Chapter 4 Multiple Choice Review

1. Which of these compounds is a strong electrolyte?
   A. H_2O
   B. N_2
   C. CH_3COOH (acetic acid)
   D. C_2H_6O (ethanol)
   E. KOH – only ionic compound listed

2. Which of these compounds is a weak electrolyte?
   A. HCl
   B. CH_3COOH (acetic acid) – weak acid
   C. $C_6H_{12}O_6$ (glucose)
   D. O_2
   E. NaCl

3. Identify the major ionic species present in an aqueous solution of Na_2CO_3.
   A. Na_2^+, CO_3^{2-}
   B. Na_2^+, C^{2-}, O_3
   C. Na^+, C^{4+}, O_3^{2-}
   D. Na^+, C^+, O^{2-}
   E. Na^+, CO_3^{2-} – ions in Na_2CO_3

4. The distinguishing characteristic of all electrolyte solutions is that they
   A. contain molecules.
   B. conduct electricity. – mobile ions
   C. react with other solutions.
   D. always contain acids.
   E. conduct heat.

5. Based on the solubility rules, which one of these compounds should be insoluble in water?
   A. Na_2SO_4
   B. $BaSO_4$ – Ba^{2+} & SO_4^{2-} form insoluble salt
   C. $CuSO_4$
   D. $MgSO_4$
   E. Rb_2SO_4

6. Based on the solubility rules, which one of these compounds should be soluble in water?
   A. Hg_2Cl_2
   B. Na_2S – all salts of Na^+ are soluble
   C. Ag_2CO_3
   D. Ag_2S
   E. $BaSO_4$

7. Which of these choices is the correct net ionic equation for the reaction that occurs when solutions of $Pb(NO_3)_2$ and NH_4Cl are mixed?
   A. $Pb(NO_3)_2(aq) + 2NH_4Cl(aq) \rightarrow NH_4NO_3(aq) + PbCl_2(s)$
   B. $Pb^{2+}(aq) + 2Cl^-(aq) \rightarrow PbCl_2(s)$
   C. $Pb^{2+}(aq) + 2NO_3^-(aq) + 2NH_4^+(aq) + 2Cl^-(aq) \rightarrow 2NH_4^+(aq) + 2NO_3^-(aq) + PbCl_2(s)$
   D. $NH_4^+(aq) + NO_3^-(aq) \rightarrow 2NH_4NO_3(s)$
   E. No reaction occurs.

   NH_4^+ and NO_3^- form soluble compound, so are spectator ions

8. What is the chemical formula of the salt produced by the neutralization of hydrobromic acid with magnesium hydroxide?
   A. MgBr
   B. Mg_2Br_3
   C. Mg_3Br_2
   D. Mg_2Br
   E. $MgBr_2$ – $Mg^{2+} + Br^-$

9. What is the chemical formula of the salt produced by the neutralization of potassium hydroxide with sulfuric acid?
   A. KSO_3
   B. $K_2(SO_4)_3$
   C. K_2SO_4 – $K^+ + SO_4^{2-}$
   D. $K(SO_4)_2$
   E. KSO_4

10. The oxidation number of S in K_2SO_4 is
    A. +6. – K is +1, O is –2, so S must be +6
    B. +4.
    C. +2.
    D. –1.
    E. none of these.

11. The highest possible oxidation number of nitrogen is
    A. +8.
    B. +5. – N has 5 valence e^-
    C. +3.
    D. +1.
    E. –3.

12. Which of these equations does not represent an oxidation–reduction reaction?
    A. $3Al + 6HCl \rightarrow 3H_2 + 4AlCl_3$
    B. $2H_2O \rightarrow 2H_2 + O_2$
    C. $2NaCl + Pb(NO_3)_2 \rightarrow PbCl_2 + 3NaNO_3$
    D. $2NaI + Br_2 \rightarrow 2NaBr + I_2$
    E. $Cu(NO_3)_2 + Zn \rightarrow Zn(NO_3)_2 + Cu$

    In DR rxn, ions recombine but no change in ox #

13. In the chemical reaction $5H_2O_2 + 2MnO_4^- + 6H^+ \rightarrow 2Mn^{2+} + 8H_2O + 5O_2$, the species being reduced is
    A. H_2O_2.
    B. MnO_4^-. – Mn goes from +7 to +2
    C. H^+.
    D. Mn^{2+}.
    E. O_2.

14. Identify the species being oxidized in the chemical reaction

$5Fe^{2+}(aq) + MnO_4^-(aq) + 8H^+(aq) \rightarrow 5Fe^{3+}(aq) + Mn^{2+}(aq) + 4H_2O(l)$.

A. Fe^{2+} -- Fe goes from +2 to +3
B. MnO_4^-
C. H^+
D. Mn^{2+}
E. Fe^{3+}

15. Predict the products of the single replacement reaction

$Fe(s) + CuSO_4(aq) \rightarrow ?$

A. $Cu(s) + FeSO_4(aq)$
B. $Fe(s) + Cu(s) + SO_4(aq)$
C. $CuS(s) + Fe_2SO_4(aq)$
D. $FeCuSO_4(aq)$
E. $FeO(s) + CuSO_3(aq)$

Fe reduces Cu^{2+} to Cu and Cu^{2+} oxidizes Fe to Fe^{2+}

16. Which of these chemical equations describes a hydrogen displacement reaction?

A. $2C_2H_6(g) + 7O_2(g) \rightarrow 4CO_2(g) + 6H_2O(l)$
B. $2KBr(aq) + Cl_2(g) \rightarrow 2KCl(aq) + Br_2(l)$
C. $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
D. $CaBr_2(aq) + H_2SO_4(aq) \rightarrow CaSO_4(s) + 2HBr(g)$
E. $2Al(s) + 3H_2SO_4(aq) \rightarrow Al_2(SO_4)_3(aq) + 3H_2(g)$

$Al \rightarrow Al^{3+}$, $H^+ \rightarrow H_2$

17. 25.0 mL of a 0.2450 M NH_4Cl solution is added to 55.5 mL of 0.1655 M $FeCl_3$. What is the concentration of chloride ion in the final solution?

A. 0.607 M
B. 0.419 M – see below
C. 1.35 M
D. 0.190 M
E. 0.276 M

$$\text{mol } Cl^-_{NH_4Cl} = 25.0 \text{ mL} \times \frac{0.2450 \text{ mol } Cl^-}{1000 \text{ mL}} = 6.13\times10^{-3} \text{ mol; mol } Cl^-_{FeCl_3} = 55.5 \text{ mL} \times \frac{3\times0.1655 \text{ mol } Cl^-}{1000 \text{ mL}} = 2.76\times10^{-2} \text{ mol}$$

$$?\ M_{Cl^-} = \frac{(6.13\times10^{-3}+2.76\times10^{-2}) \text{ mol}}{(25.0+55.5) \text{ mL}} \times \frac{1000 \text{ mL}}{1 \text{ L}} = \boxed{0.419 \text{ M}}$$

18. When 50.0 mL of a 0.3000 M $AgNO_3$ solution is added to 50.0 mL of a solution of $MgCl_2$, an AgCl precipitate forms immediately. The precipitate is then filtered from the solution, dried, and weighed. If the recovered AgCl is found to have a mass of 0.1183 g, what was the concentration of magnesium ions in the original $MgCl_2$ solution?

A. 0.300 M B. 8.25×10^{-3} M C. 1.65×10^{-2} M D. 2.06×10^{-5} M E. 4.13×10^{-3} M

$$M_{Mg^{2+}} = 0.1183 \text{ g AgCl} \times \frac{1 \text{ mol AgCl}}{143.32 \text{ g AgCl}} \times \frac{1 \text{ mol } MgCl_2}{2 \text{ mol AgCl}} \times \frac{1 \text{ mol } Mg^{2+}}{1 \text{ mol } MgCl_2} \times \frac{1}{0.0500 \text{ L}} = \boxed{8.25\times10^{-3} \text{ M}}$$

19. One method of determining the concentration of hydrogen peroxide (H_2O_2) in a solution is through titration with iodide ion. The net ionic equation for this reaction is

$$H_2O_2 + 2I^- + 2H^+ \rightarrow I_2 + 2H_2O$$

A 50.00 mL sample of a hydrogen peroxide solution is found to react completely with 37.12 mL of a 0.1500 M KI solution. What is the concentration of hydrogen peroxide in the sample?

A. 5.568×10^{-2} M B. 0.2227 M C. 0.1010 M D. 0.4041 M E. 0.1114 M

$$M\ H_2O_2 = 37.12 \text{ mL } I^- \times \frac{0.1500 \text{ M } I^-}{1000 \text{ mL}} \times \frac{1 \text{ mol } H_2O_2}{2 \text{ mol } I^-} \times \frac{1}{0.05000 \text{ L}} = \boxed{5.568\times10^{-2} \text{ M}}$$

20. Zinc dissolves in hydrochloric acid to yield hydrogen gas:

$$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$$

When a 12.7 g chunk of zinc dissolves in 500. mL of 1.450 M HCl, what is the concentration of hydrogen ions remaining in the final solution?

A. 0.776 M B. 0.388 M C. 0.674 M D. 1.06 M E. 0 M

$$?\text{ mol } H^+ \text{ used} = 12.7 \text{ g Zn} \times \frac{1 \text{ mol Zn}}{65.39 \text{ g Zn}} \times \frac{2 \text{ mol } H^+}{1 \text{ mol Zn}} = 0.388 \text{ mol } H^+$$

$$?\text{ mol } H^+ \text{ left} = \underbrace{500. \text{ mL HCl} \times \frac{1.450 \text{ M HCl}}{1000 \text{ mL}} \times \frac{1 \text{ mol } H^+}{1 \text{ mol HCl}}}_{0.725 \text{ mol } H^+} - 0.388 \text{ mol } H^+ = 0.377 \text{ mol } H^+$$

$$?\ M\ H^+ = \frac{0.377 \text{ mol } H^+}{0.500 \text{ L}} = \boxed{0.674 \text{ M}}$$