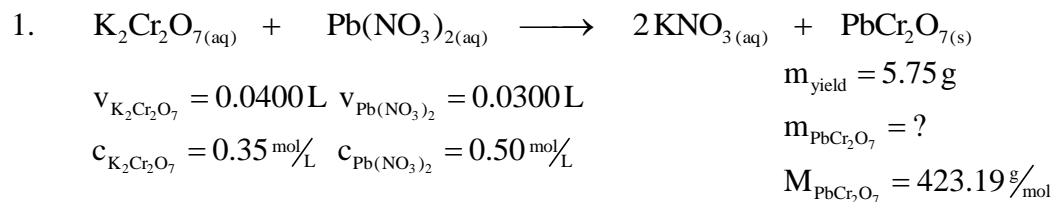


Chemistry 20 – Lesson 35
Limiting reactants – stoichiometry

/110

Practice problem



A. Find the limiting reactant.

I. calculate moles

$$n_{\text{K}_2\text{Cr}_2\text{O}_7} = 0.35 \text{ mol/L} \times 0.0400 \text{ L}$$

$$n_{\text{K}_2\text{Cr}_2\text{O}_7} = 0.014 \text{ mol}$$

$$n_{\text{Pb}(\text{NO}_3)_2} = 0.50 \text{ mol/L} \times 0.0300 \text{ L}$$

$$n_{\text{Pb}(\text{NO}_3)_2} = 0.015 \text{ mol}$$

II. mole ratios

$$\frac{n_{\text{PbCr}_2\text{O}_7}}{1} = \frac{n_{\text{K}_2\text{Cr}_2\text{O}_7}}{1}$$

$$n_{\text{PbCr}_2\text{O}_7} = 0.014 \text{ mol (LR)} \longrightarrow \boxed{m_{\text{PbCr}_2\text{O}_7} = 5.92 \text{ g}}$$

The limiting reactant is potassium dichromate.

$$\frac{n_{\text{PbCr}_2\text{O}_7}}{1} = \frac{n_{\text{Pb}(\text{NO}_3)_2}}{1}$$

$$n_{\text{PbCr}_2\text{O}_7} = \cancel{0.15 \text{ mol}}$$

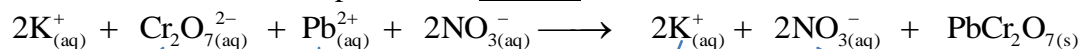
B. Calculate % error.

$$\% \text{ error} = \frac{\text{exp. yield} - \text{theo. yield}}{\text{theo. yield}} \times 100$$

$$\% \text{ error} = \frac{5.75 - 5.92}{5.92} \times 100$$

$$\boxed{\% \text{ error} = -2.9\%}$$

C. To determine the remaining ions in solution, begin with the total ionic equation and then calculate the moles of each species that remains in solution.



limiting reactant

$$n_{\text{Cr}_2\text{O}_7^{2-}} = 0$$

excess reactant

$$n_{\text{Pb}^{2+}} = 0.015 - 0.014$$

$$n_{\text{Pb}^{2+}} = 0.001 \text{ mol}$$

$$n_{\text{K}^+} = 2 \times 0.014$$

$$n_{\text{K}^+} = 0.028 \text{ mol}$$

$$n_{\text{NO}_3^-} = 2 \times 0.015$$

$$n_{\text{NO}_3^-} = 0.030 \text{ mol}$$

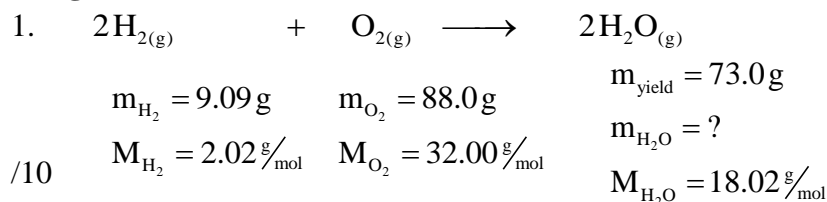
D. Calculate the concentration of each ion. Since 40.0 mL was added to 30.0 mL, the final volume is 70.0 mL.

$$[\text{K}^+_{(\text{aq})}] = \frac{0.028 \text{ mol}}{0.070 \text{ L}} = 0.40 \text{ mol/L}$$

$$[\text{NO}_3^-_{(\text{aq})}] = \frac{0.030 \text{ mol}}{0.070 \text{ L}} = 0.43 \text{ mol/L}$$

$$[\text{Pb}^{2+}_{(\text{aq})}] = \frac{0.001 \text{ mol}}{0.070 \text{ L}} = 0.0143 \text{ mol/L}$$

Assignment



A. Find the limiting reactant.

I. calculate moles

$$n_{\text{O}_2} = \frac{88.0 \text{ g}}{32.00 \text{ g/mol}}$$

$$n_{\text{O}_2} = 2.75 \text{ mol}$$

$$n_{\text{H}_2} = \frac{9.09 \text{ g}}{2.02 \text{ g/mol}}$$

$$n_{\text{H}_2} = 4.50 \text{ mol}$$

II. mole ratios

$$\frac{n_{\text{H}_2\text{O}}}{2} = \frac{n_{\text{O}_2}}{1}$$

$$\frac{n_{\text{H}_2\text{O}}}{2} = \frac{2.75 \text{ mol}}{1}$$

$$n_{\text{H}_2\text{O}} = \cancel{5.50 \text{ mol}}$$

$$\frac{n_{\text{H}_2\text{O}}}{2} = \frac{n_{\text{H}_2}}{2}$$

$$n_{\text{H}_2\text{O}} = 4.50 \text{ mol (LR)} \longrightarrow$$

III. calculate mass

$$m_{\text{H}_2\text{O}} = 4.50 \text{ mol} \times 18.02 \text{ g/mol}$$

$$\boxed{m_{\text{H}_2\text{O}} = 81.1 \text{ g}}$$

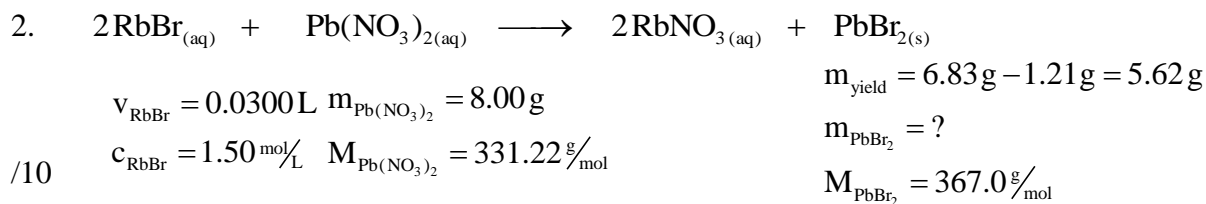
The limiting reactant is the hydrogen gas.

B. Calculate % error.

$$\% \text{ error} = \frac{\text{exp. yield} - \text{theo. yield}}{\text{theo. yield}} \times 100$$

$$\% \text{ error} = \frac{73.0 - 81.1}{81.1} \times 100$$

$$\boxed{\% \text{ error} = -10\%}$$



A. Find the limiting reactant.

I. calculate moles

$$n_{\text{RbBr}} = 1.50 \text{ mol/L} \times 0.0300 \text{ L}$$

$$n_{\text{RbBr}} = 0.0450 \text{ mol}$$

$$n_{\text{Pb}(\text{NO}_3)_2} = \frac{8.00 \text{ g}}{331.22 \text{ g/mol}}$$

$$n_{\text{Pb}(\text{NO}_3)_2} = 0.02415 \text{ mol}$$

II. mole ratios

$$\frac{n_{\text{PbBr}_2}}{1} = \frac{n_{\text{RbBr}}}{2}$$

$$\frac{n_{\text{PbBr}_2}}{1} = \frac{0.0450 \text{ mol}}{2}$$

$$n_{\text{PbBr}_2} = 0.0225 \text{ mol (LR)} \longrightarrow m_{\text{PbBr}_2} = 8.26 \text{ g}$$

The limiting reactant is rubidium bromide.

$$\frac{n_{\text{PbBr}_2}}{1} = \frac{n_{\text{Pb}(\text{NO}_3)_2}}{1}$$

$$n_{\text{PbBr}_2} = \cancel{0.02415 \text{ mol}}$$

III. calculate mass

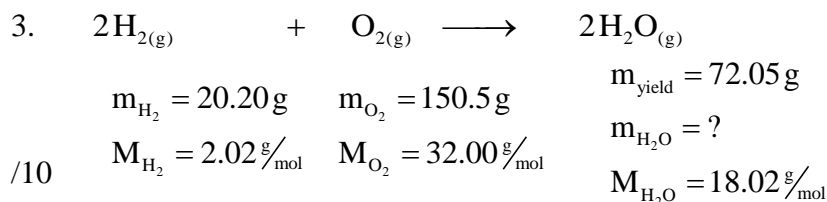
$$m_{\text{PbBr}_2} = 0.0225 \text{ mol} \times 367.0 \text{ g/mol}$$

B. Calculate % error.

$$\% \text{ error} = \frac{\text{exp. yield} - \text{theo. yield}}{\text{theo. yield}} \times 100$$

$$\% \text{ error} = \frac{5.62 - 8.26}{8.26} \times 100$$

$$\% \text{ error} = -32\%$$



A. Find the limiting reactant.

I. calculate moles

$$n_{\text{O}_2} = \frac{150.5 \text{ g}}{32.00 \text{ g/mol}}$$

$$n_{\text{O}_2} = 4.703 \text{ mol}$$

$$n_{\text{H}_2} = \frac{20.20 \text{ g}}{2.02 \text{ g/mol}}$$

$$n_{\text{H}_2} = 10.00 \text{ mol}$$

II. mole ratios

$$\frac{n_{\text{H}_2\text{O}}}{2} = \frac{n_{\text{O}_2}}{1}$$

$$\frac{n_{\text{H}_2\text{O}}}{2} = \frac{4.703 \text{ mol}}{1}$$

$$n_{\text{H}_2\text{O}} = 9.406 \text{ mol (LR)} \longrightarrow \boxed{m_{\text{H}_2\text{O}} = 169.5 \text{ g}}$$

The limiting reactant is oxygen.

$$\frac{n_{\text{H}_2\text{O}}}{2} = \frac{n_{\text{H}_2}}{2}$$

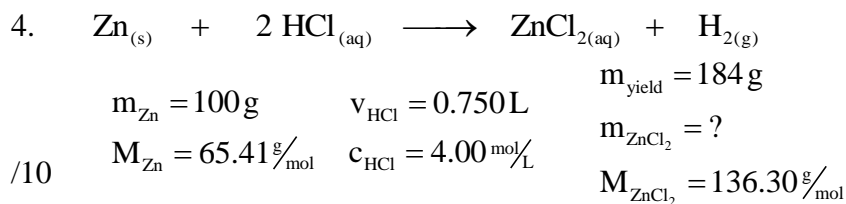
$$n_{\text{H}_2\text{O}} = \cancel{10.00 \text{ mol}}$$

B. Calculate % error.

$$\% \text{ error} = \frac{\text{exp. yield} - \text{theo. yield}}{\text{theo. yield}} \times 100$$

$$\% \text{ error} = \frac{73.0 - 169.5}{169.5} \times 100$$

$$\boxed{\% \text{ error} = -57\%}$$



A. Find the limiting reactant.

I. calculate moles

$$n_{\text{Zn}} = \frac{100 \text{ g}}{65.41 \text{ g/mol}}$$

$$n_{\text{Zn}} = 1.53 \text{ mol}$$

II. mole ratios

$$\frac{n_{\text{ZnCl}_2}}{1} = \frac{n_{\text{Zn}}}{1}$$

$$n_{\text{ZnCl}_2} = \cancel{1.53 \text{ mol}}$$

III. calculate mass

$$n_{\text{HCl}} = 4.00 \text{ mol/L} \times 0.750 \text{ L}$$

$$n_{\text{HCl}} = 3.00 \text{ mol}$$

$$\frac{n_{\text{ZnCl}_2}}{1} = \frac{n_{\text{HCl}}}{2}$$

$$\frac{n_{\text{ZnCl}_2}}{1} = \frac{3.00 \text{ mol}}{2}$$

$$n_{\text{ZnCl}_2} = 1.50 \text{ mol (LR)} \longrightarrow$$

$$m_{\text{ZnCl}_2} = 1.50 \text{ mol} \times 136.30 \text{ g/mol}$$

$$\boxed{m_{\text{ZnCl}_2} = 204 \text{ g}}$$

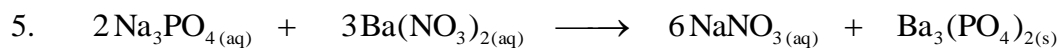
The limiting reactant is hydrochloric acid.

B. Calculate % error.

$$\% \text{ error} = \frac{\text{exp. yield} - \text{theo. yield}}{\text{theo. yield}} \times 100$$

$$\% \text{ error} = \frac{184 - 204}{204} \times 100$$

$$\boxed{\% \text{ error} = -9.8\%}$$



$$V_{\text{Na}_3\text{PO}_4} = 0.200\text{L} \quad V_{\text{Ba}(\text{NO}_3)_2} = 0.400\text{L}$$

$$/10 \quad c_{\text{Na}_3\text{PO}_4} = 0.500\text{ mol/L} \quad c_{\text{Ba}(\text{NO}_3)_2} = 0.500\text{ mol/L}$$

$$m_{\text{yield}} = 25.6\text{g}$$

$$m_{\text{Ba}_3(\text{PO}_4)_2} = ?$$

$$M_{\text{Ba}_3(\text{PO}_4)_2} = 601.93\text{ g/mol}$$

A. Find the limiting reactant.

I. calculate moles

II. mole ratios

III. calculate mass

$$n_{\text{Na}_3\text{PO}_4} = 0.500\text{ mol/L} \times 0.200\text{L}$$

$$\frac{n_{\text{Ba}_3(\text{PO}_4)_2}}{1} = \frac{n_{\text{Na}_3\text{PO}_4}}{2}$$

$$n_{\text{Na}_3\text{PO}_4} = 0.100\text{ mol}$$

$$\frac{n_{\text{Ba}_3(\text{PO}_4)_2}}{1} = \frac{0.100\text{ mol}}{2}$$

$$m_{\text{Ba}_3(\text{PO}_4)_2} = 0.0500\text{ mol} \times 601.93\text{ g/mol}$$

$$n_{\text{Ba}_3(\text{PO}_4)_2} = 0.0500\text{ mol (LR)} \longrightarrow \boxed{m_{\text{Ba}_3(\text{PO}_4)_2} = 30.1\text{g}}$$

The limiting reactant is sodium phosphate.

$$n_{\text{Ba}(\text{NO}_3)_2} = 0.500\text{ mol/L} \times 0.400\text{L} \quad \frac{n_{\text{Ba}_3(\text{PO}_4)_2}}{1} = \frac{n_{\text{Ba}(\text{NO}_3)_2}}{3}$$

$$n_{\text{Ba}(\text{NO}_3)_2} = 0.200\text{ mol} \quad \frac{n_{\text{Ba}_3(\text{PO}_4)_2}}{1} = \frac{0.200\text{ mol}}{3}$$

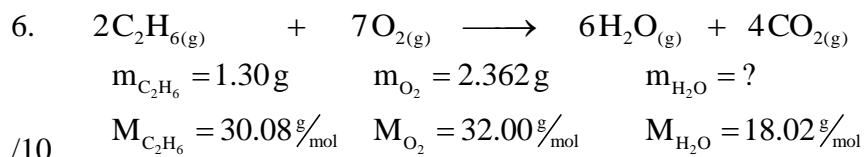
$$n_{\text{Ba}_3(\text{PO}_4)_2} = \cancel{0.0667\text{ mol}}$$

B. Calculate % error.

$$\% \text{ error} = \frac{\text{exp. yield} - \text{theo. yield}}{\text{theo. yield}} \times 100$$

$$\% \text{ error} = \frac{25.6 - 30.1}{30.1} \times 100$$

$$\boxed{\% \text{ error} = -15\%}$$



A. Find the limiting reactant.

I. calculate moles

$$n_{\text{O}_2} = \frac{2.362 \text{ g}}{32.00 \text{ g/mol}}$$

$$n_{\text{O}_2} = 0.07381 \text{ mol}$$

II. mole ratios

$$\frac{n_{\text{H}_2\text{O}}}{6} = \frac{n_{\text{O}_2}}{7}$$

$$\frac{n_{\text{H}_2\text{O}}}{6} = \frac{0.07381 \text{ mol}}{7}$$

$$n_{\text{H}_2\text{O}} = 0.06327 \text{ mol}(\mathbf{LR}) \longrightarrow$$

III. calculate mass

$$m_{\text{H}_2\text{O}} = 0.06327 \text{ mol} \times 18.02 \text{ g/mol}$$

$$m_{\text{H}_2\text{O}} = 1.14 \text{ g}$$

The limiting reactant is the oxygen gas.

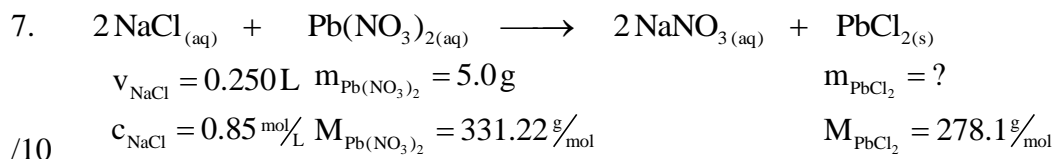
$$n_{\text{C}_2\text{H}_6} = \frac{1.30 \text{ g}}{30.08 \text{ g/mol}}$$

$$n_{\text{C}_2\text{H}_6} = 0.0432 \text{ mol}$$

$$\frac{n_{\text{H}_2\text{O}}}{6} = \frac{n_{\text{C}_2\text{H}_6}}{2}$$

$$\frac{n_{\text{H}_2\text{O}}}{6} = \frac{0.0432 \text{ mol}}{2}$$

$$n_{\text{H}_2\text{O}} = \cancel{0.130 \text{ mol}}$$



A. Find the limiting reactant.

I. calculate moles

$$n_{\text{NaCl}} = 0.85\text{ mol/L} \times 0.250\text{ L}$$

$$n_{\text{NaCl}} = 0.21\text{ mol}$$

$$n_{\text{Pb}(\text{NO}_3)_2} = \frac{5.00\text{ g}}{331.22\text{ g/mol}}$$

$$n_{\text{Pb}(\text{NO}_3)_2} = 0.015\text{ mol}$$

II. mole ratios

$$\frac{n_{\text{PbCl}_2}}{1} = \frac{n_{\text{NaCl}}}{2}$$

$$\frac{n_{\text{PbCl}_2}}{1} = \frac{0.21\text{ mol}}{2}$$

$$n_{\text{PbCl}_2} = \cancel{0.106\text{ mol}}$$

$$\frac{n_{\text{PbCl}_2}}{1} = \frac{n_{\text{Pb}(\text{NO}_3)_2}}{1}$$

$$n_{\text{PbCl}_2} = 0.015\text{ mol}(\text{LR}) \longrightarrow \boxed{m_{\text{PbCl}_2} = 4.2\text{ g}}$$

III. calculate mass

$$m_{\text{PbCl}_2} = 0.015\text{ mol} \times 278.1\text{ g/mol}$$

The limiting reactant is lead (II) nitrate.

B. Since $\text{Pb}(\text{NO}_3)_2$ is the limiting reactant, all of it would have reacted with the NaCl . Therefore, **sodium chloride remains**. To determine the amount of remaining NaCl we must first calculate the amount of NaCl that reacted with the lead (II) nitrate.

$$\frac{n_{\text{NaCl}}}{2} = \frac{n_{\text{Pb}(\text{NO}_3)_2}}{1}$$

$$\frac{n_{\text{NaCl}}}{2} = \frac{0.015\text{ mol}}{1}$$

$$n_{\text{NaCl}} = 0.030\text{ mol}$$

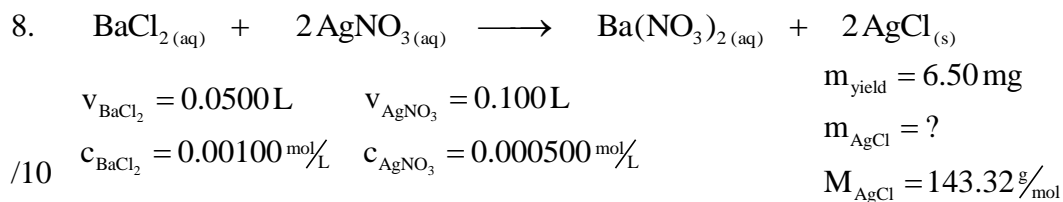
Subtracting the amount reacted from what was initially present we get the amount of NaCl remaining.

$$n_{\text{NaCl remaining}} = 0.21\text{ mol} - 0.030\text{ mol} = 0.18\text{ mol}$$

Now calculate mass

$$m_{\text{NaCl remaining}} = 0.18\text{ mol} \times 58.44\text{ g/mol}$$

$$\boxed{m_{\text{NaCl remaining}} = 10.7\text{ g}}$$



A. Find the limiting reactant.

I. calculate moles

II. mole ratios

III. calculate mass

$$n_{\text{BaCl}_2} = 0.00100\text{mol/L} (0.0500\text{L}) \frac{n_{\text{AgCl}}}{2} = \frac{n_{\text{BaCl}_2}}{1}$$

$$n_{\text{BaCl}_2} = 5.00 \times 10^{-5}\text{mol} \quad \frac{n_{\text{AgCl}}}{2} = \frac{5.00 \times 10^{-5}\text{mol}}{1}$$

$$n_{\text{AgCl}} = \cancel{1.00 \times 10^{-4}\text{mol}}$$

$$n_{\text{AgNO}_3} = 0.000500\text{mol/L} (0.100\text{L}) \frac{n_{\text{AgCl}}}{2} = \frac{n_{\text{AgNO}_3}}{2}$$

$$m_{\text{AgCl}} = 5.00 \times 10^{-5}\text{mol} \times 143.32\text{g/mol}$$

$$n_{\text{AgNO}_3} = 5.00 \times 10^{-4}\text{mol}$$

$$n_{\text{AgCl}} = 5.00 \times 10^{-5}\text{mol} (\mathbf{LR}) \longrightarrow m_{\text{AgCl}} = 7.17 \times 10^{-3}\text{g or } 7.17\text{mg}$$

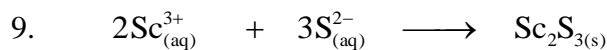
The limiting reactant is silver nitrate.

B. Calculate % error.

$$\% \text{ error} = \frac{\text{exp. yield} - \text{theo. yield}}{\text{theo. yield}} \times 100$$

$$\% \text{ error} = \frac{6.5 - 7.17}{7.17} \times 100$$

$$\% \text{ error} = -9.3\%$$



$$v_{\text{Sc}_{(\text{aq})}^{3+}} = 0.100\text{L} \quad v_{\text{S}_{(\text{aq})}^{2-}} = 0.100\text{L}$$

$$/10 \quad c_{\text{Sc}_{(\text{aq})}^{3+}} = 0.150 \text{ mol/L} \quad c_{\text{S}_{(\text{aq})}^{2-}} = 0.250 \text{ mol/L}$$

$$m_{\text{yield}} = 1.30 \text{ g}$$

$$m_{\text{Sc}_2\text{S}_3} = ?$$

$$M_{\text{Sc}_2\text{S}_3} = 186.13 \text{ g/mol}$$

A. Find the limiting reactant.

I. calculate moles

II. mole ratios

III. calculate mass

$$n_{\text{Sc}_{(\text{aq})}^{3+}} = 0.150 \text{ mol/L} (0.100\text{L})$$

$$\frac{n_{\text{Sc}_2\text{S}_3}}{1} = \frac{n_{\text{Sc}_{(\text{aq})}^{3+}}}{2}$$

$$n_{\text{Sc}_{(\text{aq})}^{3+}} = 0.0150 \text{ mol}$$

$$\frac{n_{\text{Sc}_2\text{S}_3}}{1} = \frac{0.0150 \text{ mol}}{2}$$

$$m_{\text{Sc}_2\text{S}_3} = 0.0075 \text{ mol} \times 186.13 \text{ g/mol}$$

$$n_{\text{Sc}_2\text{S}_3} = 0.0075 \text{ mol} (\mathbf{LR}) \longrightarrow \boxed{m_{\text{Sc}_2\text{S}_3} = 1.40 \text{ g}}$$

The limiting reactant is the scandium ions.

$$n_{\text{S}_{(\text{aq})}^{2-}} = 0.250 \text{ mol/L} (0.100\text{L})$$

$$\frac{n_{\text{Sc}_2\text{S}_3}}{1} = \frac{n_{\text{S}_{(\text{aq})}^{2-}}}{3}$$

$$n_{\text{S}_{(\text{aq})}^{2-}} = 0.0250 \text{ mol}$$

$$\frac{n_{\text{Sc}_2\text{S}_3}}{1} = \frac{0.0250 \text{ mol}}{3}$$

$$n_{\text{Sc}_2\text{S}_3} = \cancel{0.0083 \text{ mol}}$$

B. Calculate % error.

$$\% \text{ error} = \frac{\text{exp. yield} - \text{theo. yield}}{\text{theo. yield}} \times 100$$

$$\% \text{ error} = \frac{1.30 - 1.40}{1.40} \times 100$$

$$\boxed{\% \text{ error} = -6.9\%}$$

C. Since Sc^{3+} is the limiting reactant, all of it would have reacted with the S^{2-} . Therefore, S^{2-} **remains**. To determine the concentration of the remaining S^{2-} we must first calculate the amount of S^{2-} that reacted with the Sc^{3+} .

$$\frac{n_{\text{S}_{(\text{aq})}^{2-}}}{3} = \frac{n_{\text{Sc}_{(\text{aq})}^{3+}}}{2}$$

$$\frac{n_{\text{S}_{(\text{aq})}^{2-}}}{3} = \frac{0.0075 \text{ mol}}{2}$$

$$n_{\text{S}_{(\text{aq})}^{2-}} = 0.01125 \text{ mol}$$

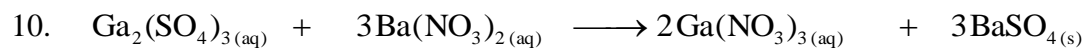
Subtracting the amount reacted from what was initially present we get:

$$n_{\text{S}_{(\text{aq})}^{2-} \text{ remaining}} = 0.0250 \text{ mol} - 0.01125 \text{ mol} = 0.01375 \text{ mol}$$

Now calculate concentration

$$[\text{S}_{(\text{aq})}^{2-}] = \frac{0.01375 \text{ mol}}{0.100\text{L} + 0.100\text{L}}$$

$$\boxed{[\text{S}_{(\text{aq})}^{2-}] = 0.0688 \text{ mol/L}}$$



$$v_{\text{Ga}_2(\text{SO}_4)_3} = 0.0150\text{L} \quad v_{\text{Ba}(\text{NO}_3)_2} = 0.0250\text{L} \quad m_{\text{BaSO}_4} = ?$$

$$/10 \quad c_{\text{Ga}_2(\text{SO}_4)_3} = 0.250 \text{ mol/L} \quad c_{\text{Ba}(\text{NO}_3)_2} = 0.140 \text{ mol/L} \quad M_{\text{BaSO}_4} = 233.40 \text{ g/mol}$$

A. Find the limiting reactant and the mass of the precipitate.

I. calculate moles

II. mole ratios

III. calculate mass

$$n_{\text{Ga}_2(\text{SO}_4)_3} = 0.250 \text{ mol/L} (0.0150\text{L})$$

$$\frac{n_{\text{BaSO}_4}}{3} = \frac{n_{\text{Ga}_2(\text{SO}_4)_3}}{1}$$

$$n_{\text{Ga}_2(\text{SO}_4)_3} = 0.00375 \text{ mol}$$

$$\frac{n_{\text{BaSO}_4}}{3} = \frac{0.00375 \text{ mol}}{1}$$

$$n_{\text{BaSO}_4} = \cancel{0.01125 \text{ mol}}$$

$$n_{\text{Ba}(\text{NO}_3)_2} = 0.140 \text{ mol/L} (0.0250\text{L})$$

$$\frac{n_{\text{BaSO}_4}}{3} = \frac{n_{\text{Ba}(\text{NO}_3)_2}}{3}$$

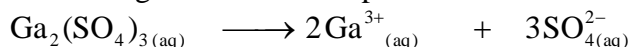
$$m_{\text{BaSO}_4} = 0.00350 \text{ mol} \times 233.40 \text{ g/mol}$$

$$n_{\text{Ba}(\text{NO}_3)_2} = 0.00350 \text{ mol}$$

$$n_{\text{BaSO}_4} = 0.00350 \text{ mol} (\mathbf{LR}) \longrightarrow m_{\text{BaSO}_4} = 0.817 \text{ g}$$

The limiting reactant is barium nitrate.

B. Since the gallium ions are spectator ions:



$$\frac{n_{\text{Ga}^{3+}(\text{aq})}}{2} = \frac{n_{\text{Ga}_2(\text{SO}_4)_3}}{1}$$

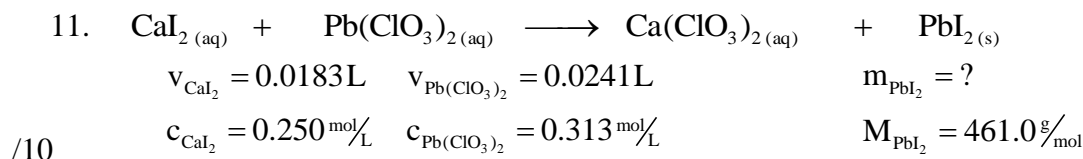
$$n_{\text{Ga}^{3+}(\text{aq})} = 2 \times 0.00375 \text{ mol}$$

$$n_{\text{Ga}^{3+}(\text{aq})} = 0.00750 \text{ mol}$$

$$\left[\text{Ga}^{3+}(\text{aq}) \right] = \frac{n_{\text{Ga}^{3+}(\text{aq})}}{v} = \frac{0.00750 \text{ mol}}{0.0150\text{L} + 0.0250\text{L}}$$

$$\left[\text{Ga}^{3+}(\text{aq}) \right] = 0.188 \text{ mol/L}$$

C. Since all the barium ions reacted to form the precipitate, the remaining concentration of barium ions in solution is zero.



A. Find the limiting reactant and the mass of the precipitate.

I. calculate moles

II. mole ratios

III. calculate mass

$$n_{\text{Pb}(\text{ClO}_3)_2} = 0.313\text{ mol/L} (0.0241\text{L})$$

$$\frac{n_{\text{PbI}_2}}{1} = \frac{n_{\text{Pb}(\text{ClO}_3)_2}}{1}$$

$$n_{\text{Pb}(\text{ClO}_3)_2} = 0.0075433\text{ mol}$$

$$n_{\text{PbI}_2} = \cancel{0.0075433\text{ mol}}$$

$$n_{\text{CaI}_2} = 0.250\text{ mol/L} (0.0183\text{L})$$

$$\frac{n_{\text{PbI}_2}}{1} = \frac{n_{\text{CaI}_2}}{1}$$

$$m_{\text{PbI}_2} = 0.004575\text{ mol} \times 461.0\text{ g/mol}$$

$$n_{\text{CaI}_2} = 0.004575\text{ mol}$$

$$n_{\text{PbI}_2} = 0.004575\text{ mol}(\text{LR}) \longrightarrow \boxed{m_{\text{PbI}_2} = 2.11\text{g}}$$

The limiting reactant is calcium iodide.

B. To determine the concentration of the remaining Pb^{2+} we must first calculate the amount of $\text{Pb}(\text{ClO}_3)_2$ that reacted with the CaI_2 .

$$\frac{n_{\text{Pb}(\text{ClO}_3)_2 \text{ reacted}}}{1} = \frac{n_{\text{CaI}_2}}{1}$$

Subtracting the amount reacted from what was initially present we get:

$$n_{\text{Pb}(\text{ClO}_3)_2 \text{ reacted}} = 0.004575\text{ mol}$$

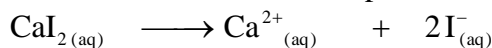
$$n_{\text{Pb}(\text{ClO}_3)_2 \text{ remaining}} = 0.0075433\text{ mol} - 0.004575\text{ mol} = 0.00297\text{ mol}$$

Now calculate concentration

$$[\text{Pb}_{(\text{aq})}^{2+}] = \frac{0.00297\text{ mol}}{0.0183\text{L} + 0.0241\text{L}}$$

$$\boxed{[\text{Pb}_{(\text{aq})}^{2+}] = 0.0700\text{ mol/L}}$$

C. Since the calcium ions are spectator ions:



$$\frac{n_{\text{Ca}^{2+}_{(\text{aq})}}}{1} = \frac{n_{\text{CaI}_2}}{1}$$

$$n_{\text{Ca}^{2+}_{(\text{aq})}} = 0.004575\text{ mol}$$

$$[\text{Ca}^{2+}_{(\text{aq})}] = \frac{n_{\text{Ca}^{2+}_{(\text{aq})}}}{v} = \frac{0.004575\text{ mol}}{0.0183\text{L} + 0.0241\text{L}}$$

$$\boxed{[\text{Ca}^{2+}_{(\text{aq})}] = 0.108\text{ mol/L}}$$