Ch. 4 HW ~~5, 12, 19, 27, 29, 31, 32, 37, 42, 46, 48, 52, 54, 56~~

(5) (a) $CaCl_2$ picture B 1:2 ratio

(b) Li_2SO_4 picture C 2:1 ratio

(c) NH_4Br picture A 1:1 ratio of ions

(12) (a) solution w/ highest molarity? B most molecules/volume

(b) solutions w/ same molarity? C & D & E or A & F

(c) A + C $\overset{?}{=}$ B

$\frac{8+4}{50}$ $\frac{12}{100}$ = $\frac{12}{50}$ A+C has lower molarity than B

(d) add 50mL H_2O to D Compare to F after 75mL H_2O added

$\frac{4}{50} \rightarrow \frac{4}{100}$ = molarity is equal $\frac{4}{25} \rightarrow \frac{4}{100}$

(e) Solution A $\frac{8}{50} = 0.16$ Solution E $= \frac{2}{25}$ evaporate 1/2 of water ≈ 12.5

(19) (a) $Rb_2SO_4 \rightarrow 2Rb^+ + SO_4^{2-}$ 0.805 mol SO_4^{2-} & 1.61 mol Rb^+

(b) $Ca(NO_3)_2 \rightarrow Ca^{2+} + 2NO_3^-$ $3.85 \times 10^{-3}\,g \times \frac{1\,mol}{164.10\,g} = 2.35 \times 10^{-5}$ mol

So 2.35×10^{-5} mol Ca^{2+} and 4.69×10^{-5} mol NO_3^-

(c) $Sr(HCO_3)_2 \rightarrow Sr^{2+} + 2HCO_3^-$ 4.03×10^{19} for. units $\times \frac{1\,mol}{6.02 \times 10^{23}} = 6.69 \times 10^{-5}$ mol Sr^{2+}

So 6.69×10^{-5} mol Sr^{2+} and 1.34×10^{-4} mol HCO_3^-

(27) (a) $MgCl_2 \rightarrow Mg^{2+} + 2Cl^-$

88mL

1.75M $\quad 0.088\,L \times \frac{1.75\,mol}{1\,L} \times \frac{1\,mol\ Mg^{2+}}{1\,mol\ MgCl_2} \times \frac{6.02\times10^{23}\ ions}{1\,mol\ Mg^{2+}} = 9.27\times10^{22}\ Mg^{2+}\ ions$

$\times 2 \downarrow$

$1.85\times10^{22}\ Cl^-\ ions$

(2 & 3)

(b) $Li_2SO_4 \rightarrow 2Li^+ + SO_4^{2-}$ $\quad \frac{2.59\,g}{L} \times \frac{1\,mol}{109.94\,g} = 0.02356\,mol/L$

9.80mL

2.59g/L $\quad 0.0098\,L \times \frac{0.02356\,mol}{1\,L} \times \frac{2\,mol\ Li^+}{1\,mol\ Li_2SO_4} \times \frac{6.02\times10^{23}}{1\,mol} = 2.78\times10^{20}\ Li^+\ ions$

$\downarrow$

$1.39\times10^{20}\ SO_4^{2-}\ ions$

27b answers: $2.5\times10^{20}\ Al^{3+}\ ions / 3.7\times10^{20}\ SO_4^{2-}\ ions$

(c) $CsNO_3 \rightarrow Cs^+ + NO_3^-$ $\quad 8.83\times10^{21}\ f.u. \times \frac{1\,mol}{6.02\times10^{23}} = 0.01467\,mol/L$

1.65L

0.01467M $\quad 1.65\,L \times \frac{0.01467\,mol}{1\,L} \times \frac{1\,mol\ Cs^+}{1\,mol\ CsNO_3} \times \frac{6.02\times10^{23}\ ions}{1\,mol} = 1.46\times10^{22}$ ions Cs^+ & NO_3^-

(29) (a) $M_1V_1 = M_2V_2$

$2.050(x) = 0.8543(750mL)$

$V_1 = 312.5\,mL = \boxed{0.313\,L}$

(b) $M_1V_1 = M_2V_2$

$(2)1.63(x) = (350mL)(2.86\times10^{-2})$

$\boxed{V_1 = 3.07\,mL = 0.0031\,L}$

* multiply by 2 because $[Cl^-]$ is 2x $[CaCl_2]$

(c) $M_1V_1 = M_2V_2$

$0.700(V_1) = 0.155(18)$

$\boxed{V_1 = 3.99\,mL = 3.99\times10^{-3}\,L}$

(31) H_2SO_4 = 18.3M d = 1.84g/mL

(a) ? moles H_2SO_4 in mL

$$\frac{18.3\,mol}{1L} \times \frac{1L}{1000mL} = 0.0183\,mol/mL$$

(b) mass % H_2SO_4 in solution $\frac{g\,H_2SO_4}{\text{Mass solution}} \times 100$

1mL has mass 1.84g

$$0.0183mol \times \frac{98.08g}{1mol} = 1.794g\ H_2SO_4 \text{ in mL}$$

so $1.794g/1.84g \times 100 =$ **97.5% H_2SO_4 by mass**

(32) $20.5g \times \frac{1\,mol}{74.44g} = 0.2754\,mol\ NaClO = \frac{0.2754\,mol}{0.375} =$ **0.734M**

(37) $Ba(NO_3)_{2(aq)} + Na_2CO_{3(aq)} \rightarrow BaCO_{3(s)} + 2\,NaNO_{3(aq)}$

★ lots of answers net ionic $Ba^{2+}_{(aq)} + CO_3^{2-}{}_{(aq)} \rightarrow BaCO_{3(s)}$

example #1 $Ba(C_2H_3O_2)_2 + Li_2CO_3 \rightarrow BaCO_{3(s)} + 2\,LiC_2H_3O_2$

example #2 $Ba(ClO_4)_2 + K_2CO_3 \rightarrow BaCO_{3(s)} + 2\,KClO_4$

★ testing knowledge of solubility rules

(45) (a) $3CaCl_{2(aq)} + 2Cs_3PO_{4(aq)} \rightarrow 6CsCl_{(aq)} + Ca_3(PO_4)_{2(s)}$

$3Ca^{2+}_{(aq)} + 6Cl^-_{(aq)} + 6Cs^+_{(aq)} + 2PO_4^{3-}{}_{(aq)} \rightarrow 6Cs^+_{(aq)} + 6Cl^-_{(aq)} + Ca_3(PO_4)_{2(s)}$

$3Ca^{2+}_{(aq)} + 2PO_4^{3-}{}_{(aq)} \rightarrow Ca_3(PO_4)_{2(s)}$

Spectator ions = Cl^- and Cs^{2+}

(b) $Na_2S_{(aq)} + ZnSO_{4(aq)} \rightarrow Na_2SO_{4(aq)} + ZnS_{(s)}$

$2Na^+_{(aq)} + S^{2-}_{(aq)} + Zn^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} \rightarrow 2Na^+_{(aq)} + SO_4^{2-}{}_{(aq)} + ZnS_{(s)}$

$S^{2-}_{(aq)} + Zn^{2+}_{(aq)} \rightarrow ZnS_{(s)}$

spectator ions = Na^+ and SO_4^{2-}

(46) (a) $Na_2S_{(aq)} + NiSO_{4(aq)} \rightarrow Na_2SO_{4(aq)} + NiS_{(s)}$

$2Na^+_{(aq)} + S^{2-}_{(aq)} + Ni^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} \rightarrow 2Na^+_{(aq)} + SO_4^{2-}{}_{(aq)} + NiS_{(s)}$

$S^{2-}_{(aq)} + Ni^{2+}_{(aq)} \rightarrow NiS_{(s)}$

(b) $Pb(NO_3)_{2(aq)} + 2KBr_{(aq)} \rightarrow 2KNO_{3(aq)} + PbBr_{2(s)}$

$Pb^{2+}_{(aq)} + 2NO_3^-{}_{(aq)} + 2K^+_{(aq)} + 2Br^-_{(aq)} \rightarrow 2K^+_{(aq)} + 2NO_3^-{}_{(aq)} + PbBr_{2(s)}$

$Pb^{2+}_{(aq)} + 2Br^-_{(aq)} \rightarrow PbBr_{2(s)}$

★ good AP Question

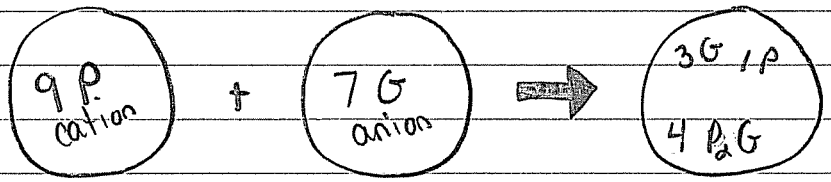
(48)

$$\underset{25.0mL}{AgNO_{3(aq)}} + KCl_{(aq)} \rightarrow \underset{0.842g}{AgCl_{(s)}} + KNO_{3(aq)}$$

$$0.842g\ KCl \times \frac{1\ mol\ AgCl}{143.32g\ AgCl} \times \frac{1\ mol\ AgNO_3}{1\ mol\ AgCl} \times \frac{1\ mol\ Ag^+\ ions}{1\ mol\ AgNO_3} = 0.00587\ mol\ Ag^+$$

$$[Ag^+]_0 = 0.00587\ mol / 0.025L = \boxed{0.235\ M}$$

(52)



25mL 35mL 60mL

1) $KNO_3 + CuCl_2 \rightarrow KCl + Cu(NO_3)_2$ ← soluble
2) $NaClO_4 + CaCl_2 \rightarrow NaCl + Ca(ClO_4)_2$
3) $Li_2SO_4 + AgNO_3 \rightarrow LiNO_3 + Ag_2SO_4$ ★ 2 cations / 1 anion
4) $NH_4Br + Pb(CH_3COO)_2 \rightarrow NH_4CH_3COO + PbBr_2$

(6) 4 spheres $(2.5 \times 10^{-3}\ mol) \times \frac{6.02 \times 10^{23}\ ions}{1\ mol} = 6.02 \times 10^{21}$ ions present in final solution

(c) mass of solid

$$Li_2SO_{4(aq)} + 2AgNO_{3(aq)} \rightarrow 2LiNO_{3(aq)} + Ag_2SO_{4(s)}$$

$$4\ \underset{\text{in molecule of } Ag_2SO_4}{SO_4^{2-}\ ions} \times \frac{2.5 \times 10^{-3}\ mol}{1\ sphere} \times \frac{1\ mol\ Ag_2SO_4}{1\ mol\ SO_4^{2-}} \times \frac{311.9g}{1\ mol\ Ag_2SO_4} = \boxed{3.12g\ Ag_2SO_4}$$

★ other ways to figure out #54

(54) $FeCl_2$ (0.750 g) $NiCl_2$ $ZnCl_2$

$$FeCl_2 + 2AgNO_3 \rightarrow Fe(NO_3)_2 + 2AgCl$$

$FeCl_2$: 0.750 g; $AgNO_3$: 22.40 mL, 0.515 M

amt of Cl $\frac{70.9\text{ g}}{126.75} = 0.559(0.750) = .4195\text{ g Cl}$

$0.02240\text{ L} \times \frac{0.515\text{ mol}}{1\text{ L}} \times \frac{2\text{ mol AgCl}}{2\text{ mol AgNO}_3} \times \frac{143.32\text{ g AgCl}}{1\text{ mol AgCl}} = 1.65\text{ g AgCl}$

amt of Cl $\frac{35.45}{143.32} = 0.247(1.65) = 0.408\text{ g Cl}$

not equal

$$NiCl_2 + 2AgNO_3 \rightarrow Ni(NO_3)_2 + 2AgCl$$

amt of Cl in $NiCl_2$ $\frac{70.9}{129.59} = 0.547(0.750) = 0.410\text{ g Cl}$

$0.02240\text{ L} \times \frac{0.515\text{ mol}}{1\text{ L}} \times \frac{2\text{ mol AgCl}}{2\text{ mol AgNO}_3} \times \frac{143.32\text{ g AgCl}}{1\text{ mol AgCl}} = 1.65\text{ g AgCl}$

amt Cl in AgCl $\frac{35.45}{143.32} = 0.247(1.65) = 0.410\text{ g Cl}$ ↓ sample of AgCl

equal so $NiCl_2$

$ZnCl_2$ amt Cl in $ZnCl_2$ $\frac{70.9}{136.29} = 0.520(0.750) = 0.390\text{ g}$

$\neq$

0.410 g Cl

(56) $Al_2(SO_4)_{3\,(aq)} + 6NaOH_{(aq)} \rightarrow 2Al(OH)_{3\,(s)} + 3Na_2SO_4$

$2Al^{3+}_{(aq)} + 3SO_4^{2-}_{(aq)} + 6Na^{+}_{(aq)} + 6OH^{-}_{(aq)} \rightarrow 2Al(OH)_{3\,(s)} + 6Na^{+}_{(aq)} + 3SO_4^{2-}_{(aq)}$

$2Al^{3+}_{(aq)} + 6OH^{-}_{(aq)} \rightarrow 2Al(OH)_{3\,(s)}$

(b) $0.185\,mL \times \frac{0.533\,mol\ NaOH}{1\,L} \times \frac{2\,mol\ Al(OH)_3}{6\,mol\ NaOH} = 0.03287\,mol \times \frac{78.01\,g}{1\,mol} = 2.56\,g\ Al(OH)_3$

$0.627\,L \times \frac{0.0462\,mol}{1\,L} \times \frac{2\,mol\ Al(OH)_3}{1\,mol\ Al_2(SO_4)} = 0.0579\,mol$

$\frac{15.8\,g}{1\,L} \times \frac{1\,mol}{342.14\,g} = 0.0462\,mol/L$

Part B is a limiting problem

Part 2 HW #66, 72, 73, 76 Acid Base Focus

66 a) $CsOH_{(aq)} + HNO_{3(aq)} \rightarrow CsNO_{3(aq)} + HOH_{(l)}$

$Cs^+_{(aq)} + OH^-_{(aq)} + H^+_{(aq)} + NO_3^-{}_{(aq)} \rightarrow Cs^+_{(aq)} + NO_3^-{}_{(aq)} + HOH_{(l)}$

$OH^-_{(aq)} + H^+_{(aq)} \rightarrow HOH_{(l)}$

b) $Ca(OH)_{2(aq)} + 2HC_2H_3O_{2(aq)} \rightarrow Ca(C_2H_3O_2)_{2(aq)} + 2HOH_{(l)}$

$Ca^{2+}_{(aq)} + 2OH^-_{(aq)} + 2HC_2H_3O_{2(aq)} \rightarrow Ca^{2+}_{(aq)} + 2C_2H_3O_2^-{}_{(aq)} + 2HOH_{(l)}$

$2OH^-_{(aq)} + 2HC_2H_3O_{2(aq)} \rightarrow 2C_2H_3O_2^-{}_{(aq)} + 2HOH_{(l)}$

72) $2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2HOH$

26.25 mL, 0.1850 M | 25.00 mL, ? M

$0.02625\,L \times \frac{0.1850\,mol\,NaOH}{1\,L} \times \frac{1\,mol\,H_2SO_4}{2\,mol\,NaOH} = 0.00242\,mol\,H_2SO_4 / 0.025$

$= 0.09713\,M$

73) $H_2SO_4 + 2NaHCO_3 \rightarrow Na_2SO_4 + 2H_2O + 2CO_2$

88 mL, 2.6 M | 1.6 M, ? mL

$0.088\,L \times \frac{2.6\,mol}{1\,L} \times \frac{2\,mol\,NaHCO_3}{1\,mol\,H_2SO_4} \times \frac{1\,L}{1.6\,mol} \times \frac{1000\,mL}{1\,L} =$ 286 mL or 2.9×10^2 mL

(76) $UO_{2(s)} + 4HF_{(aq)} \rightarrow UF_{4(s)} + 2H_2O_{(l)}$

2.15 Kg — ? L, 2.40 M

$$2.15\,Kg\,UO_2 \times \frac{1000\,g}{1\,Kg} \times \frac{1\,mol\,UO_2}{270.03\,g} \times \frac{4\,mol\,HF}{1\,mol\,UO_2} \times \frac{1\,L}{2.40\,mol} = \boxed{13.3\,L\,HF}$$

Part 3 HW #85, 87, 89, 93, 97, 104, 106, 112, 114, 116

(85) (a) KBr (−1) (b) BrF_3 (+3) (c) $\overset{+1}{H}\overset{+5}{Br}\overset{-2}{O_3}$ (+5) (d) CBr_4 (−1)

(87) (a) $\overset{+4}{S}\overset{-2}{O}\overset{-1}{Cl_2}$ (+4) (b) $\overset{+1}{H_2}\overset{-1}{S_2}$ (−1) (c) $\overset{+1}{H_2}\overset{+4}{S}\overset{2-}{O_3}$ (+4)

(d) $\overset{+1}{Na_2}\overset{2-}{S}$ (2−)

(89) (a) $\overset{+1}{H_2}\overset{+5}{P_2}\overset{2-}{O_7}^{2-}$ (+5) (b) $\overset{3-}{P}\overset{+1}{H_4}^{+}$ (3−)

(c) $\overset{+5}{P}\overset{-1}{Cl_5}$ (+5)

(93) (a) $\overset{0}{Sn} + 2\overset{+1}{H^+} \rightarrow \overset{2+}{Sn^{2+}} + \overset{0}{H_2}$

Sn: lose 2e⁻ oxidation; H: gain 1e⁻ reduction

(b) $2H^+ + H_2O_2 + 2Fe^{2+} \rightarrow 2Fe^{3+} + 2H_2O$

H_2O_2: lose 1e⁻ oxidation; gain 1e⁻ reduction

(97) $16H^+ + 2Cr_2O_7^{2-} + C_2H_5OH \rightarrow 4Cr^{3+} + 2CO_2 + 11H_2O$

for 28.00g plasma: $Cr_2O_7^{2-}$ 35.46mL, 0.05961 M; C_2H_5OH ? mass %

$$0.03546L \times \frac{0.05961mol}{1L} \times \frac{1mol\ C_2H_5OH}{2mol\ Cr_2O_7^{2-}} \times \frac{46.068g}{1mol\ C_2H_5OH} = 0.04869g$$

$$\%\ C_2H_5OH = 0.04869/28 = \boxed{0.1739\%}$$

(104) (a) $2HI \rightarrow H_2 + I_2$ decomposition

(b) $Zn + 2AgNO_3 \rightarrow Zn(NO_3)_2 + 2Ag$ single replacement

(c) $2NO + O_2 \rightarrow N_2O_4$ synthesis

(106) (a) $Mg + 2H_2O \rightarrow Mg(OH)_2 + H_2$ single replacement

(b) $Cr(NO_3)_3 + Al \rightarrow Al(NO_3)_3 + Cr$ single replacement

(c) $PF_3 + F_2 \rightarrow PF_5$ synthesis

(112) (a) $C_5H_{12(g)} + 8O_{2(g)} \rightarrow 5CO_{2(g)} + 6H_2O_{(g)}$ combustion

(b) $PCl_{3(l)} + Cl_{2(g)} \rightarrow PCl_{5(s)}$ synthesis

(c) $Zn_{(s)} + 2HBr_{(aq)} \rightarrow ZnBr_{2(aq)} + H_{2(g)}$ single replacement

(d) $2KI_{(aq)} + Br_{2(l)} \rightarrow 2KBr_{(aq)} + I_{2(s)}$ single replacement

(e) ~~$2K^+$~~ $+ 2I^- + Br_2 \rightarrow$ ~~$2K^+$~~ $+ 2Br^- + I_2$

$2I^- + Br_2 \rightarrow 2Br^- + I_2$

(114)

$$\underset{874g}{CaCl_2} \rightarrow \underset{?g}{Cl_2} + \underset{?g}{Ca}$$

$$874g \times \frac{1\ mol}{110.98\ g} \times \frac{1\ mol\ Cl_2}{1\ mol\ CaCl_2} \times \frac{70.9g}{1\ mol\ Cl_2} = \boxed{558.4g\ Cl_2\ formed}$$

Calcium $874g \times \frac{1mol}{110.98g} \times \frac{1mol\ Ca}{1mol\ CaCl_2} \times \frac{40.08g}{1mol\ Ca} = \boxed{315.6g\ Ca\ formed}$

(116) $\underset{2.22g}{3\,Mg} + \underset{3.75g}{N_2} \rightarrow Mg_3N_2$

$$2.22g\,Mg \times \frac{1\,mol}{24.30\,g} \times \frac{1\,mol\,Mg_3N_2}{3\,mol\,Mg} = 0.0305\,mol\,Mg_3N_2$$

$$3.75g\,N_2 \times \frac{1\,mol\,N_2}{28.02g} \times \frac{1\,mol\,Mg_3N_2}{1\,mol\,N_2} = 0.1338\,mol\,Mg_3N_2$$

(a) N_2 is in excess

(b) 0.0305 mol Mg_3N_2 formed

(c) After reaction

amt Mg = $\boxed{\emptyset}$

amt N_2 $\quad 2.22g \times \frac{1\,mol}{24.30\,g} \times \frac{1\,mol\,N_2}{3\,mol\,Mg} \times \frac{28.02g}{1\,mol\,N_2} = 0.8533g\,N_2$ used

$\boxed{2.897g\,N_2\ left}$

amt Mg_3N_2 $\quad 0.0305\,mol \times \frac{100.92g}{1\,mol\,Mg_3N_2} = \boxed{3.08\,g\,Mg_3N_2\ formed}$

Mixed Concept Problems 130, 132, 133, 138, 146, 150, 157

(130) $8H^+ + 5Fe^{2+} + MnO_4^- \rightarrow 5Fe^{3+} + Mn^{2+} + 4H_2O$

1.1081g — ?g — 39.32mL — 0.03190M

$0.03932L \times \frac{0.03190mol}{1L} \times \frac{5mol\ Fe^{2+}}{1mol\ MnO_4^-} \times \frac{55.85g\ Fe}{1mol\ Fe^{2+}} = 0.3503g\ Fe$

$0.3503g / 1.1081 \times 100 =$ **31.61% iron**

(132) $HCl + NaOH \rightarrow NaCl + HOH$

100mL — 27.5mL — 0.425M

$0.0275L \times \frac{0.425mol}{1L} \times \frac{1}{1} = 0.011688 / 0.100 =$ **0.117M HCl**

$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2HOH$ ★ first calculation

50.0mL — 18.4mL — 0.0782M

$0.050L \times \frac{0.0782mol}{1L} \times \frac{2mol\ NaOH}{1mol\ H_2SO_4} = 0.00782mol / 0.0184 =$ **0.425M NaOH**

(133) $H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2HOH$

25mL — 25mL

(a) $2H^+ + SO_4^{2-} + 2Na^+ + 2OH^- \rightarrow 2Na^+ + SO_4^{2-} + 2HOH$ total ionic

$2H^+ + 2OH^- \rightarrow 2HOH$ net ionic equ.

(b) $2\ spheres \times \frac{0.010mol\ SO_4^{2-}}{1\ sphere} \times \frac{1mol\ H_2SO_4}{1mol\ SO_4^{2-}} =$ **0.02 mol H_2SO_4 + 0.04mol NaOH**

(c) $H_2SO_4 = 0.02/0.025 =$ **0.8M H_2SO_4** $NaOH = 0.04/0.025 =$ **1.6M NaOH**

(138)

1) $\overset{0}{Cl} + \overset{0}{O_3} \rightarrow \overset{+1\ 1-}{ClO} + \overset{0}{O_2}$ redox

2) $\overset{1+\ 1-}{ClO} + \overset{+1\ 1-}{ClO} \rightarrow \overset{1+\ 1-}{Cl_2O_2}$

3) $Cl_2O_2 \rightarrow 2\,Cl + O_2$ redox

4) $ClO + O \rightarrow Cl + O_2$ redox

☆ O is not going to have positive oxidation number, tends to be very good a removing electrons

Combine #1-3

☆ don't worry about this part

(146) $AgCl + CuCl_2 + MgCl_2$ in total volume = 50.0mL

(a) ✓ all Ag has to be in solid
A has $2Cl^-$ for each Mg^{2+} or Cu^{2+}
✗ there should be no solid $MgCl_2$
✗ there should be no solid $CuCl_2$

(b) $12\ \text{spheres} \times \frac{5\times10^{-3}\ \text{mol ions}}{1\ \text{sphere}} = 0.06\ \text{mol ions} / 0.050 = \boxed{1.2\ M}$

(c) Mass of solid

$4\ \text{Ag spheres} \times \frac{5\times10^{-3}\ \text{mol ions } Ag^+}{1\ \text{sphere}} \times \frac{1\ \text{mol AgCl}}{1\ \text{mol } Ag^+} \times \frac{143.4\ g}{1\ \text{mol AgCl}} = \boxed{2.89\ g\ AgCl}$

(150) (a) $Na_2CO_{3(aq)} + CaCl_{2(aq)} \rightarrow 2NaCl_{(aq)} + CaCO_3$

$2Na^+ + CO_3^{2-} + Ca^{2+} + 2Cl^- \rightarrow 2Na^+ + 2Cl^- + CaCO_{3(s)}$

$Ca^{2+} + CO_3^{2-} \rightarrow CaCO_{3(s)}$

(b) 1 sphere = 0.050 mol ion → what mass in g forms?

$$2 \text{ spheres } Ca^{2+} \times \frac{0.050 \text{ mol}}{1 \text{ sphere}} \times \frac{1 \text{ mol } CaCO_3}{1 \text{ mol } Ca^{2+}} \times \frac{100.09 \text{ g}}{1 \text{ mol } CaCO_3} = \boxed{10.0 \text{ g } CaCO_3}$$

(c) $[Ca^{2+}] = 0$

$$[CO_3^{2-}] = 1 \text{ sphere} \times \frac{0.050 \text{ mol}}{1 \text{ sphere}} = 0.050 \text{ mol} / 0.5 = 0.1 M \; SO_4^{2-}$$

$$[Na^+] = 6 \text{ sphere} \times \frac{0.050 \text{ mol}}{1 \text{ sphere}} = 0.3 \text{ mol} / 0.5 = 0.6 M \; Na^+$$

$$[Cl^-] = 4 \text{ sphere} \times \frac{0.050}{1 \text{ sphere}} = 0.2 / 0.5 = 0.4 M \; Cl^-$$

(157) 8 OH^- 6 H^+
4 Ca^{2+} 6 Cl^-

(a) No - not equivalence pt → still more OH^-

(b) $$6 \text{ spheres} \times \frac{1 \times 10^{-3} \text{ mol } H^+}{1 \text{ sphere}} \times \frac{1 \text{ mol } HCl}{1 \text{ mol } H^+} = 0.006 \text{ mol} / 0.025 = 0.24 M$$

(c) $$8 \text{ spheres } OH^- \times \frac{1 \times 10^{-3} \text{ mol } OH^-}{1 \text{ sphere}} \times \frac{1 \text{ mol } H^+}{1 \text{ mol } OH^-} \times \frac{1 \text{ L}}{0.24 \text{ mol}} \times \frac{1000 \text{ mL}}{1 \text{ L}} = 33.33 \text{ mL}$$

33.33 mL needed total
8.33 mL additional