Quiz - Equilibrium, Acids & Bases

Multiple Choice
Identify the letter of the choice that best completes the statement or answers the question.

CONTENT REVIEW

____ 1. Chemical equilibrium exists when
a. no processes occur.
b. two similar forward processes occur.
c. two opposing processes occur at different rates.
d. two opposing processes occur at the same rate.

____ 2. Any chemical reaction in which the products can regenerate the reactants is called a(n)
a. double-replacement reaction.  
   c. reversible reaction.
b. single-replacement reaction.  
   d. irreversible reaction.

____ 3. What symbol is used to indicate a reversible reaction?
a. ➞  
   c. R  
b. ⇔  
   d. ∆

____ 4. What is the general relationship between the concentration and the rate of a forward reaction?
a. Rate is greater when product concentration is greater.
b. Rate is greater when reactant concentration is greater.
c. Rate is greater when reactant concentration is lower.
d. No relationship exists between concentration and rate.

____ 5. What symbol is used to denote concentration?
a. ()  
   c. ∆
b. [ ]  
   d. C

____ 6. At chemical equilibrium, which of the following is always true of the concentrations of reactants and products?
a. They are constant.  
   c. Reactant concentration is zero.
b. They are equal.  
   d. Product concentration is zero.

____ 7. What is the equilibrium constant for the general equation aA + bB ⇌ cC + dD?
a. \( \frac{a[A]^b[B]^c}{c[C]^d[D]^d} \)  
   c. \( \frac{[A]^b[B]^c}{[C]^d[D]^d} \)
b. \( \frac{c[C]^d[D]^d}{a[A]^b[B]^c} \)  
   d. \( \frac{[A]^b[B]^c}{[C]^d[D]^d} \)

____ 8. The symbol for the equilibrium constant is
a. C.  
   c. \( K_{eq} \)
b. \( K_{sp} \)  
   d. \( Q \).

____ 9. The principle that relates changes imposed on equilibrium systems to equilibrium position is
a. Haber's law.  
   c. Le Chatelier's principle.
b. the law of chemical equilibrium.  
   d. Avogadro's principle.

____ 10. If a change in conditions is imposed on a system at equilibrium, the equilibrium position will always
11. What will happen when additional reactant is added to a system at equilibrium?
   a. More products will form.
   b. All the added reactants will change to products.
   c. More products will change to reactants.
   d. Nothing will occur.

12. In the Arrhenius definition, an acid is a substance that
   a. turns litmus paper from blue to red.
   b. has a sour taste and neutralizes bases.
   c. furnishes hydrogen ions in water solution.
   d. furnishes hydroxide ions in water solution.

13. Which of the following is produced from the neutralization of an Arrhenius acid with an Arrhenius base?
   a. a metal
   b. an indicator
   c. a salt
   d. depends on the acid and base

14. In the Brønsted-Lowry definition, an acid is a substance that
   a. donates protons.
   b. accepts protons.
   c. neutralizes hydronium ions.
   d. forms a salt.

15. The origin of the word acid relates to acids' taste, which is best described as
   a. bitter.
   b. sweet.
   c. sour.
   d. salty.

16. The characteristic taste of bases is best described as
   a. bitter.
   b. sweet.
   c. sour.
   d. salty.

17. A smooth, slippery feel is associated with
   a. acids.
   b. bases.
   c. salts.
   d. indicators.

18. The reaction of acids with metals produces the gas
   a. oxygen.
   b. nitrogen.
   c. neon.
   d. hydrogen.

19. Because acids and bases are conductors of electricity, they are referred to as
   a. indicators.
   b. electrolytes.
   c. insulators.
   d. capacitors.

20. Substances that change color when added to acids or bases are called
   a. indicators.
   b. electrolytes.
   c. insulators.
   d. capacitors.

21. The ionic compound formed in an acid-base neutralization reaction is a(n)
   a. indicator.
   b. hydride.
   c. hydroxide.
   d. salt.

22. In a neutralization reaction, the individual properties of the acid and base
   a. are destroyed.
   b. become more basic.
b. become more acidic.

d. are reinforced.

23. A substance that can act as either an acid or a base is described as
   a. neutral.
   b. ambidextrous.
   c. conjugate.
   d. amphoteric.

24. The relative strengths of acids are determined by the extent to which the acid particles
   a. eat holes in clothing.
   b. ionize in water solution.
   c. are able to stay together.
   d. retain their shape.

25. The reaction of a weak acid with water can be described as
   a. complete.
   b. violent.
   c. incomplete.
   d. spontaneous.

26. What is the correct name of the acid HNO₂?
   a. nitric acid
   b. nitrous acid
   c. nitrite acid
   d. nitrate acid

27. The correct name of the acid HBr is
   a. hydrobromic acid.
   b. hydrobromous acid.
   c. bromate acid.
   d. bromite acid.

CONCEPT MASTERY

Use the diagrams to answer the questions or complete the statements.

**Figure 18-1**

28. In the experiment shown in Figure 18-1, a gas is given off, collected in a test tube, and then tested
    with a burning splint. A “pop” is heard. What is the gas?
   a. oxygen
   b. nitrogen
   c. hydrogen
   d. need more information

29. What particles will the solution in Figure 18-1 contain?
   a. H⁺ ions and NO₃⁻ ions
   b. HNO₃ molecules
   c. HNO₃ formula units
   d. HNO₃/H₂O complexes
<table>
<thead>
<tr>
<th>Acid</th>
<th>Reaction</th>
<th>Ka (AT 25°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>hydrofluoric</td>
<td>HF + H₂O → H₃O⁺ + F⁻</td>
<td>6.6 × 10⁻⁴</td>
</tr>
<tr>
<td>formic</td>
<td>HCOOH + H₂O → H₃O + HCOO⁻</td>
<td>1.8 × 10⁻⁴</td>
</tr>
<tr>
<td>hydrocyanic</td>
<td>HCN + H₂O → H₃O + CN⁻</td>
<td>6.2 × 10⁻¹⁰</td>
</tr>
<tr>
<td>hydrogen carbonate ion</td>
<td>HCO₃⁻ + H₂O → H₃O⁺ + CO₃²⁻</td>
<td>4.7 × 10⁻¹¹</td>
</tr>
</tbody>
</table>

**Figure 18-2**

30. Identify the strongest acid in Figure 18-2.
   a. HF  
   b. F⁻  
   c. HCO₃⁻  
   d. CO₃²⁻

**Figure 18-3**

31. In Figure 18-3, which substance is a binary acid?
   a. substance a  
   b. substance b  
   c. substance c  
   d. substance d

32. Which substance in Figure 18-3 is an oxy acid?
   a. substance a  
   b. substance b  
   c. substance c  
   d. substance d

33. Which substance in Figure 18-3 is the carboxylic acid?
   a. substance a  
   b. substance b  
   c. substance c  
   d. substance d

34. Which substance in Figure 18-3 has an acidic hydrogen?
   a. substance a only  
   b. substances a, b, and c  
   c. all of the above  
   d. none of the above choices

35. Which substance in Figure 18-3 would have the prefix “hydro” in its name?
   a. substance a  
   b. substance b  
   c. substance c  
   d. substance d
PROBLEM SOLVING

Use the skills you have developed in this chapter to solve each problem.

36. Write an equilibrium expression for the reaction $2 \text{HCl} (g) \rightleftharpoons \text{H}_2 (g) + \text{Cl}_2 (g)$.

37. What is the equilibrium expression for the reaction $\text{MgO} (s) \rightleftharpoons 2 \text{Mg} (s) + \text{O}_2 (g)$?

38. Given the equation $\text{SO}_3 (g) \rightleftharpoons \text{SO}_2 (g) + \frac{1}{2} \text{O}_2 (g) + \text{heat}$, predict the direction of shift in the equilibrium position if:
   (a) SO$_2$ is added;
   (b) SO$_3$ removed;
   (c) pressure is decreased;
   (d) temperature is raised.

39. Given the equation $\text{OF}_2 (g) + \text{H}_2\text{O} (g) \rightleftharpoons \text{O}_2 (g) + 2 \text{HF} (g) + 318 \text{kJ}$, predict the direction of shift in the equilibrium position if:
   (a) OF$_2$ is added;
   (b) H$_2$O is removed;
   (c) pressure is increased;
   (d) temperature is lowered.

40. In the acid-base forward reaction $\text{NH}_4^+ + \text{OH}^- \rightarrow \text{NH}_3 + \text{H}_2\text{O}$, identify the acid and its conjugate base.

41. In the acid-base forward reaction $\text{HF} + \text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+ + \text{F}^-$, identify the base and its conjugate acid.