

1. What factors determine the rate of a chemical reaction?

Ans: The concentration of reactants, their spatial orientation when they collide, the reaction temperature, and the presence of catalysts all affect the rate of reaction. Section: 8.1

2. Which statement is true about reaction rate for the reaction: $A + B \rightarrow C + D$?

- A) If the reaction begins with only A and B, the reaction rate will be positive, because C and D are forming.
- B) If the reaction begins with only C and D, the rate will be negative because the concentrations of C and D decrease as A and B form.
- C) The reaction rate will be positive because rate is defined as the change in the number of moles of a reactant or a product per unit time.
- D) The reaction rate will be zero, because there are no reactants in the mixture, so the reaction cannot take place.

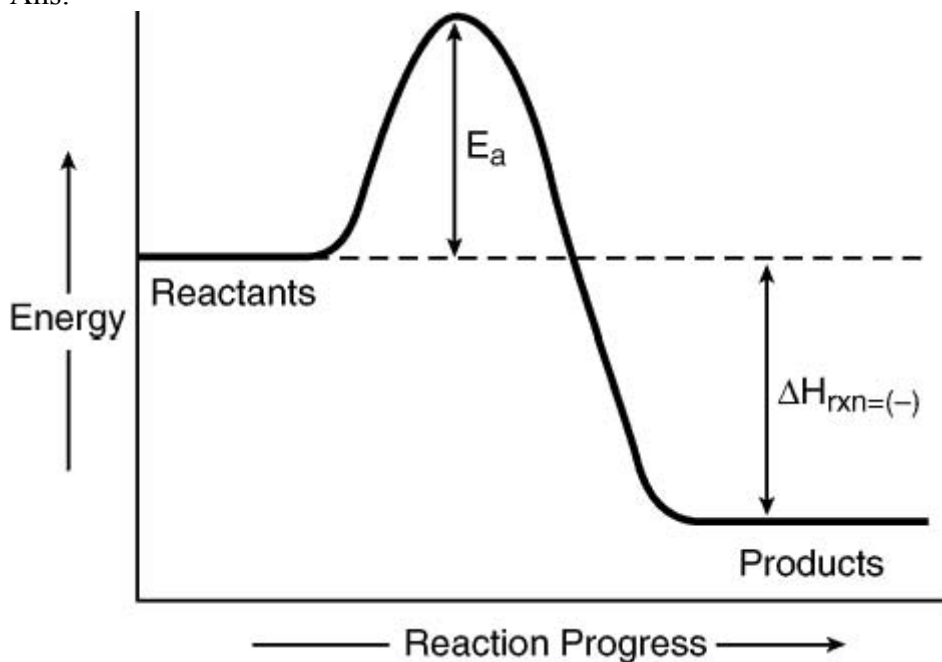
Ans: C Section: 8.1

3. The minimum energy required so colliding molecules can break chemical bonds and form new ones is called the _____ for a reaction.

Ans: activation energy Section: 8.2

4. Plot an activation-energy diagram for an exothermic reaction, labeling axes and showing the reactants and products.

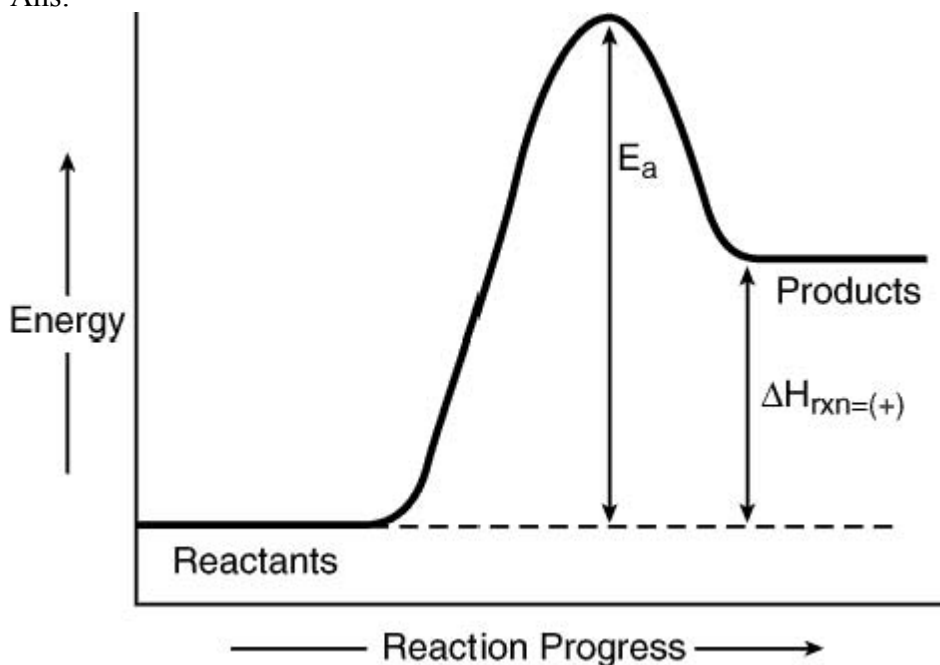
Ans:



Section: 8.2

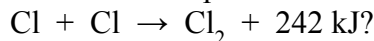
5. Plot an activation-energy diagram for an endothermic reaction, labeling axes and showing the reactants and products.

Ans:



Section: 8.2

6. Which statement best describes the production of a chlorine molecule according to the reaction:



- A) A bond is broken, and the reaction is exothermic.
- B) A bond is broken, and the reaction is endothermic.
- C) A bond is formed, and the reaction is exothermic.
- D) A bond is formed, and the reaction is endothermic.

Ans: C Section: 8.2

7. Why does the speed of some chemical reactions increase when the surface area of a solid reactant is increased?

- A) This change increases the concentration of the reactant in the reaction mixture.
- B) This change exposes more reactant particles to possible collisions.
- C) This change alters the electrical conductivity of the reactant particles.
- D) This change increases the density of the reactant particles.

Ans: B Section: 8.2

8. Which statement describes the characteristics of an endothermic reaction?

- A) ΔH_{rxn} is positive, and the reaction products have less energy than the reactants.
- B) ΔH_{rxn} is positive, and the reaction products have more energy than the reactants.
- C) ΔH_{rxn} is negative, and the reaction products have less energy than the reactants.
- D) ΔH_{rxn} is negative, and the reaction products have more energy than the reactants.

Ans: B Section: 8.2

9. Which statement is true about the reaction $A + B \rightarrow C + D + \text{heat}$?

- A) The forward and reverse reactions are exothermic.
- B) The forward reaction is exothermic, and the reverse reaction is endothermic.
- C) The forward reaction is exothermic, and the reverse reaction can be either endothermic or exothermic.
- D) The forward reaction is endothermic, and the reverse reaction can be either endothermic or exothermic.

Ans: B Section: 8.2

10. Reactions that give off heat as they progress are called _____ reactions.

Ans: exothermic Section: 8.2

11. Reactions that absorb heat are called _____ reactions.

Ans: endothermic Section: 8.2

12. Explain how it would be possible to increase the rate of reaction without changing the reactant concentrations.

Ans: Adding a catalyst lowers the activation energy, thereby increasing the rate of the reaction. Increasing the temperature gives more molecules enough energy to react (the activation energy), thereby increasing the rate of the reaction. Neither of these increases the concentration of the reactants. Section: 8.2

13. Why does increasing a reactant concentration generally increase the rate of the reaction?

Ans: Adding more reactant increases the frequency of the collisions. More molecules in the same space will collide more often. Increasing the number of collisions increases the likelihood that more collisions will be productive. Section: 8.2

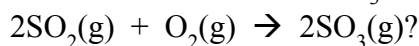
14. If the reaction temperature is increased, the rate of the reaction will:
- A) remain the same for both an endothermic and an exothermic reaction
 - B) increase if the reaction is endothermic, and decrease if the reaction is exothermic
 - C) decrease if the reaction is endothermic, and increase if the reaction is exothermic
 - D) increase if the reaction is endothermic, and increase if the reaction is exothermic
- Ans: B Section: 8.2
15. One property of a reaction that has reached equilibrium is:
- A) the concentration of products is greater than the concentration of reactants.
 - B) the concentrations of reactants and products are equal.
 - C) the rate of the forward reaction is greater than the rate of the backward reaction.
 - D) the rates of the forward and backward reactions are equal.
- Ans: D Section: 8.5
16. Given the reaction $2\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{N}_2\text{O}(\text{g})$, this system reaches equilibrium in a closed environment when:
- A) all the $\text{N}_2(\text{g})$ is consumed.
 - B) all the $\text{O}_2(\text{g})$ is consumed.
 - C) pressure changes no longer occur.
 - D) the forward reaction no longer occurs.
- Ans: C Section: 8.5
17. A system is said to be in a state of dynamic equilibrium when the:
- A) concentrations of products and reactants constantly changes
 - B) concentrations of products and reactants stops changing
 - C) rate at which products form begins to decrease
 - D) rate at which reactants are consumed begins to decrease
- Ans: B Section: 8.5
18. Generally, equilibrium reactions:
- A) proceed to completion
 - B) are nonspontaneous
 - C) produce mixtures of both reactants and products in a definite proportion
 - D) are endothermic
- Ans: C Section: 8.5

19. Given the reaction $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightarrow 2\text{HI}(\text{g})$, when 2.00 mol of each reactant are mixed in a 1.00-L vessel at a certain temperature and equilibrium is reached, 3.50 mol of HI is produced. The equilibrium constant for this reaction is:

- A) 14.1 B) 49.2 C) 56.7 D) 196

Ans: D Section: 8.6

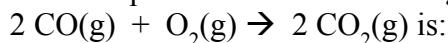
20. What is the effect of doubling the concentration of SO_3 in an equilibrium mixture for this reaction:



- A) SO_2 and O_2 increase equally. C) O_2 increases more than SO_2 .
 B) SO_2 increases more than O_2 . D) SO_2 decreases more than O_2 .

Ans: B Section: 8.6

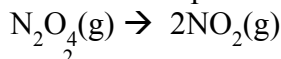
21. The equilibrium constant expression for the following **balanced** reaction



- A) $K = [\text{CO}_2] / [\text{CO}][\text{O}_2]$ C) $K = [\text{CO}_2]^2 [\text{O}_2] / [\text{CO}]$
 B) $K = [\text{CO}][\text{O}_2] / [\text{CO}_2]$ D) $K = [\text{CO}_2]^2 / [\text{CO}]^2 [\text{O}_2]$

Ans: D Section: 8.6

22. Write an equilibrium constant expression for this reaction:



Ans: $K = [\text{NO}_2]^2 / [\text{N}_2\text{O}_4]$ Section: 8.6

23. Write the chemical equation that corresponds to this equilibrium constant expression:

$$K = [\text{CO}]^2 [\text{O}_2] / [\text{CO}_2]^2$$

Ans: $2\text{CO}_2 \rightleftharpoons 2\text{CO} + \text{O}_2$ Section: 8.6

24. Given the reaction $2\text{BrCl}(\text{g}) \rightarrow \text{Br}_2(\text{g}) + \text{Cl}_2(\text{g})$, when the reaction reaches equilibrium at a particular temperature, the concentrations of BrCl, Cl_2 , and Br_2 are 0.22 M, 0.15 M, and 0.15 M, respectively. Calculate the equilibrium constant for this reaction.

Ans: 0.46 Section: 8.6

25. Given the reaction $2\text{NOCl}(\text{g}) \rightarrow 2\text{NO}(\text{g}) + \text{Cl}_2(\text{g})$, when the reaction reaches equilibrium at a particular temperature, the concentrations of NOCl , Cl_2 , and NO are 2.62 M, 0.20 M, and 1.84 M, respectively. Calculate the equilibrium constant for this reaction.

Ans: 0.099 Section: 8.6

26. What is the equilibrium constant expression for this reaction?



A) $\frac{[\text{A}]^a [\text{B}]^b [\text{C}]^c}{[\text{D}]^d [\text{E}]^e}$

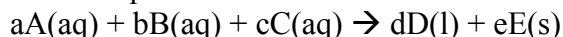
C) $1 / \frac{[\text{A}]^a [\text{B}]^b [\text{C}]^c}{[\text{D}]^d [\text{E}]^e}$

B) $[\text{A}]^a [\text{B}]^b [\text{C}]^c$

D) $[\text{D}]^d [\text{E}]^e / [\text{A}]^a [\text{B}]^b [\text{C}]^c$

Ans: D Section: 8.6

27. What is the equilibrium constant expression for this reaction?



A) $\frac{[\text{A}]^a [\text{B}]^b [\text{C}]^c}{[\text{D}]^d [\text{E}]^e}$

C) $1 / \frac{[\text{A}]^a [\text{B}]^b [\text{C}]^c}{[\text{D}]^d [\text{E}]^e}$

B) $[\text{A}]^a [\text{B}]^b [\text{C}]^c$

D) $[\text{D}]^d [\text{E}]^e / [\text{A}]^a [\text{B}]^b [\text{C}]^c$

Ans: C Section: 8.6

28. Given this equilibrium: $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g}) + \text{heat}$, which action will increase the relative number of moles of NH_3 present at equilibrium?

- A) adding hydrogen to the reaction chamber
- B) increasing the volume of the reaction chamber
- C) heating the equilibrium mixture
- D) removing N_2 from the mixture.

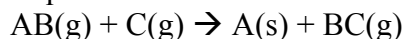
Ans: A Section: 8.8

29. In the reversible reaction $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g}) + \text{heat}$, the equilibrium shifts to the left when:

- A) H_2 is added to the mixture
- B) the equilibrium mixture is heated
- C) ammonia gas is distilled from the equilibrium mixture
- D) the pressure in the system increases

Ans: B Section: 8.8

30. Which action will shift the equilibrium of this reaction to the right?



- A) adding A
- B) removing C
- C) increasing the pressure
- D) increasing the volume of the reaction vessel

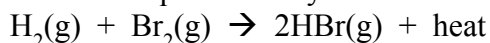
Ans: C Section: 8.8

31. Increasing the temperature of a system at equilibrium:

- A) increases the rate of an exothermic reaction
- B) increases the rate of an endothermic reaction
- C) has no effect on the rate of an exothermic reaction or an endothermic reaction
- D) increases the rates of both an exothermic and an endothermic reaction

Ans: B Section: 8.8

32. What will happen when this equilibrium system is heated?



Ans: The equilibrium will shift to the left, producing more H_2 and Br_2 , and decreasing the amount of HBr in the reaction mixture. Section: 8.8

33. The equilibrium constant for this reaction at 1000°C is $K_{\text{eq}} = 0.329$.



If 1.00 mol of COCl_2 is introduced into a 1.00 L flask at 1000°C , what will be the concentrations of all chemical species at equilibrium?

Ans: $[\text{COCl}_2] = 0.568 \text{ M}$, $[\text{CO}] = [\text{Cl}_2] = 0.432 \text{ M}$. Section: 8.2

34. A reaction with a large equilibrium constant _____.

- A) has a fast rate
- B) has a slow rate
- C) produces high concentrations of products
- D) produces low concentrations of products

Ans: C Section: 8.6

35. Which is the symbol for the heat of reaction?

- A) E_a
- B) ΔH
- C) K
- D) M

Ans: B Section: 8.2

36. Which reaction is likely to have the fastest reaction rate?

- A) Reaction with $E_a = 5 \text{ kcal/mol}$
- B) Reaction with $E_a = 20 \text{ kcal/mol}$
- C) Reaction with $E_a = 50 \text{ kcal/mol}$
- D) Reaction with $E_a = 100 \text{ kcal/mol}$

Ans: A Section: 8.2; 8.3

END OF SECTION