Chapter 4

4.49 a) SO_2 — O: −2; 2x(O): −4; S = +4

b) $COCl_2$ — O: −2; Cl: −1; 2x(Cl): −2; C: +4

c) MnO_4^- — O: −2; 4x(O): −8; Mn: +7

d) $HBrO$ — O: −2; H: +1; Br: +1

e) As_4 — As: 0

f) K_2O_2 — K: +1; O_2: −2 (↳ O_2^{-2} = Peroxide ion); each O: −1

4.51 a) $Ni_{(s)} + Cl_{2(g)} \rightarrow NiCl_{2(s)}$ (Ni: 0 → +2; Cl: 0 → −1)

Ni: Ox
Cl: Red.

b) $3\,Fe(NO_3)_{2(aq)} + 2\,Al_{(s)} \rightarrow 3\,Fe_{(s)} + 2\,Al(NO_3)_{3(aq)}$ (Fe: +2 → 0; Al: 0 → +3)

Fe: Red
Al: Ox
(NO_3^- = spectator)

c) $Cl_{2(aq)} + 2\,NaI_{(aq)} \rightarrow I_{2(aq)} + 2\,NaCl_{(aq)}$ (Cl: 0 → −1; I: −1 → 0)

Cl: Red
I: Ox
(Na: spectator)

d) $PbS_{(s)} + 4\,H_2O_{2(aq)} \rightarrow PbSO_{4(s)} + 4\,H_2O_{(l)}$ (O: −1 → −2; S: −2 → +6)

O: Red
S: Ox

4.61 a) $\frac{0.0345\ mol\ NH_4Cl}{400\ mL}\left(\frac{1\ mL}{10^{-3}\ L}\right) = 0.0863\ M\ NH_4Cl$

b) $2.20\ M\ HNO_3 = 2.20\ \frac{mol\ HNO_3}{L}$

$2.20\ \frac{mol\ HNO_3}{L}\left(35.0\ mL\right)\left(\frac{10^{-3}\ L}{1\ mL}\right) = 0.0770\ mol\ HNO_3$

c) $1.50\ M\ KOH = 1.50\ \frac{mol\ KOH}{L}$, or $1.50\ mol\ KOH = 1\ L\ KOH$ (conversion factor)

$0.125\ mol\ KOH\left(\frac{1\ L}{1.50\ mol\ KOH}\right)\left(\frac{1\ mL}{10^{-3}\ L}\right) = 83.3\ mL$

4.63 5.0 L blood

$0.135\ M\ Na^+$ in blood

$Na = 23.39\ g/mol$

$0.135\ \frac{mol}{L}\ Na^+\left(5.0\ L\right)\left(\frac{23.39\ g}{1\ mol}\right) = 16\ g\ Na^+$

4.65 a) $0.15\,M\ KBr\left(\frac{0.25\,L}{}\right)\left(\frac{119\,g}{1\,mol}\right) = \boxed{4.46\,g\ KBr}$

b) $4.75\,g\ Ca(NO_3)_2$ in $0.200\,L$

$MW\ Ca(NO_3)_2 = 164.08\,g/mol$

$4.75\,g\ Ca(NO_3)_2\left(\frac{1\,mol\ Ca(NO_3)_2}{164.08\,g}\right)\left(\frac{1}{0.200\,L}\right) = \boxed{0.145\,M\ Ca(NO_3)_2}$

c) $5.00\,g\ Na_3PO_4$, $1.50\,M\ Na_3PO_4$

$MW\ Na_3PO_4 = 164\,g/mol$

$5.00\,g\ Na_3PO_4\left(\frac{1\,mol\ Na_3PO_4}{164\,g}\right)\left(\frac{1\,L}{1.5\,mol}\right) = \boxed{20.3\,mL\ Na_3PO_4}$

4.67 a) $0.20\frac{mol}{L}\ KCl\left(\frac{1\,mol\ K^+}{1\,mol\ KCl}\right) = 0.20\,mol\ K^+$

$0.15\frac{mol}{L}\ K_2CrO_4\left(\frac{2\,mol\ K^+}{1\,mol\ K_2CrO_4}\right) = \boxed{0.30\,mol\ K^+,\ 0.15M\ K_2CrO_4}$

$.080\frac{mol}{L}\ K_3PO_4\left(\frac{3\,mol\ K^+}{1\,mol\ K_3PO_4}\right) = 0.24\,mol\ K^+$

b) $0.15\frac{mol}{L}\ K_2CrO_4\left(\frac{10^{-3}\,L}{1\,mL}\right)(30.0\,mL)\left(\frac{2\,mol\ K^+}{1\,mol\ K_2CrO_4}\right) = 0.009\,mol\ K^+$, $\boxed{30.0\,mL\ of\ 0.15M\ K_2CrO_4}$

$0.080\frac{mol}{L}\ K_3PO_4\left(\frac{10^{-3}\,L}{1\,mL}\right)(25.0\,mL)\left(\frac{3\,mol\ K^+}{1\,mol\ K_3PO_4}\right) = 0.006\,mol\ K^+$

4.69 d) $40\,mL$, $0.15\,M\ KClO_3$

$35\,mL$, $0.22\,M\ Na_2SO_4$ TOTAL Volume = $75\,mL$

$40\,mL\ KClO_3\left(\frac{0.15\,mol\ KClO_3}{1\,L}\right)\left(\frac{1}{75\,mL}\right) = 0.08\,M\ KClO_3 = \boxed{\begin{matrix}0.08\,M\ K^+\\0.08\,M\ ClO_4^-\end{matrix}}$

$35\,mL\ Na_2SO_4\left(\frac{0.22\,mol\ Na_2SO_4}{1\,L}\right)\left(\frac{1}{75\,mL}\right) = 0.10\,M\ Na_2SO_4\left(\frac{2\,mol\ Na^+}{1\,mol\ Na_2SO_4}\right) = \boxed{0.20\,M\ Na^+}$

$0.10\,M\ Na_2SO_4\left(\frac{1\,mol\ SO_4^{-2}}{1\,mol\ Na_2SO_4}\right) = \boxed{0.10M\ SO_4^{-2}}$

4.71 a) $C_iV_i = C_fV_f$

$V_i = \frac{C_fV_f}{C_i} = \frac{(0.250M\ NH_3)(100.0mL\ NH_3)}{(14.8M\ NH_3)} = \boxed{1.69\,mL\ NH_3}$

b) $C_iV_i = C_fV_f$

$C_f = \frac{C_iV_i}{V_f} = \frac{(14.8M\ NH_3)(10.0mL)}{(.250L)\left(\frac{1mL}{10^{-3}L}\right)} = \boxed{0.592\,M\ NH_3}$

4.73 a) $MW\ C_{12}H_{22}O_{11} = 342\,g/mol$

$0.150\frac{mol}{L}(125mL)\left(\frac{10^{-3}L}{1mL}\right)\left(\frac{342g}{1mol}\right) = \boxed{6.41\,g\ C_{12}H_{22}O_{11}}$

b) $400mL$ of $0.100\,M\ C_{12}H_{22}O_{11}$ contains $400mL\left(\frac{10^{-3}L}{1mL}\right)\left(\frac{0.100\,mol}{1L}\right) = 0.04\,mol\ C_{12}H_{22}O_{11}$

STOCK: $1.50\,M\ C_{12}H_{22}O_{11}$, $0.04\,mol\ C_{12}H_{22}O_{11}\left(\frac{1L}{1.50mol}\right) = \boxed{0.0267L\ STOCK}$

4.81 $2\,NaHCO_{3(s)} + H_2SO_{4(aq)} \rightarrow Na_2SO_{4(aq)} + 2H_2O_{(l)} + 2CO_{2(g)}$

if 27mL of 6.0M H_2SO_4 spilled, that is:

$$27\,mL\left(\frac{10^{-3}\,L}{1\,mL}\right)\left(\frac{6.0\,mol}{1\,L}\right) = 0.162\,mol\ H_2SO_4$$

$$0.162\,mol\ H_2SO_4\left(\frac{2\,NaHCO_3}{1\,mol\ H_2SO_4}\right) = 0.324\,mol\ NaHCO_3$$

$MW\ NaHCO_3 = 84\ g/mol$

$$0.324\,mol\ NaHCO_3\left(\frac{84\,g}{1\,mol}\right) = \boxed{27\,g\ NaHCO_3}$$