MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) Which statement concerning Arrhenius acid–base theory is not correct? 1) ______
   A) Acid–base reactions must take place in aqueous solution.
   B) An Arrhenius acid produces hydrogen ions in water solution.
   C) An Arrhenius base produces hydroxide ions in water solution.
   D) A neutralization reaction produces water plus a salt.
   E) none of the above

2) The $\text{H}_3\text{O}^+$ ion is called the ________ ion. 2) ______
   A) protium
   B) hydronium
   C) hydrogen
   D) hydroxide
   E) water

3) When acids and bases react the product other than water is a 3) ______
   A) hydroxide ion.
   B) hydrogen ion.
   C) hydronium ion.
   D) salt.
   E) metal.

4) Which of the following compounds is a salt? 4) ______
   A) NaOH
   B) KNO$_3$
   C) C$_6$H$_{12}$O$_6$
   D) H$_2$SO$_4$
   E) HBr

5) Which of the following compounds is a salt? 5) ______
   A) CH$_3$CO$_2$H
   B) NH$_4$NO$_3$
   C) C$_6$H$_6$
   D) NH$_3$
   E) Al(OH)$_3$

6) Which compound is manufactured in larger quantities in the U.S. than any other industrial chemical? 6) ______
   A) HNO$_3$
   B) H$_2$SO$_4$
   C) HCl
   D) H$_3$PO$_4$
   E) NaOH
7) Which pair of compounds is used in the manufacture of fertilizers?
   A) HCl and H₃PO₄
   B) HNO₃ and NaOH
   C) H₂SO₄ and H₃PO₄
   D) HNO₃ and HCl
   E) HCl and NaOH

8) A Bronsted–Lowry acid is a substance which
   A) accepts protons from other substances.
   B) produces hydrogen ions in aqueous solution.
   C) produces hydroxide ions in aqueous solution.
   D) donates protons to other substances.
   E) accepts hydronium ions from other substances.

9) A Bronsted–Lowry base is a substance which
   A) produces hydroxide ions in aqueous solution.
   B) accepts hydronium ions from other substances.
   C) accepts protons from other substances.
   D) produces hydrogen ions in aqueous solution.
   E) donates protons to other substances.

10) A necessary requirement for a Bronsted base is
    A) the production of hydronium ion upon reaction with water.
    B) the presence of water as a reaction medium.
    C) a lone pair of electrons in its Lewis dot structure.
    D) the presence of hydroxide in its formula.
    E) the presence of a metal ion in its formula.

    A) hydrogen        B) aquo  C) covalent  D) metallic  E) ionic

12) Which of the following is a diprotic acid?
    A) nitric acid
    B) acetic acid
    C) phosphoric acid
    D) sulfuric acid
    E) hydrochloric acid
13) What is the conjugate base of HSO$_4^-$?
   A) OH$^-$  B) H$_3$O$^+$  C) H$_2$SO$_3$  D) SO$_4^{2-}$  E) H$_2$SO$_4$

14) According to Bronsted-Lowry theory, acid-base reactions can be described as _______ reactions.
   A) proton transfer  B) nuclear transfer  C) electrolytic  D) gas phase  E) electron transfer

15) \( \text{C}_5\text{H}_5\text{N} + \text{H}_2\text{CO}_3 \rightleftharpoons \text{C}_5\text{H}_6\text{N}^+ + \text{HCO}_3^- \)
   In the reaction shown, the conjugate acid of \( \text{C}_5\text{H}_5\text{N} \) is _______.
   A) \( \text{C}_5\text{H}_5\text{N} \)  B) \( \text{H}_2\text{CO}_3 \)  C) \( \text{C}_5\text{H}_6\text{N}^+ \)  D) \( \text{H}_3\text{O}^+ \)  E) \( \text{HCO}_3^- \)

16) \( \text{CH}_3\text{NH}_2 + \text{HCl} \rightleftharpoons \text{CH}_3\text{NH}_3^+ + \text{Cl}^- \)
   A conjugate acid-base pair in the reaction shown is _______ and _______.
   A) \( \text{CH}_3\text{NH}_2 \) and \( \text{Cl}^- \)
   B) \( \text{CH}_3\text{NH}_3^+ \) and \( \text{Cl}^- \)
   C) \( \text{HCl} \) and \( \text{H}_3\text{O}^+ \)
   D) \( \text{HCl} \) and \( \text{Cl}^- \)
   E) \( \text{CH}_3\text{NH}_2 \) and \( \text{HCl} \)

17) Which of the following cannot act as a Bronsted base?
   A) \( \text{NH}_3 \)  B) \( \text{NH}_2^- \)  C) \( \text{HCO}_3^- \)  D) \( \text{CO}_3^{2-} \)  E) \( \text{NH}_4^+ \)

18) Which of the following is a triprotic acid?
   A) \( \text{NH}_3 \)
   B) \( \text{H}_3\text{PO}_4 \)
   C) \( \text{Al(OH)}_3 \)
   D) \( \text{HNO}_3 \)
   E) \( \text{CH}_3\text{COOH} \)
19) Ammonia reacts with acids because
   A) it contains the hydroxide group.
   B) it is itself an acid.
   C) it is neutral.
   D) it contains a lone pair of electrons.
   E) it is a salt.

20) What is the conjugate acid of HSO₄⁻?
   A) H₂SO₃  B) H₂SO₄  C) OH⁻  D) H₃O⁺  E) SO₄²⁻

21) Water and HSO₄⁻ can either accept protons or donate protons. Such substances are said to be
   A) monoprotic.
   B) triprotic.
   C) amphoteric.
   D) conjugate.
   E) diprotic.

22) Which statement is correct for pure water?
   A) Pure water contains no ions.
   B) Pure water contains equal amounts of hydroxide, [OH⁻], and hydronium, [H₃O⁺], ions.
   C) Pure water is an electrolyte.
   D) Pure water contains larger amounts of hydronium, [H₃O⁺], ions than hydroxide, [OH⁻], ions.
   E) Pure water contains larger amounts of hydroxide, [OH⁻], ions than hydronium, [H₃O⁺], ions.

23) Which net ionic equation correctly represents the neutralization of a solution of barium hydroxide by a solution of nitric acid?
   A) Ba(NO₃)₂ + H₂O → Ba²⁺ + 2 NO₃⁻
   B) H⁺ + OH⁻ → H₂O
   C) Ba²⁺ + 2 NO₃⁻ → Ba(NO₃)₂
   D) H⁺ + NO₃⁻ → HNO₃
   E) Ba²⁺ + 2 OH⁻ → Ba(OH)₂
24) Which substance produces carbon dioxide and water upon reaction with an acid?
   A) MgCO₃
   B) NH₄NO₃
   C) NaCH₃CO₂
   D) H₂C₂O₄
   E) C₈H₁₈

25) Which equation correctly represents the neutralization of aluminum hydroxide by sulfuric acid?
   A) Al(OH)₂ + H₂SO₄ → AlSO₄ + 2 H₂O
   B) 2 Al(OH)₃ + 3 H₂SO₄ → Al₂(SO₄)₃ + 3 H₂O
   C) 3 Al(OH)₃ + 2 H₃SO₄ → Al₃(SO₄)₂ + 6 H₂O
   D) Al(OH)₃ + H₃SO₄ → AlSO₄ + 3 H₂O
   E) 2 Al(OH)₃ + 3 H₂SO₄ → Al₂(SO₄)₃ + 6 H₂O

26) The net ionic equation for the reaction of formic acid, a weak acid, with potassium hydroxide, a strong base, is
   A) H⁺ (aq) + HCO₂⁻ (aq) + K⁺ (aq) + OH⁻ (aq) → K⁺ (aq) + HCO₂⁻ (aq) + H₂O (l)
   B) HCO₂H (aq) + K⁺ (aq) + OH⁻ (aq) → K⁺ (aq) + HCO₂⁻ (aq) + H₂O (l)
   C) HCO₂H (aq) + OH⁻ (aq) → HCO₂⁻ (aq) + H₂O (l)
   D) HCO₂H (aq) + KOH (aq) → KHCO₂ (aq) + H₂O (l)
   E) HCO₂⁻ (aq) + KOH (aq) → KHCO₂ (aq) + OH⁻ (aq)

27) Acetic acid is a weak acid in water because it is
   A) unable to hold onto its hydrogen ion.
   B) completely dissociated into hydronium ions and acetate ions.
   C) only slightly dissociated into ions.
   D) dilute.
   E) only slightly soluble.

28) Hydrogen cyanide, HCN, is a weak acid. Which equation best represents its aqueous chemistry?
   A) HCN (aq) + H₂O (l) ⇌ H₂CN⁺ (aq) + OH⁻ (aq)
   B) H₂O (l) ⇌ H⁺(aq) + OH⁻(aq)
   C) HCN (aq) ⇌ H⁻(aq) + CN⁺(aq)
   D) HCN (aq) ⇌ H⁺(aq) + CN⁻(aq)
   E) HCN (aq) + H₂O (l) ⇌ CN⁻ (aq) + H₃O⁺(aq)
29) Which of the following is a strong acid?  
A) H₃PO₄  B) H₂O  C) HNO₃  D) NH₄⁺  E) HCO₃⁻  

30) Which of the following is a weak acid?  
A) H₃PO₄  B) HCl  C) HNO₃  D) NH₃  E) OH⁻  

31) Which reaction best illustrates the behaviour of the weak base H₂PO₄⁻ in aqueous solution?  
A) H₂PO₄⁻ (aq) + H₂O (l) ⇌ H₃PO₄ (aq) + OH⁻ (aq)  
B) H₂PO₄⁻ (aq) + H⁺ (aq) ⇌ H₃PO₄ (aq)  
C) H₂PO₄⁻ (aq) ⇌ H⁺ (aq) + HPO₄²⁻ (aq)  
D) H₂PO₄⁻ (aq) + H₂O (l) ⇌ HPO₄²⁻ (aq) + H₃O⁺ (aq)  
E) H₂PO₄⁻ (aq) ⇌ 2 H⁺ (aq) + PO₄³⁻ (aq)  

32) At 25°C, the value of K_w is _______.  
A) 1.00 × 10⁻¹⁴  
B) 1.00  
C) 1.00 × 10⁻⁷  
D) 1.00 × 10⁷  
E) 1.00 × 10¹⁴  

33) Which compound has a very large value of K_a in aqueous solution?  
A) KOH  
B) NH₃  
C) H₃PO₄  
D) NaCl  
E) HNO₃  

34) Which compound has a value of K_a that is close to 10⁻⁵?  
A) KOH  
B) CH₃CH₂CO₂H  
C) NaCl  
D) NH₃  
E) HNO₃
35) Which solution is basic?
   A) [OH\(^-\)] = 1.0 \times 10^{-10}
   B) [H\(_3\)O\(^+\)] = 1.0 \times 10^{-10}
   C) [H\(_3\)O\(^+\)] = 1.0 \times 10^{-4}
   D) [H\(_3\)O\(^+\)] = 1.0 \times 10^{-7}
   E) [OH\(^-\)] = 1.0 \times 10^{-7}

36) In an aqueous solution that is basic, [H\(_3\)O\(^+\)] is _______ than 1.0 \times 10^{-7} and _______ than [OH\(^-\)].
   A) greater; greater
   B) less; greater
   C) greater; less
   D) less; less
   E) none of the above

37) Which example is not acidic?
   A) a solution of NH\(_4\)NO\(_3\) with pH < 7.00
   B) orange juice
   C) lake water that turns blue litmus to red
   D) a solution in which [H\(_3\)O\(^+\)] = 1.00 \times 10^{-7}
   E) soil for azaleas with pH of 4.8

38) Which example is not basic?
   A) shampoo
   B) limewater
   C) window cleaner
   D) vinegar
   E) Mg(OH)\(_2\), used in remedies for upset stomach

39) If the concentration of OH\(^-\) in an aqueous solution is 1.4 \times 10^{-7} M, the concentration of H\(_3\)O\(^+\) is _______.
   A) 1.0 \times 10^{-7} M
   B) 7.1 \times 10^{+6} M
   C) 7.1 \times 10^{-8} M
   D) 1.3 \times 10^{-8} M
   E) 1.4 \times 10^{-7} M
40) If the concentration of $\text{H}_3\text{O}^+$ in an aqueous solution is $7.6 \times 10^{-9}$ M, the concentration of $\text{OH}^-$ is _______.

A) $6.4 \times 10^{-5}$ M  
B) $7.6 \times 10^{-9}$ M  
C) $1.3 \times 10^8$ M  
D) $7.6 \times 10^{-23}$ M  
E) $1.3 \times 10^{-6}$ M

41) In an aqueous solution that is acidic, $[\text{H}_3\text{O}^+]$ is _______ than $1.0 \times 10^{-7}$ and _______ than $[\text{OH}^-]$.  

A) less; less  
B) greater; greater  
C) less; greater  
D) greater; less  
E) none of the above

42) Which of the following statements is correct?

A) In an acidic solution, $[\text{H}_3\text{O}^+] > 10^{-7}$; $[\text{OH}^-] < 10^{-7}$.  
B) In an acidic solution, $[\text{H}_3\text{O}^+] > 10^{-7}$; $[\text{OH}^-] = 10^{-7}$.  
C) In an acidic solution, $[\text{H}_3\text{O}^+] < 10^{-7}$; $[\text{OH}^-] < 10^{-7}$.  
D) In an acidic solution, $[\text{H}_3\text{O}^+] > 10^{-7}$; $[\text{OH}^-] > 10^{-7}$.  
E) In an acidic solution, $[\text{H}_3\text{O}^+] < 10^{-7}$; $[\text{OH}^-] > 10^{-7}$.

43) If the $[\text{H}^+]$ of a water sample is $1 \times 10^{-4}$ M, the $[\text{OH}^-]$ is

A) $1 \times 10^{-10}$ M  
B) $1 \times 10^{-14}$ M  
C) $1 \times 10^{-4}$ M  
D) $1 \times 10^4$ M  
E) none of the above

44) What is the conjugate base of water?

A) $\text{OH}^-$ (aq)  
B) $\text{H}^+$ (aq)  
C) $\text{H}_3\text{O}^+$ (aq)  
D) $\text{O}_2^-$ (aq)  
E) $\text{H}_2\text{O}$ (l)

45) What is the conjugate acid of water?

A) $\text{O}_2^-$ (aq)  
B) $\text{H}_3\text{O}^+$ (aq)  
C) $\text{H}^+$ (aq)  
D) $\text{H}_2\text{O}$ (l)  
E) $\text{OH}^-$ (aq)

46) If the concentration of $\text{OH}^-$ is $1 \times 10^{-2}$ M, the concentration of $\text{H}_3\text{O}^+$ is _______ M.

A) $1 \times 10^{-12}$  
B) $1 \times 10^{-14}$  
C) $1 \times 10^{-2}$  
D) $1 \times 10^0$  
E) $1 \times 10^{-7}$
47) If the concentration of H₃O⁺ is \(3.5 \times 10^{-3}\) M, the concentration of OH⁻ is _______ M.
   A) \(2.9 \times 10^{-12}\)
   B) \(10.5 \times 10^{-3}\)
   C) \(3.5 \times 10^{-11}\)
   D) \(1.0 \times 10^{-12}\)
   E) \(1.0 \times 10^{-7}\)

48) Which of the following statements is correct?
   A) In a basic solution, \([H_3O^+] > 10^{-7}; [OH^-] = 10^{-7}\).
   B) In a basic solution, \([H_3O^+] > 10^{-7}; [OH^-] > 10^{-7}\).
   C) In a basic solution, \([H_3O^+] < 10^{-7}; [OH^-] < 10^{-7}\).
   D) In a basic solution, \([H_3O^+] > 10^{-7}; [OH^-] < 10^{-7}\).
   E) In a basic solution, \([H_3O^+] < 10^{-7}; [OH^-] > 10^{-7}\).

49) The pH of a cup of coffee is measured as 5.45. Express this measurement as \([H^+]\), using the correct number of significant figures.
   A) \(3.55 \times 10^{-6}\) M
   B) \(3.548 \times 10^{-6}\) M
   C) \(3.5 \times 10^{-6}\) M
   D) \(2.82 \times 10^5\) M
   E) \(4 \times 10^{-6}\) M

50) What is the value of \([H_3O^+]\) in a solution with pH = 10.82?
   A) 1.03 M
   B) 10.82 M
   C) \(6.6 \times 10^{-4}\) M
   D) \(1.5 \times 10^{-11}\) M
   E) 3.18 M

51) The pH of a solution with \([H^+] = 5.9 \times 10^{-3}\) M, to the correct number of significant figures, is _______.
   A) 2.23
   B) \(5.9 \times 10^{-3}\)
   C) 1.01
   D) 2.2
   E) 2.229

52) If the \([H^+]\) of a water sample is \(1 \times 10^{-4}\) M, the pH of the sample is _______, and the sample is _______.
   A) 4; basic
   B) –10; basic
   C) –4; acidic
   D) 4; acidic
   E) 10; basic
53) What is the pH of a solution in which \([H_3O^+] = 1.2 \times 10^{-3} \ text{M}\)?
   A) 12.80
   B) 1.20
   C) 2.92
   D) 8.33 \times 10^{-12}
   E) 11.08

54) What is the pH of a solution in which \([H_3O^+] = 3.8 \times 10^{-8} \ text{M}\)?
   A) 7.42
   B) 2.6 \times 10^{-7}
   C) 6.58
   D) 3.80
   E) 1.0 \times 10^{-8}

55) What is the pH of a solution in which the hydrogen ion concentration is \(5.1 \times 10^{-8} \ text{M}\)?
   A) 8.90
   B) 7.29
   C) 6.71
   D) 5.10
   E) 1.96 \times 10^{-7}

56) What is the pH of a solution in which \([H_3O^+] = 4.1 \times 10^{-2} \ text{M}\)?
   A) 12.90
   B) 12.61
   C) 1.10
   D) 1.39
   E) 4.10

57) What is the hydrogen ion concentration in a solution with pH = 2.34?
   A) 2.19 \times 10^{-12} \ text{M}
   B) 2.34 \times 10^{-3} \ text{M}
   C) 4.27 \times 10^{-12} \ text{M}
   D) 1.17 \times 10^1 \ text{M}
   E) 4.57 \times 10^{-3} \ text{M}

58) Calculate the hydrogen ion concentration in a solution with pH = 6.35.
   A) 6.35 \ text{M}
   B) 2.2 \times 10^{-8} \ text{M}
   C) 0.80 \ text{M}
   D) 7.65 \ text{M}
   E) 4.5 \times 10^{-7} \ text{M}
59) What is the $[\text{H}_3\text{O}^+]$ in a solution with $\text{pH} = 11.61$?  
A) $1.00 \times 10^{-14} \text{ M}$  
B) $2.39 \times 10^{+1} \text{ M}$  
C) $4.07 \times 10^{-3} \text{ M}$  
D) $2.45 \times 10^{-12} \text{ M}$  
E) $1.16 \times 10^{+1} \text{ M}$  

60) Which of the following pH's corresponds to a strongly basic solution?  
A) 7.4  
B) 6.9  
C) 2.7  
D) 11.5  
E) 4.3  

61) Which of the following pH's corresponds to a neutral solution?  
A) 14.0  
B) 6.2  
C) 8.5  
D) 1.8  
E) 7.0  

62) Which of the following pH's corresponds to a weakly acidic solution?  
A) 1.4  
B) 9.2  
C) 5.3  
D) 11.5  
E) 7.8  

63) To prepare a buffer using sodium phosphate, which of the following would also be needed?  
A) phosphoric acid  
B) ammonium phosphate  
C) hydrochloric acid  
D) ammonium hydroxide  
E) sodium hydroxide  

64) A buffer solution  
A) is a strong base.  
B) closely maintains its original pH.  
C) neutralizes only acids.  
D) maintains pH at 7.00.  
E) is a salt solution.  

65) The pH of a 250. mL sample of a buffer solution is 9.85. If 1.0 mL of 6 M HCl is added, the pH of the resulting mixture is closest to  
A) 0.00  
B) 1.65  
C) 10.00  
D) 9.70  
E) 7.00
66) Which of the following solutions is a buffer?
   A) a solution of hydrochloric acid and sodium acetate
   B) a solution of sulfuric acid and sodium sulfate
   C) a solution of hydrochloric acid and sodium sulfate
   D) a solution of acetic acid and sodium acetate
   E) a solution of acetic acid and sodium sulfate

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

67) Explain the term "amphoteric." Use the hydrogen carbonate ion, HCO₃⁻ to illustrate amphoteric behavior.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

68) All of the following species are involved in the blood buffer system except ______.
   A) CO₂
   B) CO₃²⁻
   C) H₂CO₃
   D) HCO₃⁻
   E) none of the above

69) All of the statements regarding equivalents of acids and bases are true except ______.
   A) The equivalent weight of a base is the weight that produces one mole of hydroxide ions.
   B) Equivalents are used to determine normality of solutions.
   C) Equivalents are the same as moles.
   D) One equivalent of any acid will neutralize one equivalent of any base.
   E) Equivalents of acid are based on the number of hydrogen ions produced per formula unit of acid.

70) What is the normality of a solution containing 49 g of H₂SO₄ in enough water to make 400 mL of solution?
   A) 5.0 N  B) 2.5 N  C) 0.20 N  D) 1.0 N  E) 10 N

71) The normality of a solution prepared by dissolving 25.0 g of Ca(OH)₂ in water to make 250. mL solution is ______ N.
   A) 0.675  B) 2.70  C) 1.35  D) 3.51  E) 1.75

72) The normality of a solution prepared by dissolving 50.0 g of Ca(OH)₂ in water to make 250. mL solution is ______ N.
   A) 7.02  B) 3.51  C) 2.70  D) 5.40  E) 1.35

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73) What is the concentration of a weak base solution if a 25.0 mL sample is neutralized by 48.3 mL of 0.105 M H₃PO₄?
   A) 0.0676 M  B) 0.609 M  C) 0.203 M  D) 0.0543 M  E) 0.163 M

74) What is the normality of a solution containing 100 g HNO₃ in 500 mL of solution?
   A) 1.26 N  B) 0.630 N  C) 1.59 N  D) 0.500 N  E) 3.17 N

75) What is the normality of a solution prepared by dissolving 75.0 g citric acid, a triprotic acid with molar mass of 192.14 g, in water to make 250.0 mL solution:
   A) 0.0576 N  B) 0.0865 N  C) 0.147 N  D) 0.288 N  E) 2.35 N

76) What is the normality of a solution prepared by dissolving 37.5 g citric acid, a triprotic acid with molar mass of 192.14 g, in water to make 250.0 mL solution:
   A) 0.780 N  B) 0.0865 N  C) 0.147 N  D) 0.288 N  E) 2.35 N

77) How many mL of 0.100 M NaOH are needed to neutralize 24.0 mL of 0.150 M HCl?
   A) 48.0 mL  B) 36.0 mL  C) 24.0 mL  D) 12.0 mL  E) 18.0 mL

78) How many mL of 0.100 M NaOH are needed to neutralize 50.00 mL of a 0.150 M solution of CH₃CO₂H, a monoprotic acid?
   A) 100.00 mL  B) 25.00 mL  C) 50.00 mL  D) 75.00 mL  E) 37.50 mL

79) What is the concentration of a solution of HCl in which a 10.0 mL sample of acid required 50.0 mL of 0.150 M NaOH for neutralization?
   A) 0.15 M  B) 0.60 M  C) 0.030 M  D) 0.75 M  E) 7.5 M

80) What is the concentration of a nitric acid solution if a 10.00 mL sample of the acid requires 31.25 mL of 0.135 M KOH for neutralization?
   A) 0.422 M  B) 0.211 M  C) 0.844 M  D) 0.0432 M  E) 0.135 M

81) What is the concentration of an acetic acid solution if a 10.0 mL sample required 26.4 mL of 0.950 M KOH for neutralization?
   A) 0.399 M  B) 2.78 M  C) 2.51 M  D) 0.950 M  E) 0.379 M

82) What is the concentration of a phosphoric acid solution of a 25.00 mL sample of the acid requires 42.24 mL of 0.135 M NaOH for neutralization?
   A) 0.0266 M  B) 0.0760 M  C) 0.684 M  D) 0.228 M  E) 0.0799 M

83) How many mL of 0.360 M HNO₃ are needed to neutralize a 22.5 mL sample of 0.240 M KOH?
   A) 15.0 mL  B) 62.5 mL  C) 22.5 mL  D) 33.8 mL  E) 5.40 mL
84) How many mL of 0.150 M NaOH are needed to neutralize 50.00 mL of a 0.120 M solution of H₂SO₄?

A) 120.00 mL  B) 50.00 mL  C) 80.00 mL  D) 160.00 mL  E) 40.00 mL

85) How many mL of 0.241 M H₂SO₄ will be needed to neutralize a 50.0 mL sample of 0.191 M KOH?

A) 39.6 mL  B) 79.3 mL  C) 31.5 mL  D) 19.8 mL  E) 126 mL

86) Which compound produces an acidic solution when dissolved in water?

A) KCl  B) NaF  C) Ca(NO₃)₂  D) K₂SO₄  E) NH₄Cl

87) Which compound produces a basic solution when dissolved in water?

A) KClO₄  B) Ca(NO₃)₂  C) NH₄Cl  D) KCl  E) NaF

MATCHING. Choose the item in column 2 that best matches each item in column 1.

88) Arrhenius theory
89) conjugate base
90) Bronsted–Lowry theory
91) conjugate acid
92) amphoteric

A) the species that results when an acid donates a proton
B) the species that results when a base accepts a proton
C) a theory that treats acid–base reactions as proton–transfer reactions
D) an acid–base theory that bases reactions on hydrogen and hydroxide ions
E) a substance which can behave as either an acid or a base
Answer Key
Testname: UNTITLED9

1) E
2) B
3) D
4) B
5) B
6) B
7) C
8) D
9) C
10) C
11) C
12) D
13) D
14) A
15) C
16) D
17) E
18) B
19) D
20) B
21) C
22) B
23) B
24) A
25) E
26) C
27) C
28) E
29) C
30) A
31) A
32) A
33) E
34) B
35) B
36) D
37) D
38) D
39) C
40) E
41) B
42) A
43) A
44) A
45) B
46) A
47) A
48) E
49) C
50) D
Answer Key
Testname: UNTITLED9

51) A
52) D
53) C
54) A
55) B
56) D
57) E
58) E
59) D
60) D
61) E
62) C
63) A
64) B
65) D
66) D

67) An amphoteric compound or ion is one that can behave either as an acid or a base in solution, depending on the chemical environment. In reaction (1), it acts as an acid by donating a hydrogen ion. In reaction (2), it acts as a base by accepting the hydrogen ion.

(1) \( \text{HCO}_3^- (aq) + \text{H}_2\text{O} (l) \rightleftharpoons \text{HCO}_2^+ (aq) + \text{CO}_3^{2-} (aq) \)

(2) \( \text{HCO}_3^- (aq) + \text{H}_2\text{O} (l) \rightleftharpoons \text{H}_2\text{CO}_3 (aq) + \text{OH}^- (aq) \)

68) E
69) C
70) B
71) B
72) D
73) B
74) E
75) E
76) E
77) B
78) D
79) D
80) A
81) C
82) B
83) A
84) C
85) D
86) E
87) E
88) D
89) A
90) C
91) B
92) E