1. a) $Ca(OH)_2$ $0.0134 \frac{mol}{L}$

$Ca(OH)_2 \xrightarrow{H_2O} Ca^{2+}_{(aq)} + 2OH^-_{(aq)}$

$0.0134 \frac{mol}{L}$

$\therefore [Ca^{2+}]$ is $0.0134 \frac{mol}{L}$ and $[OH^-]$ is $0.0268 \frac{mol}{L}$

$C_{Ca^{2+}} = 1 \times C_{Ca(OH)_2}$
$= 0.0134 \text{ mol/L}$

$C_{OH^-} = 2 \times C_{Ca(OH)_2}$
$= 2 \times 0.0134 \frac{mol}{L}$
$= 0.0268 \frac{mol}{L}$

b) $pOH = -\log [OH^-]$
$= -\log (0.0268)$
$= 1.57$

$pH + pOH = 14$
$pH = 14 - pOH$
$= 14 - 1.57$
$= 12.43$

$\therefore$ the pH is 12.43

2. $AgI_{(s)}$ insoluble in water

$Na_2SO_{4\,(aq)}$ $NaOH_{(aq)}$ $KNO_{3\,(aq)}$ $HC_2H_3O_{2\,(aq)}$ } soluble in water

3. a) $2KCl_{(aq)} + Pb(NO_3)_{2\,(aq)} \rightarrow PbCl_{2\,(s)} + 2KNO_{3\,(aq)}$

Total ionic $2K^+_{(aq)} + 2Cl^-_{(aq)} + Pb^{2+}_{(aq)} + 2NO_3^-{}_{(aq)} \rightarrow PbCl_{2\,(s)} + 2K^+_{(aq)} + 2NO_3^-{}_{(aq)}$

Net ionic: $Pb^{2+}_{(aq)} + 2Cl^-_{(aq)} \rightarrow PbCl_{2\,(s)}$

Spectator Ions $K^+_{(aq)}$ $NO_3^-{}_{(aq)}$

b) $2HCl_{(aq)} + 2Na_2S_{(aq)} \rightarrow H_2S_{(aq)} + 2NaCl_{(aq)}$
$\rightarrow$ NR

c) $KOH(aq) + HNO_3(aq) \rightarrow H_2O(l) + KNO_3(aq)$

Total Ionic: $K^+(aq) + OH^-(aq) + H^+(aq) + NO_3^-(aq) \rightarrow H_2O(l) + K^+(aq) + NO_3^-(aq)$

Net Ionic: $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$

Spectator Ions: $K^+(aq)$ $NO_3^-(aq)$

d) $Pb(NO_3)_2(aq) + Na_2SO_4(aq) \rightarrow PbSO_4(s) + 2NaNO_3(aq)$

Total Ionic: $Pb^{2+}(aq) + 2NO_3^-(aq) + 2Na^+(aq) + SO_4^{2-}(aq) \rightarrow PbSO_4(s) + 2Na^+(aq) + 2NO_3^-(aq)$

Net Ionic: $Pb^{2+}(aq) + SO_4^{2-}(aq) \rightarrow PbSO_4(s)$

Spectator Ion: $NO_3^-(aq)$ $Na^+(aq)$

4. $Pb(NO_3)_2(aq) + 2KI(aq) \rightarrow PbI_2(s) + 2KNO_3(aq)$

$PbI_2(s) \rightarrow$ precipitate

$K^+(aq)$ and $NO_3^-(aq)$ spectator ions

5. $c_c = 11.6\ mol/L$ $c_d = 0.100\ mol/L$

$V_c = ?$ $V_d = 1.00\ L$

$c_c V_c = c_d V_d$

$V_c = \dfrac{c_d V_d}{c_c}$

$= \dfrac{(0.100\ mol/L)(1.00\ L)}{11.6\ mol/L}$

$= 0.00862\ L$

$= 8.62\ mL$

∴ the volume of concentrated acid you will add to each flask is 8.62 mL

Lab Steps

1. pipette 40 mL of the 9.0 mol/L HCl solution into a 200 mL volumetric flask
2. Fill to the mark with deionized water
3. cap + shake

∴ 40 mL of solution are required.

6. $c_c = 9.0\ mol/L$ $c_d = 2.0\ mol/L$

$V_c = ?$ $V_d = 200\ mL$

$V_c = \dfrac{c_d V_d}{c_c} = \dfrac{(2.0\ mol/L)(200\ mL)}{9.0\ mol/L} = 44.44\ mL$

$= 40\ mL$ (sf)

7. NaOH

$M_{NaOH} = 39.997 \frac{g}{mol}$

$V = 250\,mL = 0.25\,L$

$m_{NaOH} = 0.25\,L \times \frac{0.8\,mol}{L} \times \frac{39.997\,g}{mol}$

$= 8\,g$

∴ you will need 8g of NaOH

Lab Steps:
1. mass out 8g of NaOH
2. dissolve in a min. amount of deionized water
3. transfer with rinsings to a 250mL volumetric flask
4. fill to the mark with deionized water
5. cap & shake.

8. $Fe_2O_3(s) + 2Al(s) \rightarrow 2Fe(l) + Al_2O_3(s)$

m	?	?	15.0 g
M	159.687 g/mol	26.982 g/mol	55.845 g/mol

$m_{Al} = 15.0\,g\,Fe \times \frac{1\,mol\,Fe}{55.845\,g\,Fe} \times \frac{2\,mol\,Al}{2\,mol\,Fe} \times \frac{26.982\,g\,Al}{mol\,Al} = 7.25\,g$

$m_{Fe_2O_3} = 15.0\,g\,Fe \times \frac{1\,mol\,Fe}{55.845\,g\,Fe} \times \frac{1\,mol\,Fe_2O_3}{2\,mol\,Fe} \times \frac{159.087\,g\,Fe_2O_3}{mol\,Fe_2O_3} = 21.4\,g$

∴ you will need 7.25g of Al and 21.4g of Fe_2O_3

9. $Cr(NO_3)_3(aq) + 3NaOH(aq) \rightarrow Cr(OH)_3(s) + 3NaNO_3(aq)$

V = 22.50 mL = 0.0225 L	V = 45.00 mL = 0.045 L	m = ?
c = 0.150 mol/L	c = 0.200 mol/L	M = 103.017 g/mol

$n = 0.0225\,L \times 0.150\,\frac{mol}{L} = 0.003375\,mol$

$\frac{0.003375}{1} = 0.003375$

$n = 0.045\,L \times 0.2\,\frac{mol}{L} = \boxed{0.009\,mol}$

$\frac{0.009}{3} = 0.003$

↑ LR ∴ smaller #

$$m_{Cr(OH)_3} = 0.009 \text{ mol NaOH} \times \frac{1 \text{ mol } Cr(OH)_3}{3 \text{ mol NaOH}} \times \frac{103.017 \text{ g } Cr(OH)_3}{\text{mol } Cr(OH)_3}$$

$$= 0.309 \text{ g}$$

$\therefore$ 0.309 g of $Cr(OH)_3$ will be produced

10. $3AgNO_3(aq) + K_3PO_4(aq) \rightarrow Ag_3PO_4(s) + 3KNO_3(aq)$

m	3.44 g	4.22 g	m = ?
M	169.872 g/mol	212.264 g/mol	418.574 g/mol
n	0.020250 mol / 3	0.019881 mol / 1	
	0.010125	0.019881	

↑ smaller # $\therefore$ LR

$$m_{Ag_3PO_4} = 0.020250 \text{ mol } AgNO_3 \times \frac{1 \text{ mol } Ag_3PO_4}{3 \text{ mol } AgNO_3} \times \frac{418.574 \text{ g } Ag_3PO_4}{1 \text{ mol } Ag_3PO_4}$$

$$= 2.83 \text{ g}$$

$\therefore$ 2.83 g of Ag_3PO_4 is produced.

11. $2KOH_{(aq)} + Mg(NO_3)_{2\,(aq)} \rightarrow 2KNO_{3\,(aq)} + Mg(OH)_{2\,(s)}$

$V = 0.1\ L$ $\quad V = 0.1\ L$ $\quad ?\ m$

$c = 0.2\ \frac{mol}{L}$ $\quad c = 0.2\ \frac{mol}{L}$ $\quad 58.319\ \frac{g}{mol}$

$n = 0.1\ \cancel{L} \times 0.2\ \frac{mol}{\cancel{L}}$ $\quad n = 0.1\ L \times 0.2\ \frac{mol}{L}$

$= \boxed{0.02\ mol}$ $\quad = 0.02\ mol$

$\frac{0.02\ mol}{2}$ $\quad \frac{0.02\ mol}{1}$

0.01 $\quad 0.02$

↑ smaller #

∴ LR

$$m_{Mg(OH)_2} = 0.02\ mol\ \cancel{KOH} \times \frac{1\ mol\ \cancel{Mg(OH)_2}}{2\ mol\ \cancel{KOH}} \times \frac{58.319\ g\ Mg(OH)_2}{mol\ \cancel{Mg(OH)_2}}$$

$$= 0.583\ g$$

$$n_{Mg(NO_3)_2\ excess} = 0.02\ mol - 0.01\ mol = 0.01\ mol$$

$n_{Mg^{2+}} = 0.01\ mol$ $\quad n_{NO_3^-} = 2(0.01)\ mol = 0.02\ mol$

$$n_{KNO_3} = 0.02\ mol\ KOH \times \frac{2\ KNO_3}{2\ mol\ KOH} = 0.02\ mol$$

$n_{K^+} = 0.02\ mol$ $\quad n_{NO_3^-} = 0.02\ mol$

$C_{Mg^{2+}} = \frac{0.01\ mol}{\text{total } V} = \frac{0.01\ mol}{0.2\ L}$ $\quad C_{K^+} = \frac{0.02\ mol}{0.2\ L}$ $\quad C_{NO_3^-} = \frac{0.02 + 0.02}{0.2\ L}$

$= 0.05\ \frac{mol}{L}$ $\quad = 0.1\ \frac{mol}{L}$ $\quad = \frac{0.04\ mol}{0.2\ L}$

$= 0.2\ \frac{mol}{L}$

12. $H_2C_2O_4\ (aq) + 2NaOH\ (aq) \rightarrow Na_2C_2O_4\ (aq) + 2H_2O\ (l)$

$c = 0.2042\ \frac{mol}{L}$ $\quad c = ?$

$V = 25\ mL$ $\quad V = 10.42\ mL$

$= 0.025\ L$ $\quad = 0.01042\ L$

$$C_{NaOH} = 0.025\ L\ H_2C_2O_4 \times \frac{0.2042\ mol\ H_2C_2O_4}{L\ H_2C_2O_4} \times \frac{2\ mol\ NaOH}{1\ mol\ H_2C_2O_4} \times \frac{}{0.01042\ L}$$

$$= 0.9798\ \frac{mol}{L}$$

∴ the concentration of NaOH is $0.9798\ \frac{mol}{L}$

13. a) $c_c = 3.0\ \frac{mol}{L}$ $\quad c_d = ?$ $\quad c_c V_c = c_d V_d$

$V_c = 10\ mL$ $\quad V_d = 250\ mL$ $\quad c_d = \frac{c_c V_c}{V_d} = \frac{(3.0\ mol/L)(10\ mL)}{250\ mL}$

$= 0.12\ mol/L$

∴ the concentration is $0.12\ \frac{mol}{L}$ of KOH

b) $3KOH\ (aq) + H_3PO_4\ (aq) \rightarrow 3H_2O\ (l) + K_3PO_4\ (aq)$

$V = 38.5\ mL$ $\quad c = ?$

$= 0.0385\ L$ $\quad V = 10.0\ mL$

$c = 0.12\ mol/L$ $\quad = 0.01\ L$

$$C_{H_3PO_4} = 0.0385\ L\ KOH \times \frac{0.12\ mol\ KOH}{L\ KOH} \times \frac{1\ mol\ H_3PO_4}{3\ mol\ KOH} \times \frac{}{0.01\ L\ H_3PO_4}$$

$$= 0.154\ \frac{mol}{L}$$

∴ the concentration of H_3PO_4 is $0.154\ \frac{mol}{L}$