Chapter 4 Multiple Choice Review Key

1. E. Only KOH will dissociate into ions in aqueous solution.
2. B. CH_3COOH is a weak acid, so dissociates slightly in aqueous solution.
3. E. Na_2CO_3 is an ionic compound containing 2 Na^+ ions and one CO_3^{2-} ion.
4. B. Mobile ions (charge carriers) respond to an electric field to allow electrical conduction.
5. B. SO_4^{2-} is insoluble with Ba^{2+}.
6. B. All compounds containing Na^+ ions are soluble.
7. B. $PbCl_2$ is insoluble, so the reaction forming $PbCl_2$ from Pb^{2+} and 2 Cl^- ions is correct.
8. E. Mg^{2+} requires 2 Br^- ions to form $MgBr_2$.
9. C. SO_4^{2-} requires 2 K^+ ions to form K_2SO_4.
10. A. In K_2SO_4, each K has a +1 oxidation number, each oxygen has a –2 oxidation number, so algebraically, the oxidation number on S is given by $2(+1) + x + 4(-2) = 0$, or $x = +6$.
11. B. N has 5 valence electrons, so losing all 5 results in a +5 oxidation number.
12. C. In double-replacement reactions, ions change places but no oxidation numbers are changed.
13. B. In $MnO_4^- \rightarrow Mn^{2+}$, the oxidation number of Mn changes from +7 to +2, so it is reduced; hence MnO_4^- is the oxidizing agent.
14. A. In $Fe^{2+} \rightarrow Fe^{3+}$, the oxidation number of Fe changes from +2 to +3, so it is oxidized and is the reducing agent.
15. A. Elemental Fe will reduce Cu^{2+} to elemental Cu and be oxidized to Fe^{2+}, forming Cu and $FeSO_4$.
16. E. Elemental Al reduces H^+ to H_2 and is oxidized to Al^{3+}, replacing H^+ in the compound.
17. B. Convert each solution to the number of moles of Cl^-, then add the moles and divide by the new total volume to obtain the concentration:

$$?\ \text{mol Cl}^-_{\text{NH}_4\text{Cl}} = 25.0\ \text{mL} \times \frac{0.2450\ \text{mol Cl}^-}{1000\ \text{mL}} = 6.13 \times 10^{-3}\ \text{mol}$$

$$?\ \text{mol Cl}^-_{\text{FeCl}_3} = 55.5\ \text{mL} \times \frac{3\ \text{Cl}^-\ \text{ions} \times 0.1655\ \text{mol Cl}^-}{1000\ \text{mL}} = 2.76 \times 10^{-2}\ \text{mol}$$

$$?\ \text{M}_{\text{Cl}^-} = \frac{(6.13 \times 10^{-3} + 2.76 \times 10^{-2})\ \text{mol}}{(25.0 + 55.5)\ \text{mL}} \times \frac{1000\ \text{mL}}{1\ \text{L}} = \boxed{0.419\ \text{M}}$$

18. B. Assume that the $MgCl_2$ is the limiting reagent, so all Cl^- ends up in the AgCl precipitate. Simply determine the moles of Mg^{2+} stoichiometrically from the equation

$$\text{MgCl}_2\ (aq) + 2\ \text{AgNO}_3\ (aq) \rightarrow \text{Mg(NO}_3)_2\ (aq) + 2\ \text{AgCl}\ (aq)$$

to determine the concentration:

$$?\ \text{M}_{\text{Mg}^{2+}} = 0.1183\ \text{g AgCl} \times \frac{1\ \text{mol AgCl}}{143.32\ \text{g AgCl}} \times \frac{1\ \text{mol MgCl}_2}{2\ \text{mol AgCl}} \times \frac{1\ \text{mol Mg}^{2+}}{1\ \text{mol MgCl}_2} \times \frac{1}{0.0500\ \text{L}} = \boxed{8.25 \times 10^{-3}\ \text{M}}$$

19. A. Since all of the I^- and the H_2O_2 react in the given reaction, neither is limiting. Determine the moles of H_2O_2 stoichiometrically and divide by the volume to determine the concentration:

$$?\ \text{M H}_2\text{O}_2 = 37.12\ \text{mL I}^- \times \frac{0.1500\ \text{M I}^-}{1000\ \text{mL}} \times \frac{1\ \text{mol H}_2\text{O}_2}{2\ \text{mol I}^-} \times \frac{1}{0.05000\ \text{L}} = \boxed{5.568 \times 10^{-2}\ \text{M}}$$

20. C. First determine the mol H^+ used in the given reaction, then subtract from the moles H^+ in the original solution and divide by the volume to find the concentration:

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

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

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