AP Chemistry-Practice Questions Chpt 10 and 11

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

1. The following describe properties of substances. Which one is **not** a property of acids?
   a. They have a sour taste.
   b. They react with metal oxides to form salts and water.
   c. They react with other acids to form salts and water.
   d. Their aqueous solutions conduct an electric current.
   e. They react with active metals to liberate H$_2$.

2. According to the Arrhenius theory, which of the following is an acid?
   a. NH$_3$
   b. CH$_4$
   c. HCl
   d. H$_2$
   e. NaOH

3. Which statement is **not** consistent with the Arrhenius theory of acid-base reactions?
   a. An acid is a substance that contains hydrogen and produces H$^+$ in aqueous solution.
   b. A base is a substance that contains the OH group and produces OH$^-$ in aqueous solution.
   c. Ammonia is classified as a base.
   d. Neutralization is the combination of H$^+$ ions with OH$^-$ ions to form H$_2$O.
   e. The Arrhenius theory satisfactorily explained the reactions of protonic acids with metal hydroxides.

4. According to the Brønsted-Lowry theory, a base is defined as __________.
   a. an electron pair acceptor
   b. a proton acceptor
   c. an electron pair donor
   d. a proton donor
   e. any species that can produce hydroxide ions in aqueous solution

5. Which of the following can be a Brønsted-Lowry acid?
   a. AlCl$_3$
   b. CH$_4$
   c. NaOH
   d. H$_2$O
   e. H$_2$

6. Which one of the following species could **not** react as a Brønsted-Lowry acid?
   a. HCl
   b. H$_2$O
   c. CaO
   d. NH$_3$
   e. CH$_3$COOH

7. Which one of the following statements is **true**?
   \[
   \text{CH}_3\text{NH}_2 + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{NH}_3^+ + \text{OH}^{-}
   \]
   methylamine + water = methylammonium ion + hydroxide ion
a. CH₃NH₂ is the conjugate base of H₂O.
b. CH₃NH₃⁺ is the conjugate base of CH₃NH₂.
c. H₂O is the conjugate acid of OH⁻.
d. OH⁻ is the conjugate acid of H₂O.
e. There are no conjugate acid-base pairs.

8. Which one of the following pairs of acids and conjugate bases is incorrectly labeled or **incorrectly** matched?

<table>
<thead>
<tr>
<th>Acid</th>
<th>Conjugate Base</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. HF</td>
<td>F⁻</td>
</tr>
<tr>
<td>b. HClO</td>
<td>ClO⁻</td>
</tr>
<tr>
<td>c. H₂O</td>
<td>OH⁻</td>
</tr>
<tr>
<td>d. NH₄⁺</td>
<td>NH₂⁻</td>
</tr>
<tr>
<td>e. H₃O⁺</td>
<td>H₂O</td>
</tr>
</tbody>
</table>

9. The following acids are listed in order of decreasing acid strength in water.

HI > HNO₂ > CH₃COOH > HClO > HCN

According to the Brønsted-Lowry theory, which one of the following anions is the weakest base?

a. I⁻
b. NO₂⁻
c. CH₃COO⁻
d. ClO⁻
e. CN⁻

10. Which of the following compounds will dissolve in (by reaction with) hydrochloric acid and will also dissolve in (by reaction with) an excess of 6 M NaOH solution?

a. KOH
b. Mg(OH)₂
c. Ba(OH)₂
d. Sn(OH)₂
e. Sr(OH)₂

11. Which one of the following hydroxides is amphoteric?

a. Ca(OH)₂
b. Ba(OH)₂
c. Fe(OH)₃
d. NaOH
e. Zn(OH)₂

12. Which of the following is not an amphoteric metal hydroxide?

a. La(OH)₃
b. Be(OH)₂
c. Cr(OH)₃
d. Al(OH)₃
e. Zn(OH)₂

13. Which response lists all the following compounds that are amphoteric and no others?

I. RbOH
II. Fe(OH)$_3$
III. Al(OH)$_3$
IV. Be(OH)$_2$
V. Mn(OH)$_2$

a. I, II, and V
b. II, III, IV, and V
c. II and V
d. III and IV
e. IV and V

14. Write the net ionic equation for the reaction of aluminum hydroxide with an excess of concentrated sodium hydroxide solution. The complex ion that is formed in this reaction has __________ hydroxide ions bonded to each aluminum, and the charge on the complex ion is __________.

a. one, 2+
b. two, 1+
c. three, 0
d. four, 1-
e. four, 4+

15. Which of the following oxides is amphoteric?

a. BeO
b. MgO
c. CaO
d. SrO
e. BaO

16. Which one of the following is a weak acid?

a. H$_2$SO$_4$
b. HF
c. HCl
d. HBr
e. HI

17. Which of the following is the strongest acid?

a. HF
b. HCl
c. HBr
d. HI
e. CH$_3$COOH

18. Which of the following is the strongest acid?

a. NH$_3$
b. HNO$_2$
c. HNO$_3$
d. H$_2$NNH$_2$
e. NH$_4^+$

19. Which response includes all the acids listed below that are strong acids, and no weak acids?

H$_2$SO$_4$, HI, HF, H$_3$PO$_4$, HNO$_3$
a. HI, HF, HNO₃
b. H₂SO₄, HNO₃
c. H₂SO₄, HI, HNO₃
d. H₂SO₄, H₃PO₄, HNO₃
e. another one or another combination

20. Which response includes all of the following that are strong acids, and no others?

I. HClO₄
II. HNO₂
III. H₃AsO₄
IV. HCl
V. H₃PO₄

a. I, III, IV, and V
b. I and V
c. I and IV
d. II and III
e. IV and V

21. Which response includes all the weak acids listed below, and no strong acids?

I. HF
II. HI
III. HNO₃
IV. HBrO
V. HClO₄

a. II and III
b. I, II, and IV
c. IV and V
d. II, III, and IV
e. I and IV

22. Arrange the following in order of increasing acid strength.

H₂O, H₂Se, H₂Te, H₂S

Increasing Strength

a. H₂O < H₂Te < H₂Se < H₂S
b. H₂Se < H₂Te < H₂O < H₂S
c. H₂S < H₂Se < H₂Te < H₂O
d. H₂O < H₂S < H₂Se < H₂Te
e. H₂Se < H₂Te < H₂S < H₂O

23. Why is HI a stronger acid than HCl?

a. Because I is more electronegative than Cl.
b. Because Cl is more electronegative than I.
c. The bond strength of HCl is greater than the bond strength of HI.
d. The bond strength of HI is greater than the bond strength of HCl.
e. HI is not a stronger acid than HCl.
24. Which one of the following is a soluble, strong base?
   a. CsOH  
   b. Cu(OH)$_2$  
   c. Fe(OH)$_3$  
   d. Mn(OH)$_2$  
   e. Al(OH)$_3$

25. Which one of the following is **not** a soluble, strong base?
   a. NaOH  
   b. KOH  
   c. RbOH  
   d. CsOH  
   e. NH$_2$OH

26. Which response includes all of the following that are insoluble bases, and no others?
   I. LiOH  
   II. KOH  
   III. Ni(OH)$_2$  
   IV. Mg(OH)$_2$  
   V. Ca(OH)$_2$
   a. IV  
   b. IV and V  
   c. I and III  
   d. III and IV  
   e. I, IV, and V

27. Which response includes all of the following that are insoluble bases, and no others?
   LiOH, Cu(OH)$_2$, Be(OH)$_2$, Ba(OH)$_2$, KOH
   a. LiOH, Ba(OH)$_2$  
   b. Cu(OH)$_2$, KOH, Ba(OH)$_2$  
   c. LiOH, Be(OH)$_2$  
   d. Cu(OH)$_2$, Ba(OH)$_2$  
   e. another one or another combination

28. Which one of the following salts is **insoluble** in water?
   a. MgCO$_3$  
   b. (NH$_4$)$_2$SO$_4$  
   c. KCH$_2$COO  
   d. Cu(NO$_3$)$_2$  
   e. Fe$_2$(SO$_4$)$_3$

29. For which one of the pairs of acids and bases does the following represent the **net ionic** equation?
   H$_3$O$^+$ + OH$^-$ → 2H$_2$O
   a. NaOH, HBr  
   b. CH$_3$COOH, Ca(OH)$_2$  
   c. HNO$_3$, Mg(OH)$_2$
d. CH₃COOH, Cu(OH)₂
e. CH₃COOH, Cr(OH)₃

30. Consider the following pairs of acids and bases:

   I. HBr, KOH
   II. HF, TlOH
   III. HNO₂, NaOH
   IV. HClO₄, LiOH

If net ionic equations are written for reactions between each pair of acids and bases, for which two pairs will the net ionic equations be identical?
   a. I and IV
   b. II and III
   c. II and IV
   d. I and II
   e. III and IV

31. According to the Lewis theory, a base __________.
   a. is a proton acceptor
   b. is a proton donor
   c. makes available a share in a pair of electrons
   d. is any compound that contains electron pairs
   e. accepts a share in a pair of electrons

32. In the reaction AlCl₃ + Cl⁻ → AlCl₄⁻, the Cl⁻ functions as a(an) __________.
   a. Brønsted-Lowry acid
   b. Brønsted-Lowry base
   c. Arrhenius base
   d. Lewis acid
   e. Lewis base

33. Which indication of relative acid strength is incorrect?
   a. HNO₃ > HNO₂
   b. HI > HF
   c. H₂PO₄⁻ > HPO₄²⁻
   d. HClO₃ > HBrO₃
   e. HClO > HCl

34. What volume of 12.6 M HCl must be added to enough water to prepare 5.00 liters of 3.00 M HCl?
   a. 1.19 L
   b. 21.0 L
   c. 0.840 L
   d. 7.56 L
   e. 2.14 L

35. What volume of 12.0 M HNO₃ is required to prepare 900. mL of 2.0 M HNO₃ solution?
   a. 100. mL
   b. 150. mL
   c. 200. mL
   d. 250. mL
   e. 300. mL
36. What is the molarity of 1600. mL of a solution that contains 3.25 g of $\text{H}_3\text{PO}_4$?
   a. $2.03 \times 10^{-3} \ M$
   b. $6.90 \times 10^{-3} \ M$
   c. $6.22 \times 10^{-2} \ M$
   d. $6.09 \times 10^{-3} \ M$
   e. $2.07 \times 10^{-2} \ M$

37. What is the oxidation number of bromine in $\text{KBrO}_3$?
   a. +1
   b. +7
   c. +3
   d. -1
   e. +5

38. Balance the following net ionic equation. Use $\text{H}^+$ rather than $\text{H}_3\text{O}^+$. What is the coefficient of $\text{NO}_3^-$?

   $\text{NO}_3^- \cdot \text{Cr}_2\text{O}_7^{2-} + \text{HNO}_2 \rightarrow \text{Cr}^{3+} + \text{NO}_3^-$ (acidic solution)

   a. 1
   b. 2
   c. 3
   d. 4
   e. 5

39. Balance the following net ionic equation. Use $\text{H}^+$ rather than $\text{H}_3\text{O}^+$. What is the coefficient of $\text{H}_2\text{O}$?

   $\text{H}_2\text{O}\cdot \text{C} + \text{H}^+ + \text{SO}_4^{2-} \rightarrow \text{CO}_2 + \text{SO}_2$ (acidic solution)

   a. 1
   b. 2
   c. 3
   d. 4
   e. 5

40. A 30.0 mL sample of a solution of $\text{NaClO}_3$ that contains 1.06 g of $\text{NaClO}_3$ is to react with a solution of $\text{I}_2$. What is the molarity of the $\text{NaClO}_3$ solution?

   $\text{NaClO}_3 + \text{H}_2\text{O} + \text{I}_2 \rightarrow \text{HIO}_3 + \text{NaCl}$ (unbalanced)

   a. $5.53 \times 10^{-2} \ M$
   b. 0.332 $M$
   c. 2.00 $M$
   d. 0.249 $M$
   e. $2.67 \times 10^{-2} \ M$
AP Chemistry-Practice Questions Chpt 10 and 11
Answer Section

MULTIPLE CHOICE

1. ANS: C PTS: 1 TOP: Properties of Aqueous Solutions of Acids and Bases
2. ANS: C PTS: 1 TOP: The Arrhenius Theory
3. ANS: C PTS: 1 TOP: The Arrhenius Theory
4. ANS: B PTS: 1 TOP: The Brønsted-Lowry Theory
5. ANS: D PTS: 1 TOP: The Brønsted-Lowry Theory
6. ANS: C PTS: 1 TOP: The Brønsted-Lowry Theory
7. ANS: C PTS: 1 TOP: The Brønsted-Lowry Theory
8. ANS: D PTS: 1 TOP: The Brønsted-Lowry Theory
10. ANS: D PTS: 1 TOP: Amphoterism
11. ANS: E PTS: 1 TOP: Amphoterism
12. ANS: A PTS: 1 TOP: Amphoterism
13. ANS: D PTS: 1 TOP: Amphoterism
14. ANS: D PTS: 1 TOP: Amphoterism
15. ANS: A PTS: 1 TOP: Amphoterism
16. ANS: B PTS: 1 TOP: Strengths of Acids
17. ANS: D PTS: 1 TOP: Strengths of Acids
18. ANS: C PTS: 1 TOP: Strengths of Acids
19. ANS: C PTS: 1 TOP: Strengths of Acids
20. ANS: C PTS: 1 TOP: Strengths of Acids
21. ANS: E PTS: 1 TOP: Strengths of Acids
22. ANS: D PTS: 1 TOP: Strengths of Acids
23. ANS: C PTS: 1 TOP: Strengths of Acids
24. ANS: A PTS: 1 TOP: Acid-Base Reactions in Aqueous Solutions
25. ANS: E PTS: 1 TOP: Acid-Base Reactions in Aqueous Solutions
26. ANS: D PTS: 1 TOP: Acid-Base Reactions in Aqueous Solutions
27. ANS: E PTS: 1 TOP: Acid-Base Reactions in Aqueous Solutions
28. ANS: A PTS: 1 TOP: Acid-Base Reactions in Aqueous Solutions
29. ANS: A PTS: 1 TOP: Acid-Base Reactions in Aqueous Solutions
30. ANS: A PTS: 1 TOP: Acid-Base Reactions in Aqueous Solutions
31. ANS: C PTS: 1 TOP: The Lewis Theory
32. ANS: E PTS: 1 TOP: The Lewis Theory
33. ANS: E PTS: 1 TOP: Strengths of Acids
34. ANS: A PTS: 1 TOP: Calculations Involving Molarity
35. ANS: B PTS: 1 TOP: Calculations Involving Molarity
36. ANS: E PTS: 1 TOP: Calculations Involving Molarity
37. ANS: E PTS: 1 TOP: Balancing Redox Reactions
38. ANS: C PTS: 1 TOP: Balancing Redox Reactions
39. ANS: B PTS: 1 TOP: Balancing Redox Reactions
40. ANS: B PTS: 1 TOP: Stoichiometry of Redox Reactions