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

1) The total concentration of ions in a 0.250 M solution of HCl is __________.
   A) 0.250 M
   B) 0.500 M
   C) 0.750 M
   D) essentially zero.
   E) 0.125 M

2) A strong electrolyte is one that __________ completely in solution.
   A) ionizes
   B) reacts
   C) disappears
   D) decomposes

3) A weak electrolyte exists predominantly as __________ in solution.
   A) an isotope
   B) electrons
   C) ions
   D) atoms
   E) molecules

4) Which of the following are strong electrolytes?
   HCl
   HCO₂H
   NH₃
   KCl
   A) HCl, KCl
   B) HCl, NH₃, KCl
   C) HCl, HCO₂H, KCl
   D) HCO₂H, KCl
   E) HCl, HCO₂H, NH₃, KCl
5) Which of the following are weak electrolytes?
   1) HCl
   2) HC₂H₃O₂
   3) NH₃
   4) KCl
       A) HC₂H₃O₂, NH₃
       B) HCl, HC₂H₃O₂, KCl
       C) HCl, HC₂H₃O₂, NH₃, KCl
       D) HCl, KCl
       E) HC₂H₃O₂, KCl

6) What are the spectator ions in the reaction between KOH (aq) and HNO₃ (aq)?
   A) K⁺ and H⁺
   B) H⁺ and OH⁻
   C) K⁺ and NO₃⁻
   D) OH⁻ only
   E) H⁺ and NO₃⁻

7) The net ionic equation for the reaction between aqueous solutions of HF and KOH is ________.
   A) H⁺ + OH⁻ → H₂O
   B) HF + KOH → H₂O + K⁺ + F⁻
   C) HF + OH⁻ → H₂O + F⁻
   D) HF + K⁺ + OH⁻ → H₂O + KF
   E) H⁺ + F⁻ + K⁺ + OH⁻ → H₂O + K⁺ + F⁻

8) Combining aqueous solutions of Ba₂ and Na₂SO₄ affords a precipitate of BaSO₄. Which ion(s) is/are spectator ions in the reaction?
   A) Na⁺ and I⁻
   B) Na⁺ only
   C) Ba²⁺ only
   D) Ba²⁺ and SO₄²⁻
   E) SO₄²⁻ and I⁻
9) Which ion(s) is/are spectator ions in the formation of a precipitate of AgCl via combining aqueous solutions of CoCl₂ and AgNO₃?
   A) NO₃⁻
   B) Co²⁺ and NO₃⁻
   C) Cl⁻
   D) NO₃⁻ and Cl⁻
   E) Co²⁺ and Ag⁺

10) The balanced net ionic equation for precipitation of CaCO₃ when aqueous solutions of Na₂CO₃ and CaCl₂ are mixed is __________.
    A) Na₂CO₃ (aq) + CaCl₂ (aq) → 2NaCl (aq) + CaCO₃ (s)
    B) 2Na⁺ (aq) + CO₃²⁻ (aq) → Na₂CO₃ (aq)
    C) Na⁺ (aq) + Cl⁻ (aq) → NaCl (aq)
    D) 2Na⁺ (aq) + 2Cl⁻ (aq) → 2NaCl (aq)
    E) Ca²⁺ (aq) + CO₃²⁻ (aq) → CaCO₃ (s)

11) When aqueous solutions of AgNO₃ and KI are mixed, AgI precipitates. The balanced net ionic equation is __________.
    A) Ag⁺ (aq) + NO₃⁻ (aq) → AgNO₃ (aq)
    B) Ag⁺ (aq) + I⁻ (aq) → AgI (s)
    C) AgNO₃ (aq) + KI (aq) → AgI (s) + KNO₃ (aq)
    D) AgNO₃ (aq) + KI (aq) → AgI (aq) + KNO₃ (s)
    E) Ag⁺ (aq) + NO₃⁻ (aq) → AgNO₃ (s)

12) When H₂SO₄ is neutralized by NaOH in aqueous solution, the net ionic equation is __________.
    A) 2H⁺ (aq) + 2NaOH (aq) → 2H₂O (l) + 2Na⁺ (aq)
    B) H₂SO₄ (aq) + 2OH⁻ (aq) → 2H₂O (l) + SO₄²⁻ (aq)
    C) SO₄²⁻ (aq) + 2Na⁺ (aq) → Na₂SO₄ (s)
    D) H⁺ (aq) + OH⁻ (aq) → H₂O (l)
    E) SO₄²⁻ (aq) + 2Na⁺ (aq) → Na₂SO₄ (aq)
13) The spectator ions in the reaction between aqueous perchloric acid and aqueous barium hydroxide are ________.
   A) H\(^+\) and Ba\(^{2+}\)
   B) OH\(^-\) and ClO\(_4\)\(^-\)
   C) H\(^+\), OH\(^-\), ClO\(_4\)\(^-\), and Ba\(^{2+}\)
   D) H\(^+\) and OH\(^-\)
   E) ClO\(_4\)\(^-\) and Ba\(^{2+}\)

14) The spectator ions in the reaction between aqueous hydrofluoric acid and aqueous barium hydroxide are ________.
   A) H\(^+\), OH\(^-\), F\(^-\), and Ba\(^{2+}\)
   B) F\(^-\) and Ba\(^{2+}\)
   C) OH\(^-\), F\(^-\), and Ba\(^{2+}\)
   D) Ba\(^{2+}\) only
   E) OH\(^-\) and F\(^-\)

15) The spectator ions in the reaction between aqueous hydrochloric acid and aqueous ammonia are ________.
   A) H\(^+\), Cl\(^-\), NH\(_3\), and NH\(_4^+\)
   B) Cl\(^-\) only
   C) Cl\(^-\) and NH\(_4^+\)
   D) H\(^+\), Cl\(^-\), and NH\(_4^+\)
   E) H\(^+\) and NH\(_3\)

16) Which of the following are strong acids?
   HI
   HCl
   HF
   HBr
   A) HI, HF, HBr
   B) HF, HBr
   C) HCl, HF, HBr
   D) HI, HCl, HF, HBr
   E) HI, HCl, HBr
17) Which hydroxides are strong bases?
   Sr(OH)₂
   KOH
   NaOH
   Ba(OH)₂
   A) KOH, Ba(OH)₂
   B) KOH, NaOH, Ba(OH)₂
   C) Sr(OH)₂, KOH, NaOH, Ba(OH)₂
   D) KOH, NaOH
   E) None of these is a strong base.

18) A neutralization reaction between an acid and a metal hydroxide produces
    __________.
    A) water and a salt
    B) ammonia
    C) hydrogen gas
    D) oxygen gas
    E) sodium hydroxide

19) Of the metals below, only ________ will not dissolve in an aqueous solution containing nickel ions.
    aluminum
    chromium
    barium
    tin
    potassium
    A) barium
    B) potassium
    C) tin
    D) chromium
    E) aluminum

20) Which of these metals is the least easily oxidized?
    Na
    Au
    Fe
    Ca
    Ag
    A) Ca
    B) Au
    C) Na
    D) Ag
    E) Fe
21) Of the following elements, _______ is the only one that cannot be found in nature in its elemental form.

C) Au
D) Cu
E) Na

22) Of the following elements, _______ is the most easily oxidized.

A) nitrogen
B) aluminum
C) fluorine
D) gold
E) oxygen

23) Based on the equations below, which metal is the most active?

\[
Pb(NO_3)_2 (aq) + Ni (s) \rightarrow Ni(NO_2)_2 (aq) + Pb (s)
\]
\[
Pb(NO_3)_2 (aq) + Ag (s) \rightarrow \text{No reaction}
\]
\[
Cu(NO_3)_2 (aq) + Ag (s) \rightarrow \text{No reaction}
\]

A) Pb
B) Ni
C) Cu
D) N
E) Ag

24) Consider the following reactions:

\[
AgNO_3 (aq) + Zn (s) \rightarrow Ag (s) + Zn(NO_3)_2
\]
\[
Co(NO_3)_2 (aq) + Zn (s) \rightarrow \text{no reaction}
\]
\[
AgNO_3 (aq) + Co (s) \rightarrow Co(NO_3)_2 (aq) + Ag (s)
\]

Which is the correct order of increasing activity for these metals?

A) Ag < Co < Zn
B) Co < Zn < Ag
C) Co < Ag < Zn
D) Ag < Zn < Co
E) Zn < Co < Ag
25) When gold dissolves in aqua regia, what is reduced

\[ \text{H}^+ \quad \text{NO}_3^- \quad \text{Cl}^- \quad \text{H}_2\text{O} \quad \text{Au} \]

A) NO$_3^-$  B) Au  C) H$_2$O  D) H$^+$  E) Cl$^-$

26) What is the concentration (M) of KCl in a solution made by mixing 25.0 mL of 0.100 M KCl with 50.0 mL of 0.100 M KCl?

A) 125  B) 0.100  C) 0.0500  D) 0.0250  E) 0.0333

27) What is the concentration (M) of CH$_3$OH in a solution prepared by dissolving 11.7 g of CH$_3$OH in sufficient water to give exactly 230 mL of solution?

A) 1.59  B) $1.59 \times 10^{-3}$  C) $11.9 \times 10^{-3}$  D) 11.9  E) 0.0841

28) How many grams of H$_3$PO$_4$ are in 175 mL of a 3.5 M solution of H$_3$PO$_4$?

A) 60  B) 612  C) 20  D) 4.9  E) 0.61

29) What is the concentration (M) of a NaCl solution prepared by dissolving 9.3 g of NaCl in sufficient water to give 350 mL of solution?

A) 0.16  B) 0.45  C) 18  D) $2.7 \times 10^{-2}$  E) 27

30) How many grams of NaOH (MW = 40.0) are there in 500.0 mL of a 0.175 M NaOH solution?

A) 114  B) $3.50 \times 10^3$  C) 14.0  D) $2.19 \times 10^{-3}$  E) 3.50

31) How many grams of CH$_3$OH must be added to water to prepare 150 mL of a solution that is 2.0 M CH$_3$OH?

A) $9.6 \times 10^3$  B) $4.3 \times 10^2$  C) 4.3  D) 9.6  E) 2.4
32) There are _______ mol of bromide ions in 0.500 L of a 0.300 M solution of AlBr₃.
   A) 0.450  B) 0.167  C) 0.0500  D) 0.500  E) 0.150

33) How many moles of Co²⁺ are present in 0.200 L of a 0.400 M solution of Co₂?
   A) 0.0400  B) 0.500  C) 2.00  D) 0.160  E) 0.0800

34) How many moles of K⁺ are present in 343 mL of a 1.27 M solution of K₃PO₄?
   A) 1.31  B) 0.436  C) 0.145  D) 11.1  E) 3.70

35) What are the respective concentrations (M) of Na⁺ and SO₄²⁻ afforded by dissolving 0.500 mol Na₂SO₄ in water and diluting to 1.33 L?
   A) 0.665 and 1.33  B) 0.665 and 0.665  C) 1.33 and 0.665  D) 0.752 and 0.376  E) 0.376 and 0.752

36) Calculate the concentration (M) of sodium ions in a solution made by diluting 50.0 mL of a 0.874 M solution of sodium sulfide to a total volume of 250.0 mL.
   A) 0.525  B) 0.175  C) 0.874  D) 4.37  E) 0.350

37) An aqueous ethanol solution (400 mL) was diluted to 4.00 L, giving a concentration of 0.0400 M. The concentration of the original solution was _________ M.
   A) 0.200  B) 2.00  C) 4.00  D) 0.400  E) 1.60

38) The concentration (M) of an aqueous methanol produced when 0.200 L of a 2.00 M solution was diluted to 0.800 L is _________.
   A) 0.200  B) 0.500  C) 0.400  D) 0.800  E) 8.00

39) The molarity (M) of an aqueous solution containing 22.5 g of sucrose (C₁₂H₂₂O₁₁) in 35.5 mL of solution is _________.
   A) 1.85  B) 0.104  C) 3.52  D) 1.85 × 10⁻³  E) 0.0657
40) The molarity (M) of an aqueous solution containing 52.5 g of sucrose \((C_{12}H_{22}O_{11})\) in 35.5 mL of solution is \(\underline{\hspace{2cm}}\).  
A) 1.48  
B) 0.104  
C) 1.85  
D) 4.32  
E) 5.46

41) The molarity (M) of an aqueous solution containing 22.5 g of glucose \((C_6H_{12}O_6)\) in 35.5 mL of solution is \(\underline{\hspace{2cm}}\).  
A) 1.85  
B) 3.52  
C) 0.197  
D) 0.125  
E) 0.634

42) The molarity of an aqueous solution containing 75.3 g of glucose \((C_6H_{12}O_6)\) in 35.5 mL of solution is \(\underline{\hspace{2cm}}\).  
A) 11.8  
B) 0.197  
C) 3.52  
D) 2.12  
E) 1.85

43) How many grams of sodium chloride are there in 55.0 mL of a 1.90 M aqueous solution of sodium chloride?  
A) 0.105  
B) \(6.11 \times 10^3\)  
C) 6.11  
D) 12.2  
E) 3.21

44) How many grams of sodium chloride are there in 550 mL of a 1.90 M aqueous solution of sodium chloride?  
A) 122  
B) 61.1  
C) 1.05  
D) 30.5  
E) \(6.11 \times 10^4\)

45) The molarity of a solution prepared by diluting 43.72 mL of 1.005 M aqueous \(K_2Cr_2O_7\) to 500 mL is \(\underline{\hspace{2cm}}\).  
A) 0.0115  
B) 0.0218  
C) 87.9  
D) 0.870  
E) 0.0879

46) The molarity of a solution prepared by diluting 43.72 mL of 5.005 M aqueous \(K_2Cr_2O_7\) to 500 mL is \(\underline{\hspace{2cm}}\).  
A) 0.438  
B) 0.0044  
C) 0.870  
D) 0.0879  
E) 57.2

47) The concentration of chloride ions in a 0.193 M solution of potassium chloride is \(\underline{\hspace{2cm}}\).  
A) 0.193 M  
B) 0.386 M  
C) 0.579 M  
D) 0.0643 M  
E) 0.0965 M

48) The concentration of iodide ions in a 0.193 M solution of barium iodide is \(\underline{\hspace{2cm}}\).  
A) 0.386 M  
B) 0.0965 M  
C) 0.579 M  
D) 0.193 M  
E) 0.0643 M
49) The concentration of species in 500 mL of a 2.104 M solution of sodium sulfate is _______ M sodium ion and _______ M sulfate ion.
   A) 2.104, 1.052
   B) 2.104, 4.208
   C) 2.104, 2.104
   D) 4.208, 2.104
   E) 1.052, 1.052

50) When 0.500 mol of \( \text{HC}_2\text{H}_3\text{O}_2 \) is combined with enough water to make a 300 mL solution, the concentration of \( \text{HC}_2\text{H}_3\text{O}_2 \) is _______ M.
   A) 0.150
   B) 3.33
   C) 0.835
   D) 0.00167
   E) 1.67

51) In a titration of 35.00 mL of 0.737 M \( \text{H}_2\text{SO}_4 \), _______ mL of a 0.827 M KOH solution is required for neutralization.
   A) 35.0
   B) 1.12
   C) 25.8
   D) 39.3
   E) 62.4

52) Oxalic acid is a diprotic acid. Calculate the percent of oxalic acid (\( \text{H}_2\text{C}_2\text{O}_4 \)) in a solid given that a 0.7984 g sample of that solid required 37.98 mL of 0.2283 M NaOH for neutralization.
   A) 97.78
   B) 28.59
   C) 1.086
   D) 22.83
   E) 48.89

53) A 17.5 mL sample of an acetic acid (\( \text{CH}_3\text{CO}_2\text{H} \)) solution required 29.6 mL of 0.250 M NaOH for neutralization. The concentration of acetic acid was _______ M.
   A) 6.8
   B) 0.21
   C) 0.42
   D) 130
   E) 0.15

54) A 25.5 mL aliquot of HCl (aq) of unknown concentration was titrated with 0.113 M NaOH (aq). It took 51.2 mL of the base to reach the endpoint of the titration. The concentration (M) of the acid was _______.
   A) 0.227
   B) 0.114
   C) 0.113
   D) 0.454
   E) 1.02

55) A 31.5 mL aliquot of HNO₃ (aq) of unknown concentration was titrated with 0.0134 M NaOH (aq). It took 23.9 mL of the base to reach the endpoint of the titration. The concentration (M) of the acid was _______.
   A) 0.0051
   B) 1.02
   C) 0.0102
   D) 0.227
   E) 0.0204

56) A 31.5 mL aliquot of H₂SO₄ (aq) of unknown concentration was titrated with 0.0134 M NaOH (aq). It took 23.9 mL of the base to reach the endpoint of the titration. The concentration (M) of the acid was _______.
   A) 0.227
   B) 0.0102
   C) 0.0051
   D) 0.0204
   E) 0.102
1) B
2) A
3) E
4) A
5) A
6) C
7) C
8) A
9) B
10) E
11) B
12) D
13) E
14) D
15) B
16) E
17) C
18) A
19) C
20) B
21) E
22) B
23) B
24) A
25) A
26) B
27) A
28) A
29) B
30) E
31) D
32) A
33) E
34) A
35) D
36) E
37) D
38) B
39) A
40) D
41) B
42) A
43) C
44) B
45) E
46) A
47) A
48) A
49) D
50) E
Answer Key
Testname: SAMPLE QUESTIONS CHAPTER 4

51) E
52) E
53) C
54) A
55) C
56) C