kJ
- D. + 50 kJ

16. The activation energy, E_a , for the reverse reaction is

- A. + 50 kJ
- B. + 200 kJ
- C. -150 kJ
- D. + 150 kJ

17. Which of the following substances act as catalysts in the body?

- A. carbohydrates
- B. lipids
- C. nucleic acids
- D. enzymes

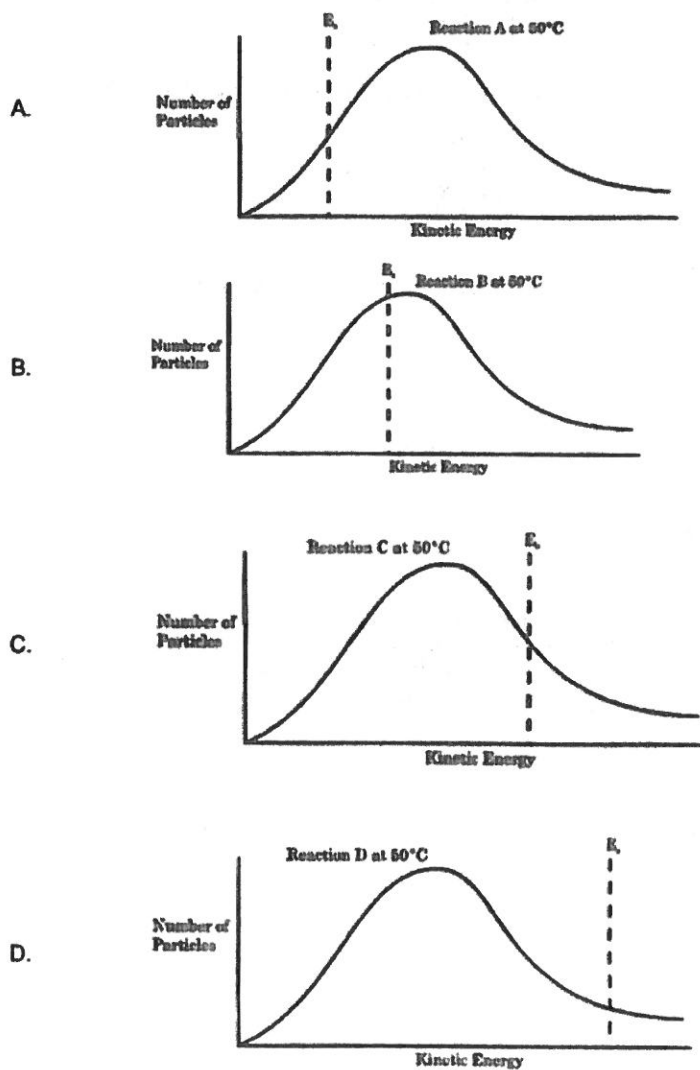
18. The activation energy for the following reaction is 40.8 kcal.



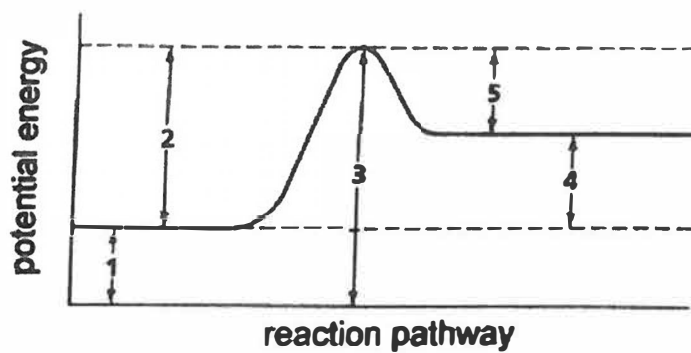
The activation energy for the reverse reaction is

- A. 43.8 kcal
B. 40.8 kcal
C. 3.0 kcal
D. 37.8 kcal

19. The following kinetic energy diagrams represent four different reactions, all carried out at 50°C, with different threshold energies (represented by the vertical dashed lines). Which reaction would likely have the fastest rate:



20. Consider the potential energy curve shown below.



The activation energy of the forward reaction is best represented by what number shown on the graph:

- A. 2
- B. 4
- C. 5
- D. 3

ANSWERS:

1 C 2 B 3 A 4 A 5 C 6 D 7 D 8 B 9 C 10 A 11 B 12 A 13 C 14 A 15 D 16 D 17 D 18 A 19 A 20 A

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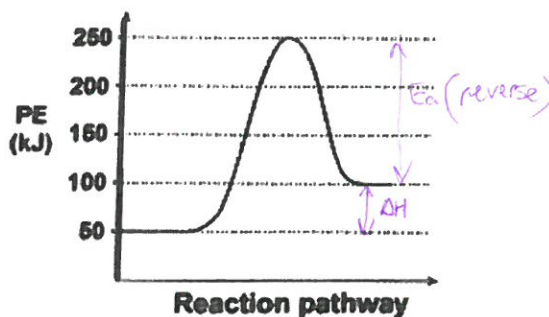
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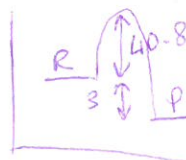
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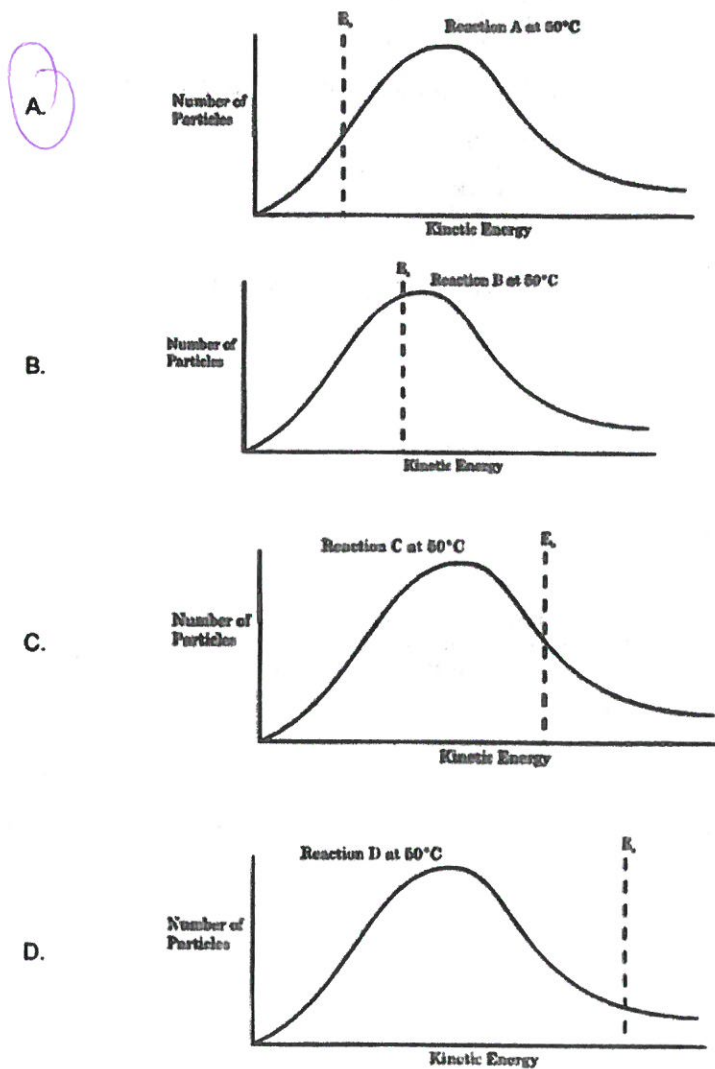


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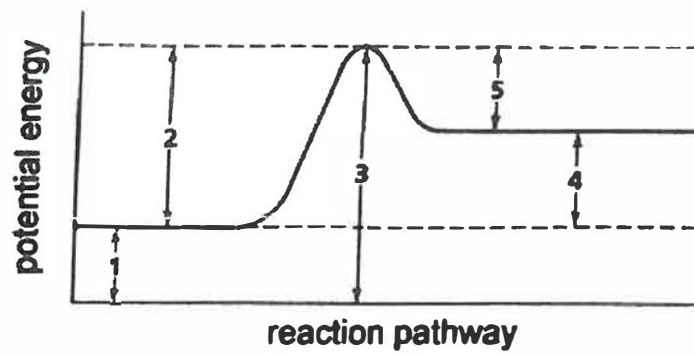
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Handwritten notes:
- Activation energy is the energy difference between the reactants and the peak.
- The reactant level is higher than the product level, so this is an exothermic reaction.