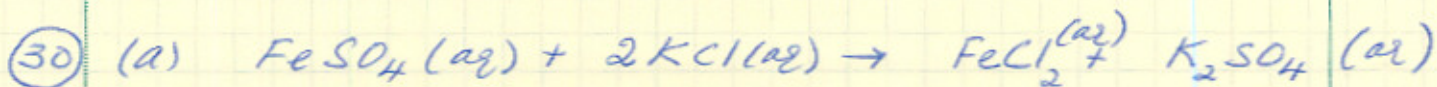


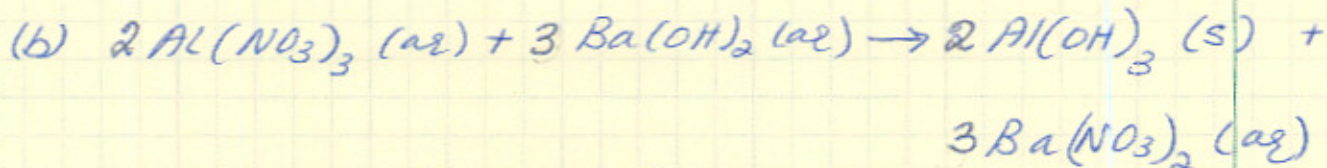
MATTER & MINERALS

CHEMISTRY HOMEWORK - FALL - WEEK 6

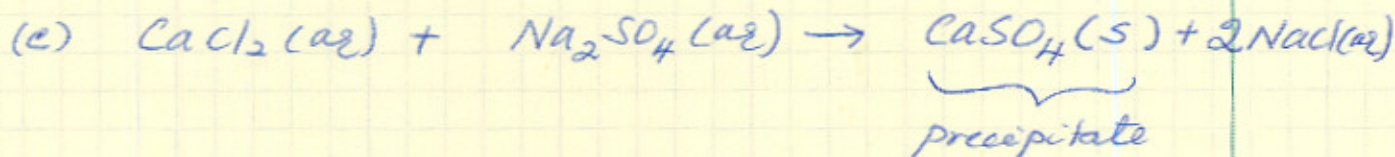
Chapter 4



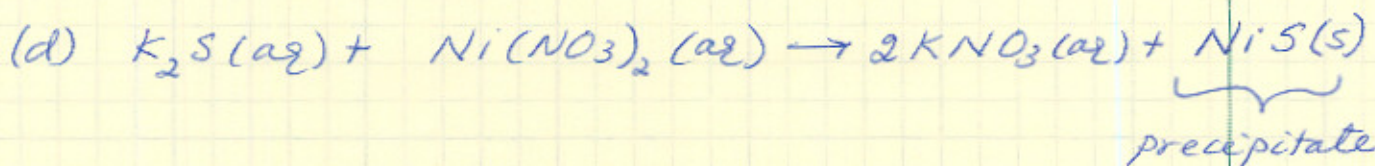
both are soluble
no precipitate



precipitate Al(OH)₃



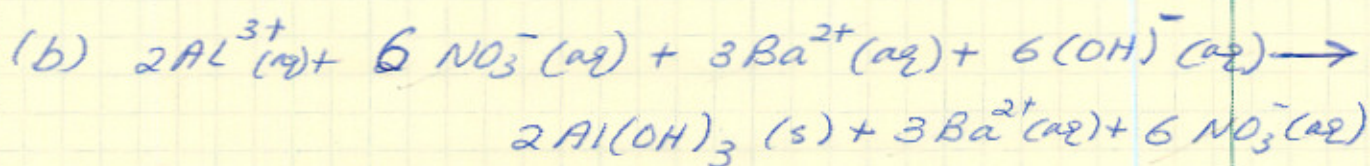
precipitate



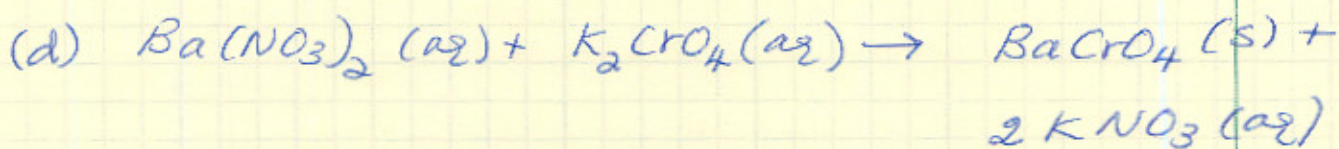
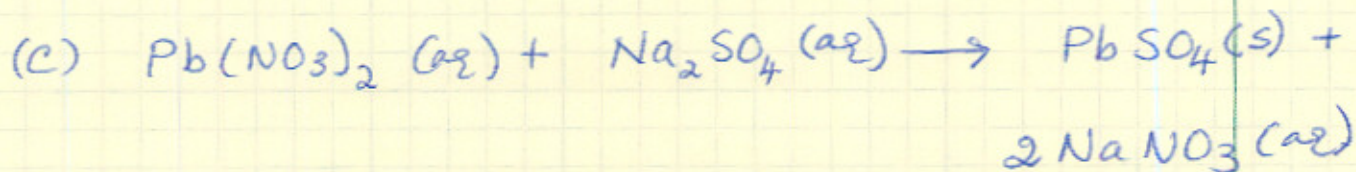
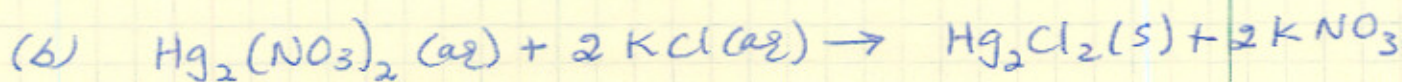
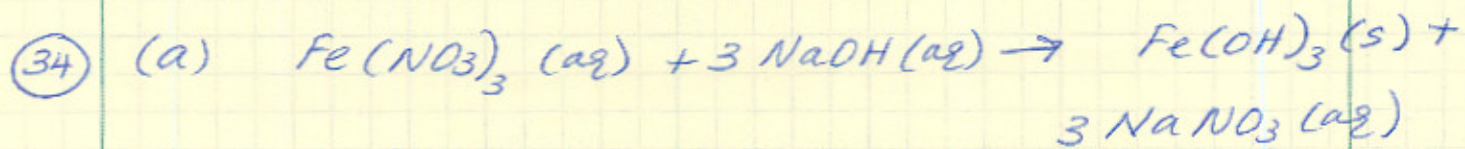
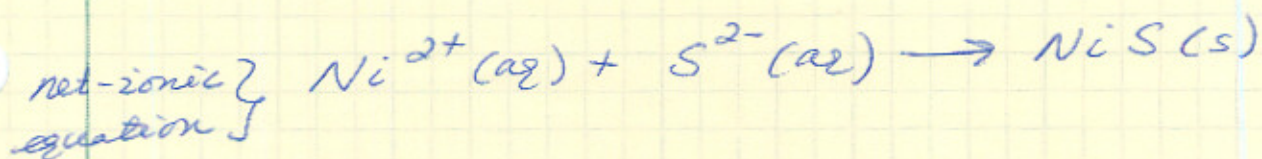
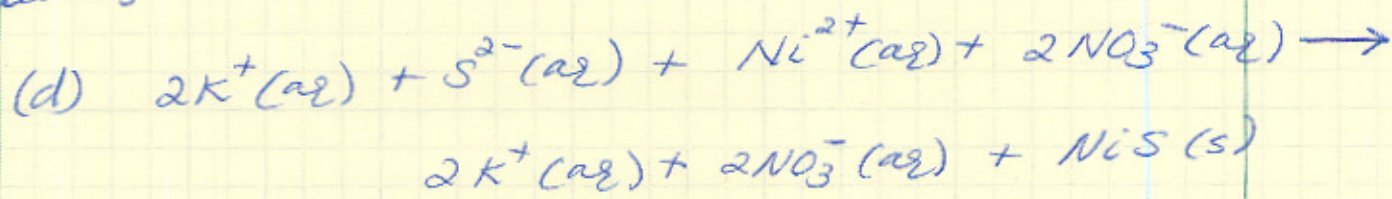
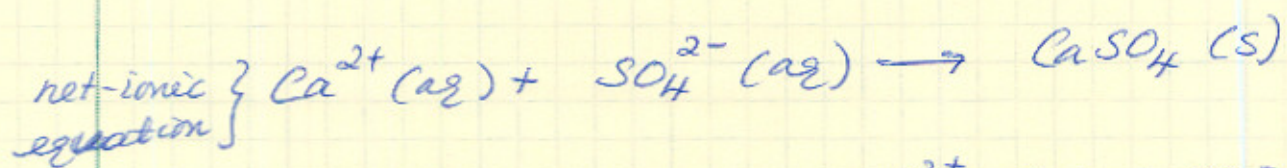
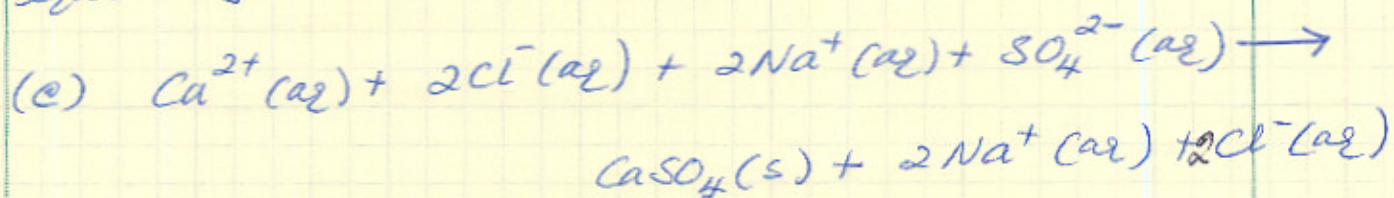
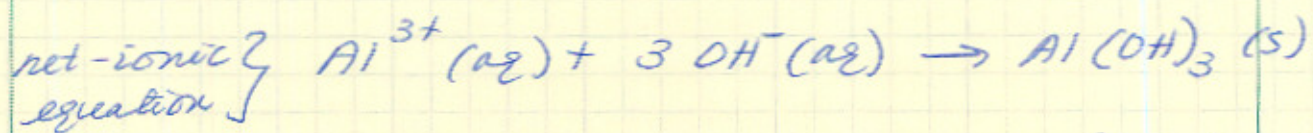
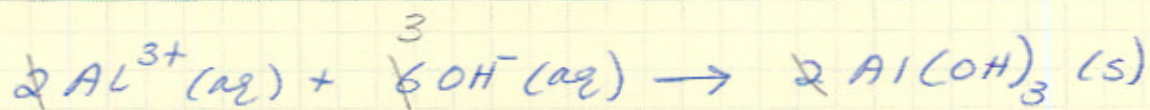
precipitate

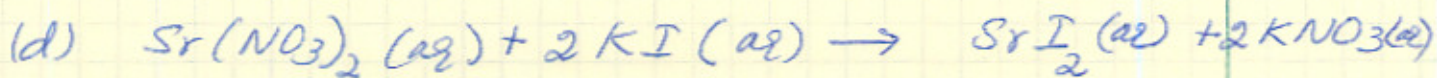
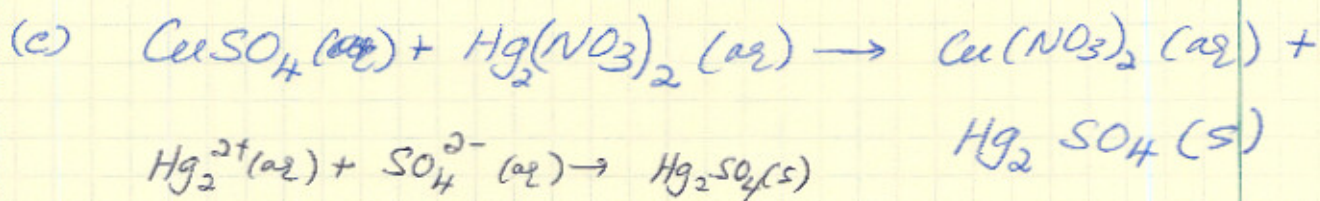
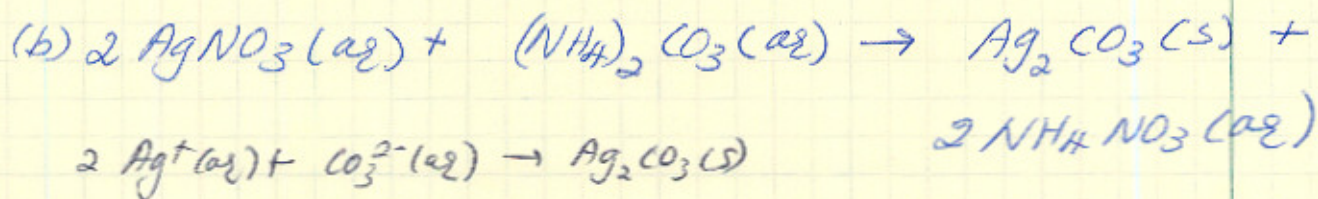
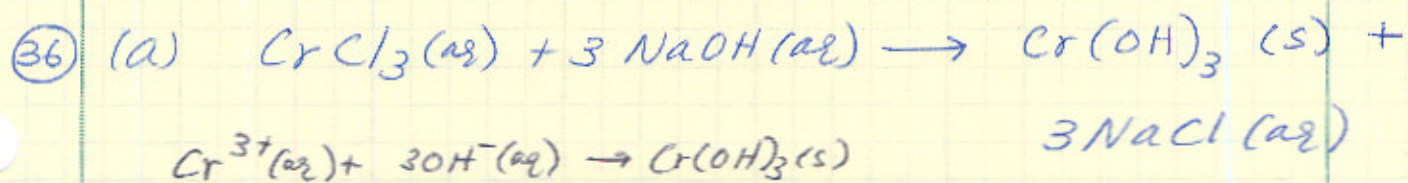
(32) all the molecular reactions (balanced) are given above.

(a) No reaction



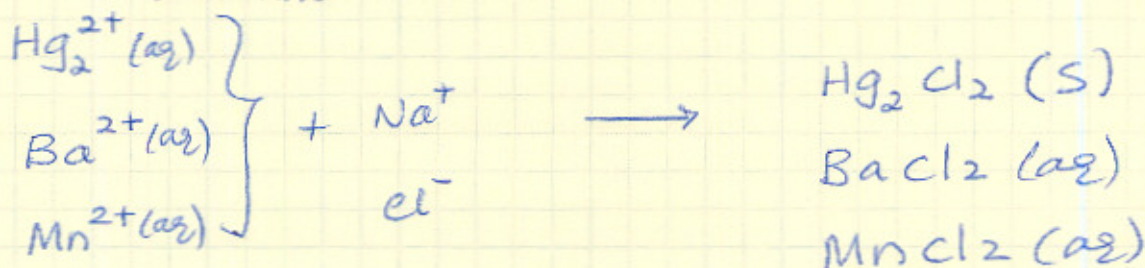
21



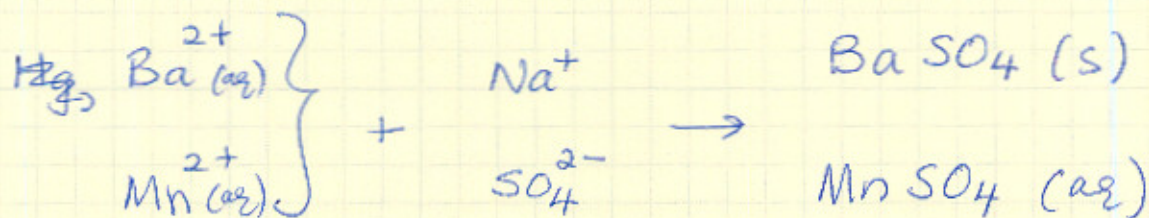


no reaction

$\textcircled{38}$ possible in original solution



Since no precipitate was formed, Hg_2^{2+} cannot be in the original solution.

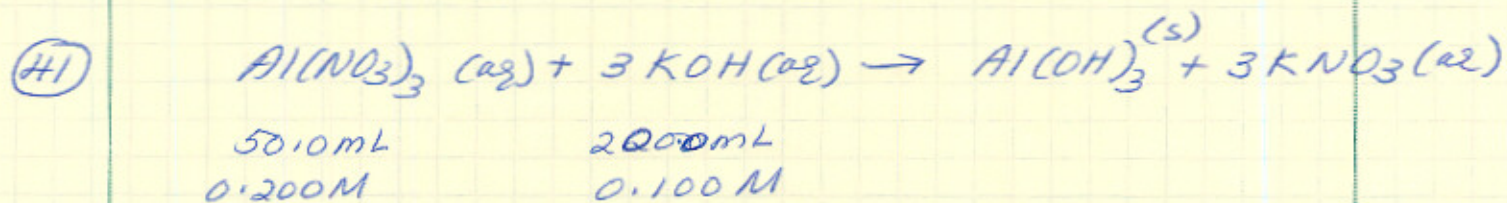


Since no precipitate was formed, Ba^{2+} ions cannot be in the original solution.

4/



Therefore Mn^{2+} ions can be in the original solution.



$$\begin{aligned} \# \text{ of moles of } \text{Al}(\text{NO}_3)_3 &= \left(0.200 \frac{\text{mol}}{\text{L}}\right) 50.0 \text{ mL} \times \left(\frac{\text{L}}{10^3 \text{ mL}}\right) \\ &= 0.010 \text{ mol} \end{aligned}$$

$$\begin{aligned} \# \text{ of moles of } \text{KOH} &= \left(0.100 \frac{\text{mol}}{\text{L}}\right) (200.0 \text{ mL}) \left(\frac{\text{L}}{10^3 \text{ mL}}\right) \\ &= 0.020 \text{ mol} \end{aligned}$$

$$\begin{aligned} \left. \begin{array}{l} \# \text{ of mol } \text{Al}(\text{NO}_3)_3 \text{ needed to} \\ \text{react with } 0.020 \text{ mol } \text{KOH} \end{array} \right\} &= 0.020 \text{ mol } \text{KOH} \times \left(\frac{1 \text{ mol } \text{Al}(\text{NO}_3)_3}{3 \text{ mol } \text{KOH}}\right) \\ &= 0.00667 \text{ mol } \text{Al}(\text{NO}_3)_3 \end{aligned}$$

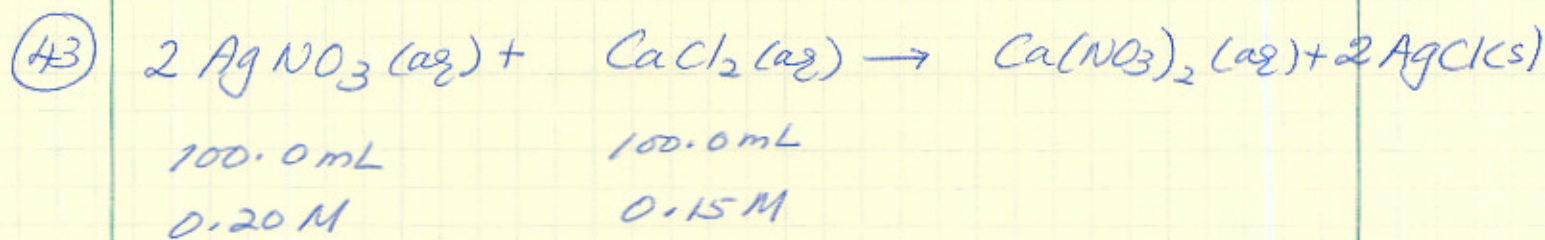
Since we have 0.010 mol $\text{Al}(\text{NO}_3)_3$, we have excess of it. KOH is the limiting reagent.

$$\begin{aligned} \text{moles of } \text{Al}(\text{OH})_3 \text{ formed} &= 0.020 \text{ mol } \text{KOH} \times \left(\frac{1 \text{ mol } \text{Al}(\text{OH})_3}{3 \text{ mol } \text{KOH}}\right) \\ &= 0.00667 \text{ mol } \text{Al}(\text{OH})_3 \end{aligned}$$

$$\begin{aligned} \text{molar mass of } \text{Al}(\text{OH})_3 &= [26.98 + 3(16.00) + 3(1.008)] \\ &= 78.004 \text{ g/mol} \end{aligned}$$

5/

$$\begin{aligned} \text{mass of Al(OH)}_3 \text{ formed} &= 0.00667 \text{ mol} \times \left(\frac{78.004 \text{ g}}{\text{mol}} \right) \\ &= \underline{\underline{0.520 \text{ g}}} \end{aligned}$$



$$\begin{aligned} \# \text{ of moles of AgNO}_3 &= \left(0.20 \frac{\text{mol}}{\text{L}} \right) 100 \text{ mL} \times \left(\frac{\text{L}}{10^3 \text{ mL}} \right) \\ &= 0.020 \text{ mol} \end{aligned}$$

$$\begin{aligned} \# \text{ moles of CaCl}_2 &= \left(0.15 \frac{\text{mol}}{\text{L}} \right) (100.0 \text{ mL}) \times \left(\frac{\text{L}}{10^3 \text{ mL}} \right) \\ &= 0.015 \text{ mol} \end{aligned}$$

$$\begin{aligned} \left. \begin{array}{l} \text{moles of AgNO}_3 \text{ required to} \\ \text{react with } 0.015 \text{ mol of CaCl}_2 \end{array} \right\} &= 0.015 \text{ mol} \times \left(\frac{2 \text{ mol AgNO}_3}{1 \text{ mol CaCl}_2} \right) \\ &= 0.030 \text{ mol AgNO}_3 \end{aligned}$$

Since we have only 0.020 mol AgNO₃, AgNO₃ is the limiting reagent. CaCl₂ is in excess.

$$\begin{aligned} \text{moles of AgCl formed} &= 0.020 \text{ mol} \times \left(\frac{2 \text{ mol AgCl}}{2 \text{ mol AgNO}_3} \right) \\ &= 0.020 \text{ mol AgCl} \end{aligned}$$

$$\begin{aligned} \text{molar mass of AgCl} &= (107.9 + 35.5) \text{ g/mol} \\ &= 143.4 \text{ g/mol} \end{aligned}$$

6/

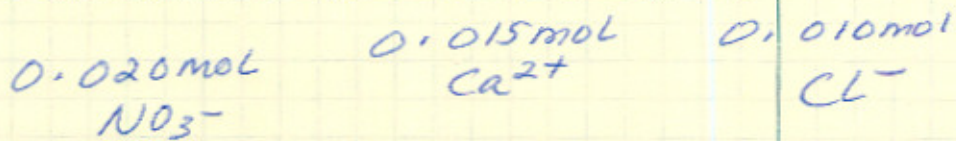
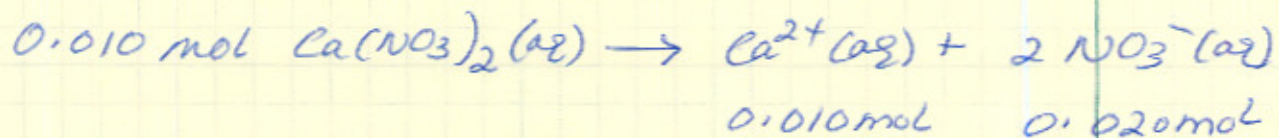
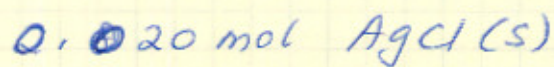
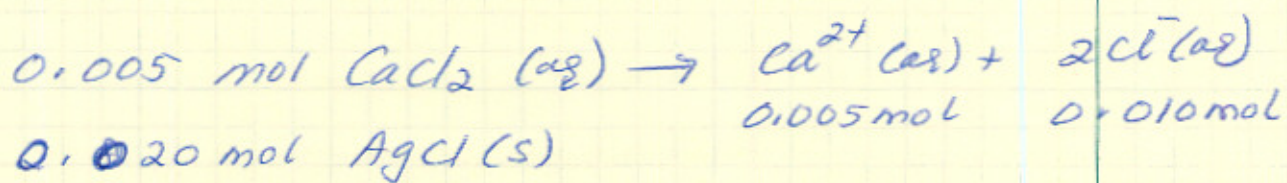
$$\begin{aligned} \text{Mass of AgCl} &= 0.020 \text{ mol AgCl} \times \left(\frac{143.4 \text{ g}}{\text{mol}} \right) \\ &= \underline{\underline{2.868 \text{ g AgCl}}} \end{aligned}$$

$$\begin{aligned} \text{mol of Ca(NO}_3)_2 \text{ produced} &= \left(\frac{0.020 \text{ mol}}{\text{AgNO}_3} \right) \times \left(\frac{1 \text{ mol Ca(NO}_3)_2}{2 \text{ mol AgNO}_3} \right) \\ &= 0.010 \text{ mol Ca(NO}_3)_2 \end{aligned}$$

$$\begin{aligned} \text{mol of CaCl}_2 \text{ reacted} &= \left(\frac{0.020 \text{ mol}}{\text{AgNO}_3} \right) \times \left(\frac{1 \text{ mol CaCl}_2}{2 \text{ mol AgNO}_3} \right) \\ &= 0.010 \text{ mol CaCl}_2 \end{aligned}$$

$$\begin{aligned} \text{mol of CaCl}_2 \text{ left unreacted} &= 0.015 \text{ mol} - 0.010 \text{ mol} \\ &= 0.005 \text{ mol CaCl}_2 \end{aligned}$$

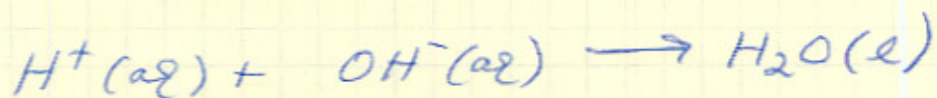
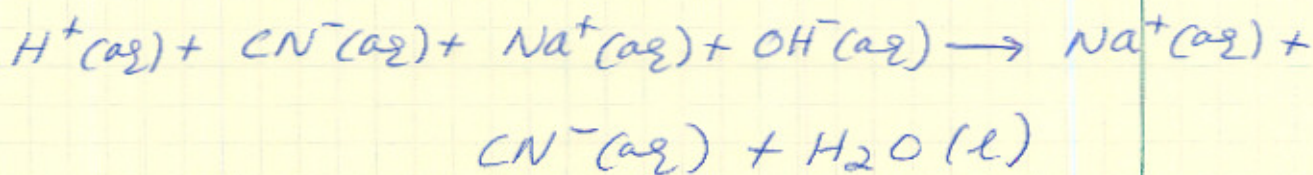
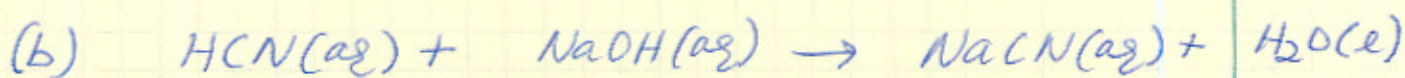
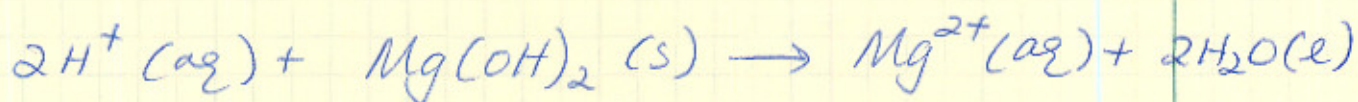
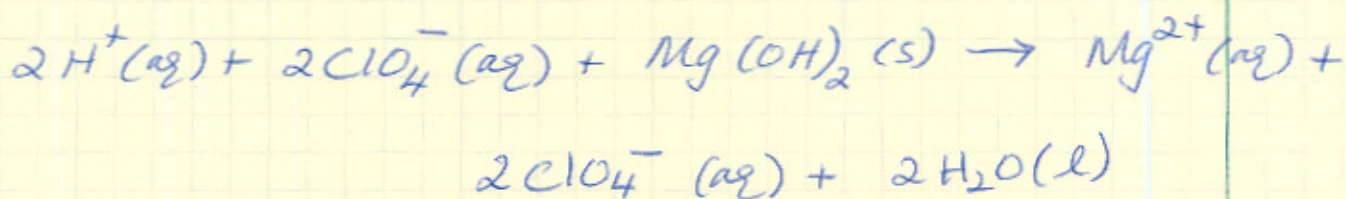
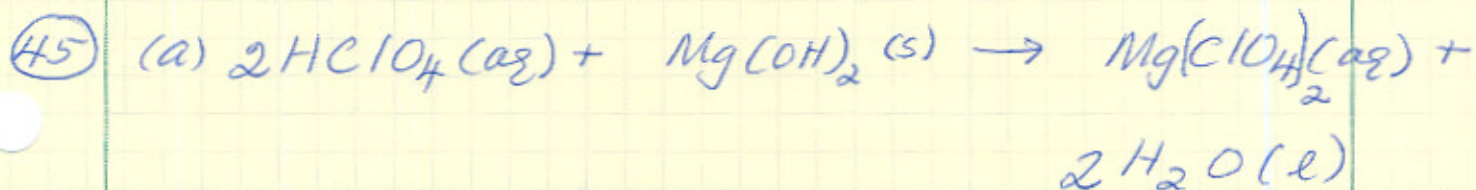
What is left in the reaction vessel after the reaction is complete =

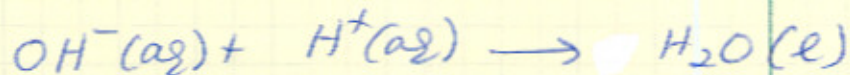
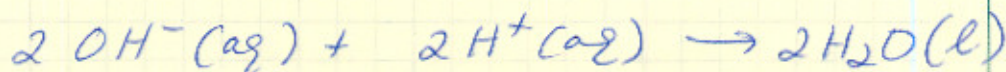
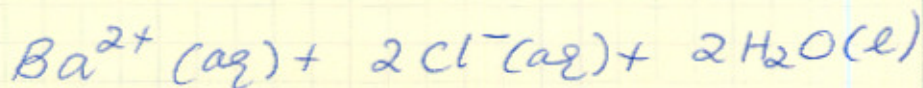
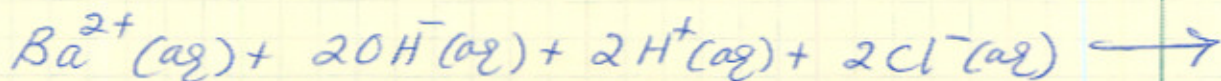
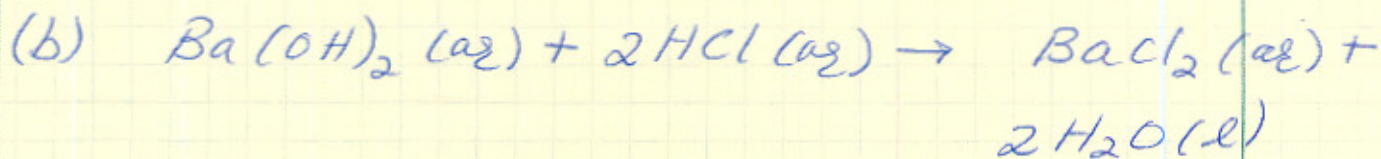
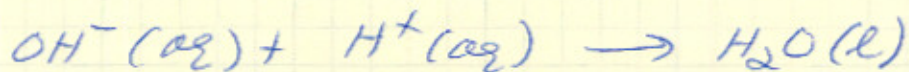
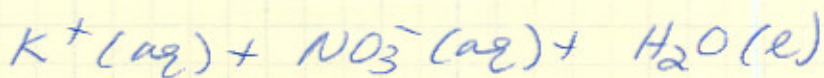
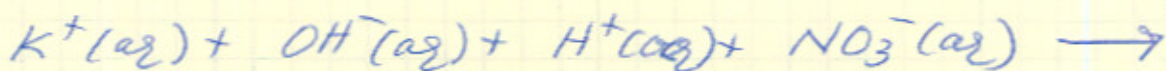
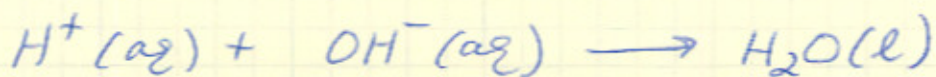
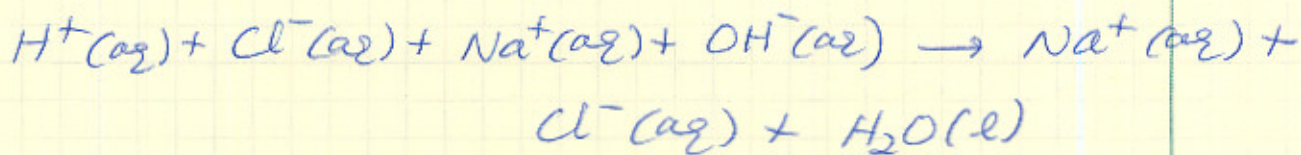
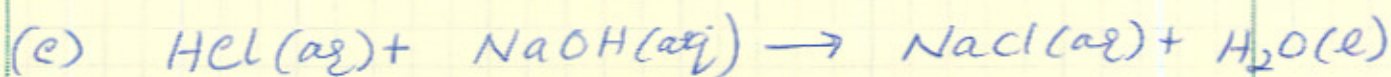


$$\begin{aligned} \text{Total volume of solution} &= 100.0 \text{ mL} + 100.0 \text{ mL} \\ &= 200.0 \text{ mL} \\ &= 200.0 \times 10^{-3} \text{ L} \end{aligned}$$

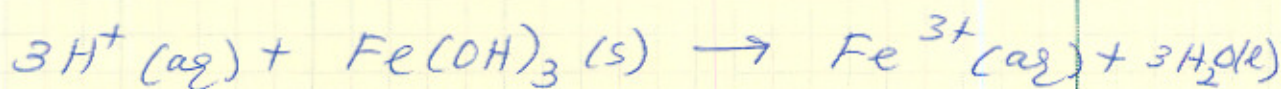
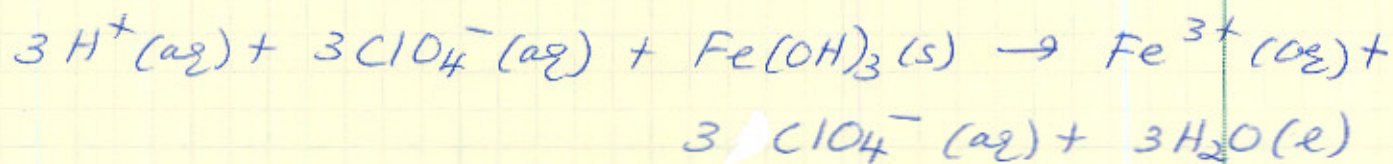
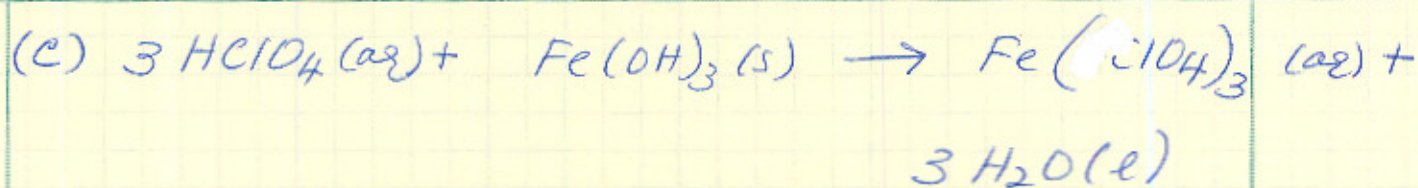
Concentration of the ions left

$\begin{aligned} \text{NO}_3^- \\ \hline \frac{0.020 \text{ mol}}{200.0 \times 10^{-3} \text{ L}} \\ \hline = \underline{\underline{0.10 \text{ M}}} \end{aligned}$	$\begin{aligned} \text{Ca}^{2+} \\ \hline \frac{0.015 \text{ mol}}{200.0 \times 10^{-3} \text{ L}} \\ \hline = \underline{\underline{0.075 \text{ M}}} \end{aligned}$	$\begin{aligned} \text{Cl}^- \\ \hline \frac{0.010 \text{ mol}}{200.0 \times 10^{-3} \text{ L}} \\ \hline = \underline{\underline{0.050 \text{ M}}} \end{aligned}$
---	---	--



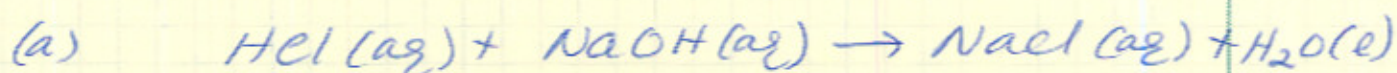


91



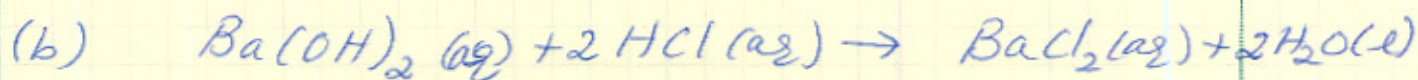
(50) 25.00 mL of 0.200 M HCl

$$\begin{aligned} \# \text{ of mol of HCl} &= \left(\frac{0.200 \text{ mol}}{\text{L}} \right) \left(25.00 \text{ mL} \right) \times \left(\frac{\text{L}}{10^3 \text{ mL}} \right) \\ &= 5.00 \times 10^{-3} \text{ mol} \end{aligned}$$



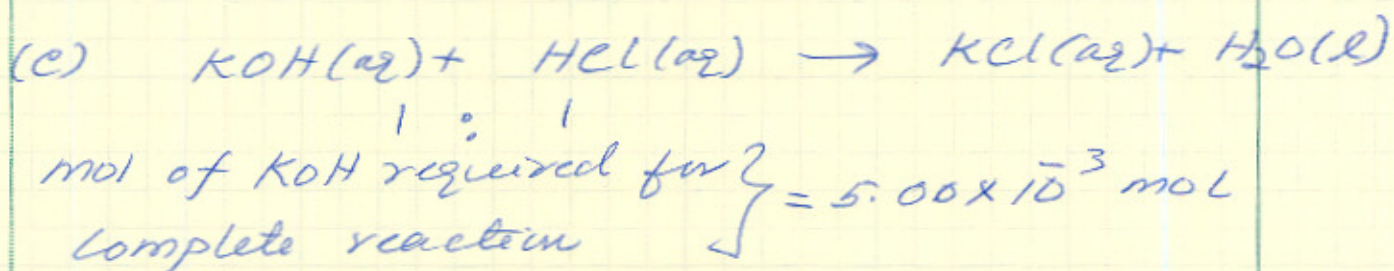
$$\left. \begin{array}{l} \text{mol of NaOH required} \\ \text{for complete reaction} \end{array} \right\} = 5.00 \times 10^{-3} \text{ mol NaOH}$$

$$\begin{aligned} \therefore \text{Volume of NaOH} &= \frac{5.00 \times 10^{-3} \text{ mol}}{0.100 \text{ mol L}^{-1}} \cdot \left(\frac{10^3 \text{ mL}}{\text{L}} \right) \\ &= \underline{\underline{50.0 \text{ mL}}} \end{aligned}$$

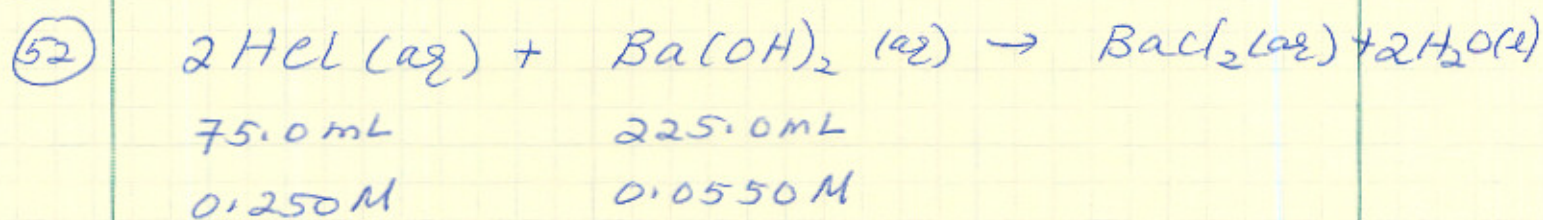


$$\begin{aligned} \left. \begin{array}{l} \text{mol of Ba}(\text{OH})_2 \text{ required} \\ \text{for complete reaction} \end{array} \right\} &= 5.00 \times 10^{-3} \text{ mol HCl} \times \frac{1 \text{ mol Ba}(\text{OH})_2}{2 \text{ mol HCl}} \\ &= 0.0025 \text{ mol} \end{aligned}$$

$$\begin{aligned} \text{volume of Ba(OH)}_2 &= \frac{0.0025 \text{ mol}}{0.0500 \text{ mol L}^{-1}} \left(\frac{10^3 \text{ mL}}{\text{L}} \right) \\ &= \underline{\underline{50.0 \text{ mL}}} \end{aligned}$$



$$\begin{aligned} \text{volume of KOH} &= \frac{5.00 \times 10^{-3} \text{ mol}}{0.250 \text{ mol L}^{-1}} \left(\frac{10^3 \text{ mL}}{\text{L}} \right) \\ &= \underline{\underline{20.0 \text{ mL}}} \end{aligned}$$



$$\begin{aligned} \text{mol of HCl} &= (0.250 \text{ M})(75.0 \text{ mL}) \times \left(\frac{\text{L}}{10^3 \text{ mL}} \right) \\ &= 1.875 \times 10^{-2} \text{ mol} \end{aligned}$$

$$\begin{aligned} \text{mol of Ba(OH)}_2 &= (0.0550 \text{ M})(225.0 \text{ mL}) \times \left(\frac{\text{L}}{10^3 \text{ mL}} \right) \\ &= 1.2375 \times 10^{-2} \text{ mol} \end{aligned}$$

$$\left. \begin{array}{l} \text{mol of HCl needed to} \\ \text{react with all of Ba(OH)}_2 \end{array} \right\} = 1.2375 \times 10^{-2} \text{ mol Ba(OH)}_2 \times \left(\frac{2 \text{ mol HCl}}{1 \text{ mol Ba(OH)}_2} \right)$$

$$= 2.475 \times 10^{-2} \text{ mol HCl}$$

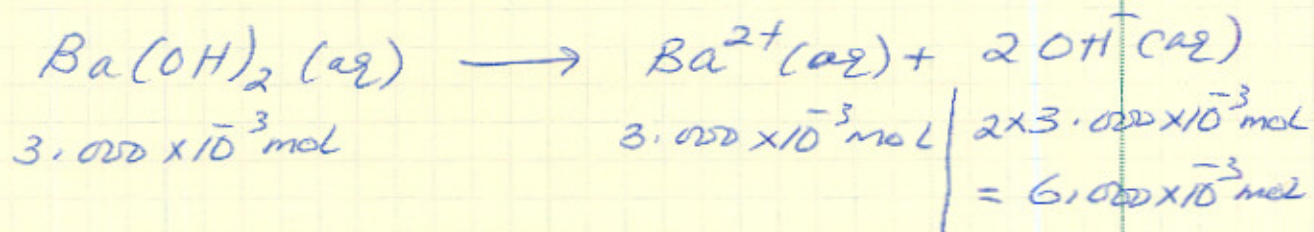
∴ We do not have enough HCl. HCl is the limiting reagent.

$$\text{Amount of Ba(OH)}_2 \text{ that reacts} = \left(\frac{1.875 \times 10^{-2} \text{ mol}}{\text{HCl}} \right) \left[\frac{1 \text{ mol Ba(OH)}_2}{2 \text{ mol HCl}} \right]$$

$$= 9.375 \times 10^{-3} \text{ mol Ba(OH)}_2$$

$$\text{∴ Amount of Ba(OH)}_2 \text{ left} = \left(1.2375 \times 10^{-2} - 9.375 \times 10^{-3} \right) \text{ mol}$$

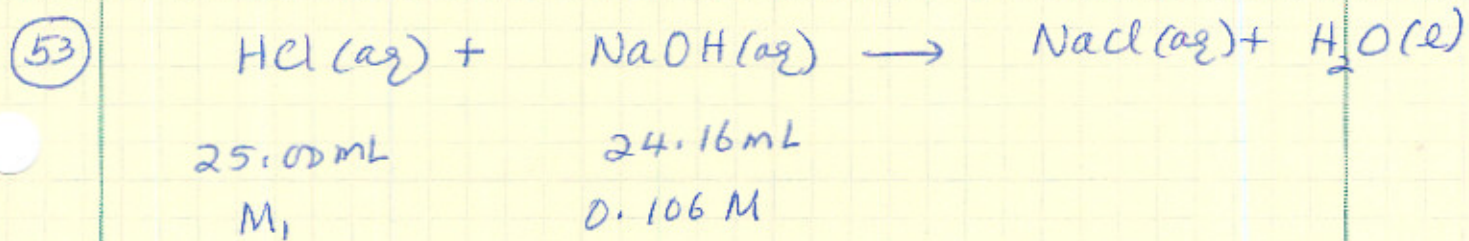
$$= 3.000 \times 10^{-3} \text{ mol}$$



$$\begin{aligned} \text{Excess OH}^- \text{ left after reaction} &= 6.000 \times 10^{-3} \text{ mol} \\ &= 6.00 \times 10^{-3} \text{ mol} \end{aligned}$$

$$\begin{aligned} \text{Volume of solution after reaction} &= (75.0 + 225.0) \text{ mL} \\ &= 300 \text{ mL} \end{aligned}$$

$$\begin{aligned} \text{Concentration of OH}^- \text{ after reaction} &= \frac{6.00 \times 10^{-3} \text{ mol}}{300 \text{ mL}} \times \frac{10^3 \text{ mL}}{\text{L}} \\ &= \underline{\underline{0.0200 \text{ M}}} \end{aligned}$$



M_1 = Concentration of HCl

$$\# \text{ moles of HCl} = (M_1 \times 25.00 \times 10^{-3} \text{ L})$$

$$\begin{aligned} \# \text{ moles of NaOH} &= (0.106 \text{ M} \times 24.16 \times 10^{-3} \text{ L}) \\ &= 2.561 \times 10^{-3} \text{ mol} \end{aligned}$$

$$\# \text{ mol HCl} = \# \text{ of NaOH}$$

$$M_1 \times 25.00 \times 10^{-3} \text{ L} = 2.561 \times 10^{-3} \text{ mol}$$

$$M_1 = \frac{2.561 \times 10^{-3} \text{ mol}}{25.00 \times 10^{-3} \text{ L}} = \underline{\underline{0.102 \text{ M}}}$$