AP Chemistry Chapter 5 Answers - Kotz

5.3 (a) $CuCl_2$

(b) $AgNO_3$

(c) K_2CO_3, KI, $KMnO_4$

5.9 $CdCl_2(aq) + 2\ NaOH(aq) \rightarrow Cd(OH)_2(s) + 2\ NaCl(aq)$

$Cd^{2+}(aq) + 2\ OH^-(aq) \rightarrow Cd(OH)_2(s)$

5.15 $H_2C_2O_4(aq) \rightarrow H^+(aq) + HC_2O_4^-(aq)$

$HC_2O_4^-(aq) \rightarrow H^+(aq) + C_2O_4^{2-}(aq)$

5.19 (a) $2\ CH_3CO_2H(aq) + Mg(OH)_2(s) \rightarrow Mg(CH_3CO_2)_2(aq) + 2\ H_2O(\ell)$

acetic acid, magnesium hydroxide, magnesium acetate, water

(b) $HClO_4(aq) + NH_3(aq) \rightarrow NH_4ClO_4(aq)$

perchloric acid, ammonia, ammonium perchlorate

5.25 (a) $AgNO_3(aq) + KI(aq) \rightarrow AgI(s) + KNO_3(aq)$

$Ag^+(aq) + I^-(aq) \rightarrow AgI(s)$

(b) $Ba(OH)_2(aq) + 2\ HNO_3(aq) \rightarrow Ba(NO_3)_2(aq) + 2\ H_2O(\ell)$

$OH^-(aq) + H^+(aq) \rightarrow H_2O(\ell)$

(c) $2\ Na_3PO_4(aq) + 3\ Ni(NO_3)_2(aq) \rightarrow Ni_3(PO_4)_2(s) + 6\ NaNO_3(aq)$

$2\ PO_4^{3-}(aq) + 3\ Ni^{2+}(aq) \rightarrow Ni_3(PO_4)_2(s)$

5.27 $FeCO_3(s) + 2\ HNO_3(aq) \rightarrow Fe(NO_3)_2(aq) + CO_2(g) + H_2O(\ell)$

iron(II) carbonate, nitric acid, iron(II) nitrate, carbon dioxide, water

5.29 (a) $Ba(OH)_2(aq) + 2\ HCl(aq) \rightarrow BaCl_2(aq) + 2\ H_2O(\ell)$

acid-base reaction

(b) $2\ HNO_3(aq) + CoCO_3(s) \rightarrow Co(NO_3)_2(aq) + H_2O(\ell) + CO_2(g)$

gas-forming reaction

(c) $2\ Na_3PO_4(aq) + 3\ Cu(NO_3)_2(aq) \rightarrow Cu_3(PO_4)_2(s) + 6\ NaNO_3(aq)$

precipitation reaction

5.33 (a) The formation of an insoluble compound, CuS

(b) The formation of water, H_2O, in an acid-base reaction

5.35 (a) Br is +5 and O is –2

(b) C is +3 and O is –2

(c) F is –1

(d) Ca is +2 and H is –1

(e) H is +1, Si is +4, and O is –2

(f) H is +1, S is +6, and O is –2

5.39 (a) C_2H_4 is oxidized and is the reducing agent; O_2 is reduced and is the oxidizing agent

(b) Si is oxidized and is the reducing agent; Cl_2 is reduced and is the oxidizing agent

5.41 $6.73\ \text{g } Na_2CO_3 \cdot \dfrac{1\ \text{mol } Na_2CO_3}{106.0\ \text{g}} = 0.0635\ \text{mol } Na_2CO_3$

$\dfrac{0.0635\ \text{mol } Na_2CO_3}{0.250\ \text{L}} = 0.254\ \text{M } Na_2CO_3$

$[Na^+] = 2 \times [Na_2CO_3] = 0.508\ \text{M } Na^+$ $[CO_3^{2-}] = [Na_2CO_3] = 0.254\ \text{M } CO_3^{2-}$

5.47 (a) 0.50 M NH_4^+; 0.25 M SO_4^{2-}

(b) 0.246 M Na^+; 0.123 M CO_3^{2-}

(c) 0.056 M H^+; 0.056 M NO_3^-

5.49 $500.0\ \text{mL} \cdot \dfrac{1\ \text{L}}{10^3\ \text{mL}} \cdot \dfrac{0.0200\ \text{mol } Na_2CO_3}{1\ \text{L}} \cdot \dfrac{105.99\ \text{g}}{1\ \text{mol } Na_2CO_3} = 1.06\ \text{g } Na_2CO_3$

Weigh out 1.06 g of Na_2CO_3 and place it in the 500.0 mL flask. Add a small amount of distilled water and mix until the solute dissolves. Add water until the meniscus of the solution rests at the calibrated mark on the neck of the volumetric flask. Cap the flask and swirl to ensure adequate mixing.

5.51 $c_d = c_c \cdot \dfrac{V_c}{V_d} = 1.50\ \text{M} \cdot \dfrac{25.0\ \text{mL}}{500.\ \text{mL}} = 0.0750\ \text{M HCl}$

5.59

	pH	$[H^+]$	
(a)	1.00	0.10 M	acidic
(b)	10.50	3.2×10^{-11} M	basic
(c)	4.89	1.3×10^{-5} M	acidic
(d)	7.64	2.3×10^{-8} M	basic

5.65 $0.225\ \text{g AgBr} \cdot \dfrac{1\ \text{mol AgBr}}{187.8\ \text{g}} \cdot \dfrac{2\ \text{mol } Na_2S_2O_3}{1\ \text{mol AgBr}} \cdot \dfrac{1\ \text{L}}{0.0138\ \text{mol } Na_2S_2O_3} \cdot \dfrac{10^3\ \text{mL}}{1\ \text{L}} = 174\ \text{mL solution}$

5.73 $36.04\ \text{mL} \cdot \dfrac{1\ \text{L}}{10^3\ \text{mL}} \cdot \dfrac{0.509\ \text{mol NaOH}}{1\ \text{L}} \cdot \dfrac{1\ \text{mol } H_2A}{2\ \text{mol NaOH}} = 0.00917\ \text{mol } H_2A$

$\dfrac{0.954\ \text{g}}{0.00917\ \text{mol}} = 104\ \text{g/mol}$

5.75 $22.25\ \text{mL} \cdot \dfrac{1\ \text{L}}{10^3\ \text{mL}} \cdot \dfrac{0.0123\ \text{mol } KMnO_4}{1\ \text{L}} \dfrac{5\ \text{mol } Fe^{2+}}{1\ \text{mol } KMnO_4} \cdot \dfrac{55.85\ \text{g}}{1\ \text{mol } Fe^{2+}} = 0.0764\ \text{g Fe}$

$\dfrac{0.0764\ \text{g Fe}}{0.598\ \text{g sample}} \cdot 100\% = 12.8\%\ \text{Fe}$

5.83 (a) Cl_2, chlorine, has been reduced and NaBr, sodium bromide, has been oxidized

(b) Cl_2, chlorine, is the oxidizing agent and NaBr, sodium bromide, is the reducing agent

(c) $125\ \text{mL} \cdot \dfrac{1\ \text{L}}{10^3\ \text{mL}} \cdot \dfrac{0.153\ \text{mol NaBr}}{1\ \text{L}} \cdot \dfrac{1\ \text{mol } Cl_2}{2\ \text{mol NaBr}} \cdot \dfrac{70.91\ \text{g}}{1\ \text{mol } Cl_2} = 0.678\ \text{g } Cl_2$

5.105 $HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(\ell)$

$[H^+] = 10^{-1.92} = 0.012\ M\ H^+ = 0.012\ M\ HCl$ $\qquad 0.250\ L \cdot \dfrac{0.012\ mol}{1\ L} = 0.0030\ mol\ HCl$

$$0.250\ L \cdot \frac{0.0105\ mol\ NaOH}{1\ L} \cdot \frac{1\ mol\ HCl}{1\ mol\ NaOH} = 0.00263\ mol\ HCl\ reacted$$

$0.0030\ mol - 0.00263\ mol = 0.0004\ mol\ HCl\ remains$

$$pH = -\log\left(\frac{0.0004\ mol}{0.500\ L}\right) = 3.1$$