

Review - Solutions - V1

1.) If you dissolve 1.50 mol of aluminum chloride in 2.25 L of water, calculate [] of each ion.

$$\text{Answer - } \frac{1.50 \text{ mol}}{2.25 \text{ L}} = 0.66667 \text{ M AlCl}_3 \quad \frac{\text{AlCl}_3}{0.667 \text{ M}} \rightarrow \frac{\text{Al}^{+3}}{0.667 \text{ M}} + \frac{3 \text{ Cl}^-}{2.00 \text{ M}}$$

$$[\text{Al}^{+3}] = 0.667 \text{ M} \quad [\text{Cl}^{-1}] = 2.00 \text{ M}$$

2.) If you dissolve 0.240 mol of ammonium sulphate in 320 mL of water, calculate $[\text{NH}_4^{+1}(\text{aq})]$.

$$\text{Answer - } \frac{0.240 \text{ mol}}{0.320 \text{ L}} = 0.750 \text{ M } (\text{NH}_4)_2\text{SO}_4 \quad \frac{(\text{NH}_4)_2\text{SO}_4}{0.750 \text{ M}} \rightarrow \frac{2 \text{ NH}_4^{+1}}{1.50 \text{ M}} + \frac{\text{SO}_4^{-2}}{0.750 \text{ M}}$$

$$[\text{NH}_4^{+1}] = 1.50 \text{ M}$$

3.) If the $[\text{Cl}^-] = 0.015 \text{ M}$ in 75 mL of water, how many moles of iron (III) chloride were there?

$$\text{Answer - } \frac{\text{FeCl}_3}{0.0050 \text{ M}} \rightarrow \frac{\text{Fe}^{+3}}{0.0050 \text{ M}} + \frac{3 \text{ Cl}^-}{0.015 \text{ M}} \quad 0.075 \text{ L} \times \frac{0.0050 \text{ mol}}{1 \text{ L}} = 0.000375 \text{ mol FeCl}_3$$

$$= 0.00038 \text{ mol FeCl}_3$$

4.) How much water would you need if you started with 1.20 mol of sodium oxalate but wanted a solution with $[\text{Na}^{+1}] = 0.48 \text{ M}$?

$$\text{Answer - } \frac{\text{Na}_2\text{C}_2\text{O}_4}{0.24 \text{ M}} \rightarrow \frac{2 \text{ Na}^+}{0.48 \text{ M}} + \frac{\text{C}_2\text{O}_4^{-2}}{0.24 \text{ M}} \quad 1.20 \text{ mol Na}_2\text{C}_2\text{O}_4 \times \frac{1 \text{ L}}{0.24 \text{ mol}} = 5.0 \text{ L}$$

$$= 5.0 \text{ L water}$$

5.) In 1.25 L of a 0.50 M nickel (III) sulphate solution, calculate moles of nickel (III) ions.

$$\text{Answer - } 1.25 \text{ L} \times \frac{0.50 \text{ mol}}{1 \text{ L}} = 0.625 \text{ mol Ni}_2(\text{SO}_4)_3 \quad \frac{\text{Ni}_2(\text{SO}_4)_3}{0.625} \rightarrow \frac{2 \text{ Ni}^{+3}}{1.25} + \frac{3 \text{ SO}_4^{-2}}{1.875}$$

$$\text{Ni}^{+3} = 1.3 \text{ mol} \quad \text{SO}_4^{-2} = 1.9 \text{ mol}$$

Or

$$0.625 \text{ mol Ni}_2(\text{SO}_4)_3 \times \frac{3 \text{ mol SO}_4^{-2}}{1 \text{ mol Ni}_2(\text{SO}_4)_3} = 1.875 \text{ mol SO}_4^{-2} \quad 0.625 \text{ mol Ni}_2(\text{SO}_4)_3 \times \frac{2 \text{ mol Ni}^{+3}}{1 \text{ mol Ni}_2(\text{SO}_4)_3} = 1.25 \text{ mol Ni}^{+3}$$

$$\text{Ni}^{+3} = 1.3 \text{ mol} \quad \text{SO}_4^{-2} = 1.9 \text{ mol}$$

6.) How many grams of ammonium chloride are present in a 0.30 L beaker of a 0.40 M solution of ammonium chloride?

$$\text{Answer - } 0.30 \text{ L} \times \frac{0.40 \text{ mol}}{1 \text{ L}} \times \frac{53.50 \text{ g}}{1 \text{ mol}} = 6.42 \text{ g NH}_4\text{Cl}$$

7.) How many litres of a 0.250 M potassium chromate solution contains 38.8 g of K_2CrO_4 solution?

$$\text{Answer - } 38.8 \text{ g K}_2\text{CrO}_4 \times \frac{1 \text{ mol}}{194.20 \text{ g}} \times \frac{1 \text{ L}}{0.250 \text{ mol}} = 0.79916 \text{ L K}_2\text{CrO}_4$$

$$= 0.799 \text{ L K}_2\text{CrO}_4$$

8.) A chemist evaporated 25.0 mL of a sodium chloride solution to dryness. He found 0.585 g of NaCl.

What was the original concentration of the salt?

$$\begin{aligned} \text{Answer - } 0.585 \text{ g NaCl} \times \frac{1 \text{ mol}}{58.44 \text{ g}} \times \frac{1}{0.0250 \text{ L}} &= 0.400 \text{ M K}_2\text{CrO}_4 \\ &= 0.400 \text{ M NaCl} \end{aligned}$$

9.) If you dissolve 316 g of magnesium bromide in 859 mL of water, calculate []'s of each ion.

$$\begin{aligned} \text{Answer - } 316 \text{ g MgBr}_2 \times \frac{1 \text{ mol}}{184.11 \text{ g}} \times \frac{1}{0.859 \text{ L}} &= 1.9980 \text{ M MgBr}_2 & \frac{\text{MgBr}_2}{2.00 \text{ M}} &\rightarrow \frac{\text{Mg}^{+2}}{2.00 \text{ M}} + \frac{2 \text{ Br}^-}{4.00 \text{ M}} \\ [\text{Mg}^{+2}] &= 2.00 \text{ M} & [\text{Br}^-] &= 4.00 \text{ M} \end{aligned}$$

10.) 31.1 g of aluminum sulphate is dissolved in 756 mL of water. Calculate [] of each ion.

$$\begin{aligned} \text{Answer - } 31.1 \text{ g Al}_2(\text{SO}_4)_3 \times \frac{1 \text{ mol}}{342.14 \text{ g}} \times \frac{1}{0.756 \text{ L}} &= 0.12024 \text{ M Al}_2(\text{SO}_4)_3 & \frac{\text{Al}_2(\text{SO}_4)_3}{0.120 \text{ M}} &\rightarrow \frac{2 \text{ Al}^{+3}}{0.240 \text{ M}} + \frac{3 \text{ SO}_4^{-2}}{0.361 \text{ M}} \\ [\text{Al}^{+3}] &= 0.240 \text{ M} & [\text{SO}_4^{-2}] &= 0.361 \text{ M} \end{aligned}$$

11.) 250.0 mL of a 1.2 M $[\text{Pb}(\text{NO}_3)_2(\text{aq})]$ solution is diluted to 600.0 mL. Calculate $[\text{Pb}(\text{NO}_3)_2(\text{aq})]$ and $[\text{Pb}^{+2}(\text{aq})]$ and $[\text{NO}_3^{-1}(\text{aq})]$.

$$\begin{aligned} \text{Answer - } C_{\text{dil}} &= \frac{C_{\text{conc}} \times V_{\text{conc}}}{V_{\text{dil}}} & C_{\text{dil}} &= \frac{(1.2)(0.250)}{(0.600)} & C_{\text{dil}} &= 0.50 \text{ M Pb}(\text{NO}_3)_2 \\ \frac{\text{Pb}(\text{NO}_3)_2}{0.50 \text{ M}} &\rightarrow \frac{\text{Pb}^{+2}}{0.50 \text{ M}} + \frac{2 \text{ NO}_3^-}{1.00 \text{ M}} \\ [\text{NO}_3^-] &= 1.0 \text{ M} & [\text{Pb}^{+2}] &= 0.50 \text{ M} & [\text{Pb}(\text{NO}_3)_2] &= 0.50 \text{ M} \end{aligned}$$

12.) 0.300 L of a sodium sulphate solution is diluted to 0.750 L. The **diluted** concentration of sodium ions is 0.72 M. Calculate the **original** concentration of the sodium sulphate solution.

$$\begin{aligned} \text{Answer - } \frac{\text{Na}_2\text{SO}_4}{0.36 \text{ M}} &\rightarrow \frac{2 \text{ Na}^+}{0.72 \text{ M}} + \frac{\text{SO}_4^{-2}}{0.36 \text{ M}} & C_{\text{conc}} &= \frac{C_{\text{dil}} \times V_{\text{dil}}}{V_{\text{conc}}} & C_{\text{conc}} &= \frac{(0.36)(0.750)}{(0.300)} \\ C_{\text{conc}} &= 0.90 \text{ M Na}_2\text{SO}_4 \end{aligned}$$

13.) In soda pop, the concentration of dissolved sugar is approximately 0.0125 M. However, in the syrup mix, the sugar concentration is 5.6 M. How many millilitres of the syrup would be needed to make 2.0 L of drinkable soda pop?

$$\begin{aligned} \text{Answer - } V_{\text{conc}} &= \frac{C_{\text{dil}} \times V_{\text{dil}}}{C_{\text{conc}}} & V_{\text{conc}} &= \frac{(0.0125)(2.0)}{(5.6)} & V_{\text{conc}} &= 0.0045 \text{ L} \\ V_{\text{conc}} &= 4.5 \text{ mL} \end{aligned}$$

14.) By accident, 3.57 mL of syrup from the previous question was used instead. Calculate the concentration of the sugar in the 2.0 L soda pop.

$$\text{Answer - } C_{dil} = \frac{C_{conc} \times V_{conc}}{V_{dil}} \quad C_{dil} = \frac{(5.6)(0.00357)}{(2.0)} \quad C_{dil} = 0.010 M$$

15.) A chemist has 46.8 mL of a 0.400 M NaCl solution. How much water should be added to make a 0.250 M solution?

$$\text{Answer - } V_{dil} = \frac{C_{conc} \times V_{conc}}{C_{dil}} \quad V_{dil} = \frac{(0.400)(0.0468)}{(0.250)} \quad V_{dil} = 0.0750 L$$

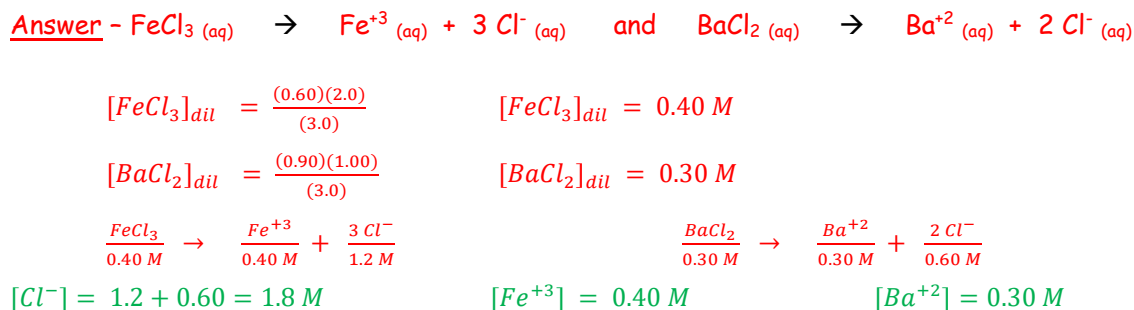
$$0.0750 - 0.0468 = 0.028176 L \quad = 0.0282 L \text{ or } 28.2 mL$$

16.) Stephanie adds water to a 125 mL, 3.6 M sodium phosphate solution until she has 1.00 L. Calculate the [] of each ion.

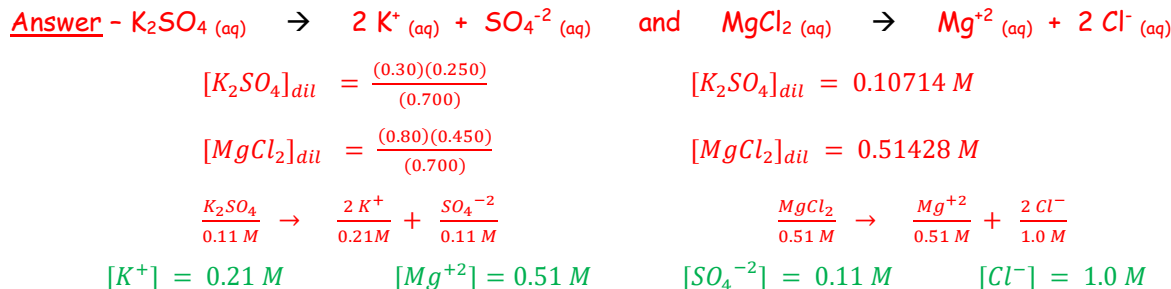
$$\text{Answer - } C_{dil} = \frac{C_{conc} \times V_{conc}}{V_{dil}} \quad C_{dil} = \frac{(3.6)(0.125)}{(1.0)} \quad C_{dil} = 0.45 M Na_3PO_4$$

$$\frac{Na_3PO_4}{0.45 M} \rightarrow \frac{3 Na^+}{1.35 M} + \frac{PO_4^{-3}}{0.45 M} \quad [Na^+] = 1.35 M \quad [PO_4^{-3}] = 0.45 M$$

17.) 2.0 L of a 0.60 M ferric chloride (iron (III) chloride) solution are mixed with 1.00 L of a 0.90 M barium chloride solution. Calculate the [] of each ion.

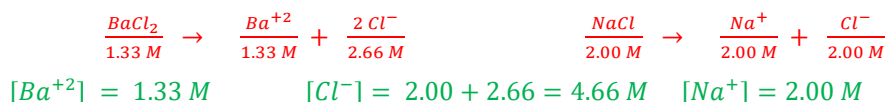


18.) 250.0 mL of a 0.30 M potassium sulphate and 450.0 mL of a 0.80 M magnesium chloride solutions are mixed. Calculate the [] of each ion.



19.) 20.83 g of BaCl_2 is dissolved in 75.0 mL of 2.00 M NaCl. Calculate the concentrations of all ions.

$$\text{Answer} - 20.83 \text{ g BaCl}_2 \times \frac{1 \text{ mol BaCl}_2}{208.2 \text{ g BaCl}_2} \times \frac{1}{0.0750 \text{ L BaCl}_2} = 1.3334 \text{ M BaCl}_2$$



20.) 71.0 g of aluminum nitrate and 53.4 g of magnesium nitrate are dissolved in 800.0 mL of water.

Calculate $[\text{Al}(\text{NO}_3)_3 \text{ (aq)}]$, $[\text{Mg}(\text{NO}_3)_2 \text{ (aq)}]$, and $[\text{NO}_3^{-1} \text{ (aq)}]$.

$$\text{Answer} - 71.0 \text{ g Al(NO}_3)_3 \times \frac{1 \text{ mol Al(NO}_3)_3}{213.01 \text{ g Al(NO}_3)_3} \times \frac{1}{0.8000 \text{ L Al(NO}_3)_3} = 0.4166 \text{ M Al(NO}_3)_3$$

$$53.4 \text{ g Mg(NO}_3)_2 \times \frac{1 \text{ mol Mg(NO}_3)_2}{148.33 \text{ g Mg(NO}_3)_2} \times \frac{1}{0.8000 \text{ L Mg(NO}_3)_2} = 0.4500 \text{ M Mg(NO}_3)_2$$

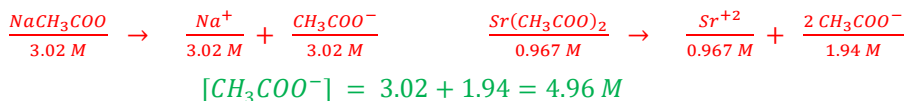


21.) 123.0 g of sodium acetate and 0.48 mol of strontium acetate are dissolved in 496 mL of water.

Calculate the concentration of acetate.

$$\text{Answer} - 0.48 \text{ mol Sr(CH}_3\text{COO)}_2 \times \frac{1}{0.496 \text{ L Sr(CH}_3\text{COO)}_2} = 0.96774 \text{ M Sr(CH}_3\text{COO)}_2$$

$$123.0 \text{ g NaCH}_3\text{COO} \times \frac{1 \text{ mol NaCH}_3\text{COO}}{82.04 \text{ g NaCH}_3\text{COO}} \times \frac{1}{0.496 \text{ L NaCH}_3\text{COO}} = 3.0227 \text{ M NaCH}_3\text{COO}$$



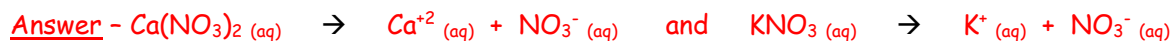
22.) 40.3 g of ferric nitrate and 97.38 g of ferric chloride are dissolved in 0.25 L of water. Calculate the concentration of the ferric iron ion (Fe^{+3}).

$$\text{Answer} - 40.3 \text{ g Fe(NO}_3)_3 \times \frac{1 \text{ mol Fe(NO}_3)_3}{241.88 \text{ g Fe(NO}_3)_3} \times \frac{1}{0.25 \text{ L Fe(NO}_3)_3} = 0.6664 \text{ M Fe(NO}_3)_3$$

$$97.38 \text{ g FeCl}_3 \times \frac{1 \text{ mol FeCl}_3}{162.2 \text{ g FeCl}_3} \times \frac{1}{0.25 \text{ L FeCl}_3} = 2.4014 \text{ M FeCl}_3$$



23.) 150. mL of 0.80 M $\text{Ca}(\text{NO}_3)_2$ are mixed with 650. mL of 1.20 M KNO_3 . Calculate the concentration of all ions in the diluted solution.



$$[\text{KNO}_3]_{\text{dil}} = \frac{(1.20)(0.650)}{(0.800)} \quad [\text{KNO}_3]_{\text{dil}} = 0.975 \text{ M}$$

$$[\text{Ca}(\text{NO}_3)_2]_{\text{dil}} = \frac{(0.80)(0.150)}{(0.800)} \quad [\text{Ca}(\text{NO}_3)_2]_{\text{dil}} = 0.150 \text{ M}$$

$$\frac{\text{KNO}_3}{0.975 \text{ M}} \rightarrow \frac{\text{K}^+}{0.975 \text{ M}} + \frac{\text{NO}_3^-}{0.975 \text{ M}} \quad \frac{\text{Ca}(\text{NO}_3)_2}{0.150 \text{ M}} \rightarrow \frac{\text{Ca}^{+2}}{0.150 \text{ M}} + \frac{2 \text{NO}_3^-}{0.30 \text{ M}}$$

$$[\text{K}^+] = 0.975 \text{ M} \quad [\text{Ca}^{+2}] = 0.150 \text{ M} \quad [\text{NO}_3^-] = 0.975 + 0.30 = 1.3 \text{ M}$$

24.) 25 mL of a 4.4 M magnesium sulphate solution are mixed with 75.0 mL of a 1.25 M magnesium phosphate solution. Calculate the concentrations of all ions of the dilute solution.



$$[\text{MgSO}_4]_{\text{dil}} = \frac{(4.4)(0.025)}{(0.100)} \quad [\text{MgSO}_4]_{\text{dil}} = 1.1 \text{ M}$$

$$[\text{Mg}_3(\text{PO}_4)_2]_{\text{dil}} = \frac{(1.25)(0.075)}{(0.100)} \quad [\text{Mg}_3(\text{PO}_4)_2]_{\text{dil}} = 0.9375 \text{ M}$$

$$\frac{\text{MgSO}_4}{1.1 \text{ M}} \rightarrow \frac{\text{Mg}^{+2}}{1.1 \text{ M}} + \frac{\text{SO}_4^{-2}}{1.1 \text{ M}} \quad \frac{\text{Mg}_3(\text{PO}_4)_2}{0.9375 \text{ M}} \rightarrow \frac{3 \text{Mg}^{+2}}{2.8125 \text{ M}} + \frac{2 \text{PO}_4^{-2}}{1.875 \text{ M}}$$

$$[\text{Mg}^{+2}] = 1.1 + 2.8 = 3.9 \text{ M} \quad [\text{SO}_4^{-2}] = 1.1 \text{ M} \quad [\text{PO}_4^{-2}] = 1.9 \text{ M}$$

25.) 0.200 L of a 0.050 M AlBr_3 solution is added to 50.0 mL of a 0.40 M KOH solution.

a.) Will a precipitate form? If so, what is it?



b.) Write a net ionic equation.



c.) Calculate the mass of the precipitate, if a precipitate formed.



$$0.200 \text{ L AlBr}_3 \times \frac{0.050 \text{ mol AlBr}_3}{1 \text{ L AlBr}_3} \times \frac{1 \text{ mol Al}(\text{OH})_3}{1 \text{ mol AlBr}_3} = 0.010 \text{ mol Al}(\text{OH})_3$$

$$0.050 \text{ L KOH} \times \frac{0.40 \text{ mol KOH}}{1 \text{ L KOH}} \times \frac{1 \text{ mol Al}(\text{OH})_3}{3 \text{ mol KOH}} = 0.00666 \text{ mol Al}(\text{OH})_3$$

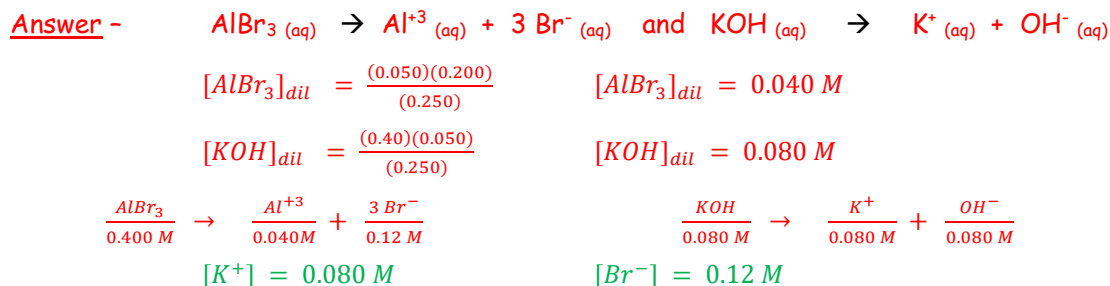
$$0.00666 \text{ mol Al}(\text{OH})_3 \times \frac{78.01 \text{ g Al}(\text{OH})_3}{1 \text{ mol Al}(\text{OH})_3} = 0.52 \text{ g Al}(\text{OH})_3$$

d.) If 0.65 g of precipitate are recovered, calculate the % yield.

Answer - $\text{percent yield} = \frac{\text{mass of product obtained}}{\text{mass of product expected}} \times 100\%$

$$\text{percent yield} = \frac{0.65 \text{ g}}{0.52 \text{ g}} \times 100\% = 125\% \quad 130.0\%$$

e.) Calculate the concentrations of spectator ions.



26.) 0.25 L of a 0.24 M zinc iodide solution is mixed with an equal volume of a 0.30 M sodium sulphate solution.

a.) Will a precipitate form? If so, what is it?

Answer - No

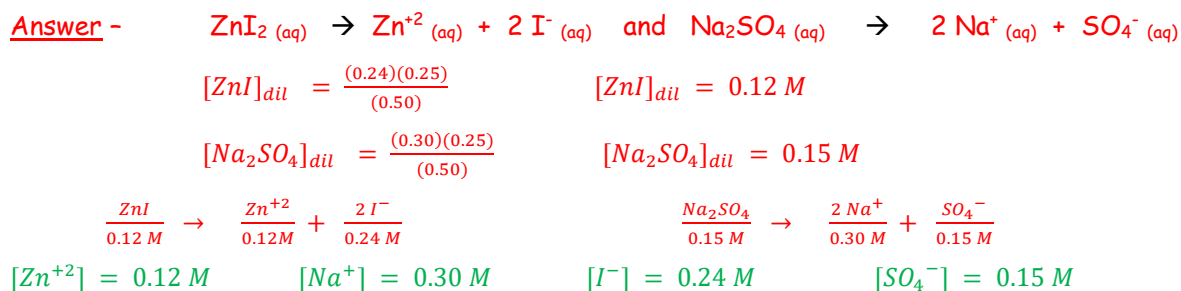
b.) Write a net ionic equation.

Answer - no net ionic.

c.) Calculate the mass of the precipitate, if a precipitate formed.

Answer - No precipitate.

d.) Calculate the concentrations of spectator ions.



27.) 200.0 mL of a 0.25 M AgNO₃ is mixed with 300.0 mL of a 0.10 M MgCl₂ solution.

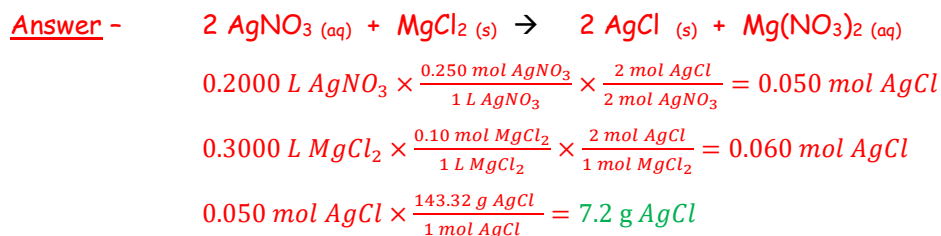
a.) Will a precipitate form? If so, what is it?

Answer - Yes, AgCl

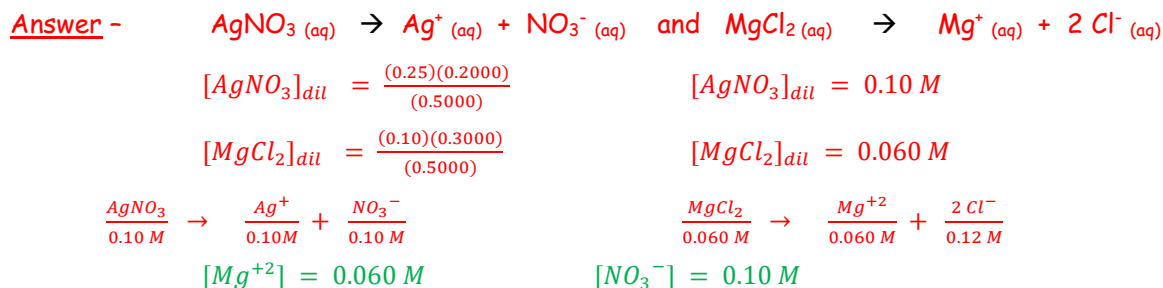
b.) Write a net ionic equation.

Answer - $\text{Ag}^+ \text{ (aq)} + \text{Cl}^- \text{ (aq)} \rightarrow \text{AgCl (s)}$

c.) Calculate the mass of the precipitate, if a precipitate formed.



d.) Calculate the concentrations of spectator ions.

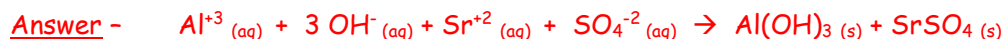


28.) 125 mL of a 0.12 M aluminum sulphate solution is added to 0.25 L of a 0.12 M strontium hydroxide solution.

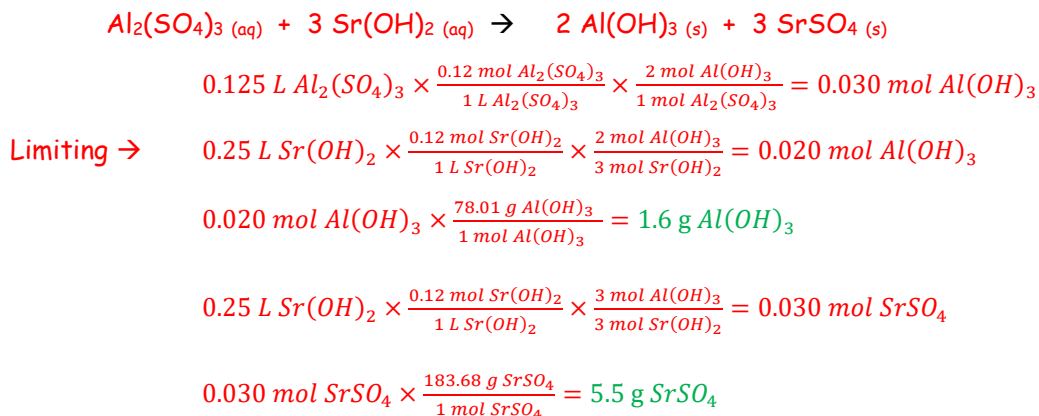
a.) Will a precipitate form? If so, what is it?

Answer - Yes, Al(OH)_3 and SrSO_4

b.) Write a net ionic equation.



c.) Calculate the mass of the precipitate, if a precipitate formed.



d.) Calculate the concentrations of spectator ions.

Answer - N/A.