

Gravimetric Analysis, Redox and Titration Problems

- 1) When a sample of impure potassium chloride (0.4500g) was dissolved in water and treated with an excess of silver nitrate, 0.8402 g of silver chloride was precipitated. Calculate the percentage KCl in the original sample.

	NEED (+)		HAVE (-)	
	KCl_(aq)	+ Ag(NO₃)_(aq)	→	AgCl_(s) K(NO₃)_(aq)
Molarity or MM	74.5 g/mol			143 g/mol
Amount				0.8402g
Moles Gram/ MM or Molarity x L				0.0059 mol
Moles/rxn (divide moles by SC)				0.0059 mol
React (Least Mol/ Rxn)	+0.0059 mol			-0.0059 mol
Final Mole/ Rxn	0.0059 mol			0
Final Moles (SC x final mol/ rxn)	0.0059mol			0
Final Amt (final moles x MM) or Concentration (final mols/ total volume)	0.0059 mol x 74.5 g/mol = 0.440g			

$$\text{Percent Purity} = \frac{\text{Pure}}{\text{Impure}} \times 100 = \frac{0.440\text{g}}{0.450\text{g}} \times 100 = 97.78\%$$

- 2) Calculate the percent purity of a sample of Mg(OH)₂ if titration of 2.568 g of the sample required 38.45 mL of 0.6695 M H₃PO₄.

	NEED (+)	HAVE (-)		
	3 Mg(OH)_{2(aq)}	+ 2 H₃PO_{4(aq)}	→	Mg₃(PO₄)_{2(s)} + 6H₂O_(l)
Molarity or MM	58 g/mol	0.6695 mol/ L		
Amount	?	0.03845 L		
Moles Gram/ MM or Molarity x L		0.0257 mol		
Moles/rxn (divide moles by SC)		0.0129 mol		
React (Least Mol/ Rxn)	+0.0129 mol	-0.0129 mol		
Final Mole/ Rxn	0.00129	0		
Final Moles (SC x final mol/ rxn)	0.0386 mol			
Final Amt (final moles x MM) or Concentration (final mols/ total volume)	2.24g			

$$\text{Percent Purity} = \frac{\text{Pure}}{\text{Impure}} \times 100 = \frac{2.24\text{g}}{2.568\text{g}} \times 100 = 87.23\%$$

3) If 19g of BaCl₂(aq) is mixed with 42g of Na₂SO₄(aq) in 250 mL of water, what is the resulting precipitate and the mass of the precipitate and what is the concentration of all ions left in solution?

	BaCl ₂ (aq)	+ Na ₂ (SO ₄) _(aq)	→	Ba(SO ₄) _(s)	+ 2NaCl _(aq)
Molarity or MM	208.3 g/mol	142 g/mol		233.4 g/mol	58.5 g/mol
Amount	19	42			
Moles Gram/ MM or Molarity x L	0.0912 mol	0.296 mol			
Moles/rxn (divide moles by SC)	0.0912 mol	0.296 mol			
React (Least Mol/ Rxn)	-0.0912 mol	-0.0912 mol		+0.0912 mol	+0.0912 mol
Final Mole/ Rxn	0	0.205 mol		0.0912 mol	0.0912 mol
Final Moles (SC x final mol/ rxn)	0	0.205 mol		0.0912 mol	0.182 mol
Final Amt (final moles x MM) or Concentration (final mols/ total volume)	0	<u>0.205 mol</u> 0.25 L = 0.82 mol Na ₂ SO ₄ / L		21.29g	<u>0.182 mol</u> 0.25 L = 0.73 mol NaCl / L

Mass = 21.29 g BaSO₄

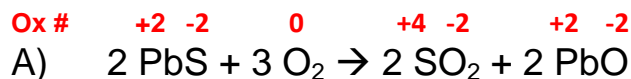
Concentrations

Ba²⁺ = 0 is part of the limiting reagent

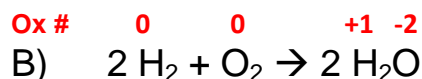
$$\text{Na}^+ = \frac{0.82 \text{ mol Na}_2\text{SO}_4}{1 \text{ L}} \times \frac{2 \text{ mol Na}^+}{1 \text{ mol Na}_2\text{SO}_4} = 0.164 \text{ M} + \frac{0.73 \text{ mol NaCl}}{1 \text{ L}} \times \frac{1 \text{ mol Na}^+}{1 \text{ mol NaCl}} = 0.073 \text{ M} = 0.237 \text{ M}$$

$$\text{Cl}^- = \frac{0.73 \text{ mol NaCl}}{1 \text{ L}} \times \frac{1 \text{ mol Cl}^-}{1 \text{ mol NaCl}} = 0.073 \text{ M}$$

4) In each of the following equations, indicate the element that has been oxidized and the one that has been reduced. You should also label the oxidation state of each before and after the process:



S goes from a -2 to a +4 which means it's getting more positive or being oxidized and is the "reducing agent"
O goes from a 0 to a -2 which means it's getting more negative or being reduced and is the "oxidizing agent"



H goes from a 0 to a +1 which means it's getting more positive or being oxidized and is the "reducing agent"
O goes from a 0 to a -2 which means it's getting more negative or being reduced and is the "oxidizing agent"

5) When aqueous solutions, like AgF and Sr(NO₃)₂ combine, the precipitate, SrF₂ forms. Calculate the mass of the precipitate formed if 3.0L of 6.0M AgF and 12.0L of 0.10M Sr(NO₃)₂ are mixed. Also, give the concentration of all ions in solution.

	2 AgF_(aq)	+ Sr(NO₃)_{2(aq)}	→	SrF_{2(s)}	+ 2Ag(NO₃)_(aq)
Molarity or MM	6 mol/ L	1 mol/ L		125.6 g/mol	
Amount	3 L	12			
Moles Gram/ MM or Molarity x L	18 mol	12 mol			
Moles/rxn (divide moles by SC)	9 mol	12 mol			
React (Least Mol/ Rxn)	-9	-9 mol		+9 mol	+9 mol
Final Mole/ Rxn	0	3 mol		9 mol	9 mol
Final Moles (SC x final mol/ rxn)	0	3 mol		9 mol	18 mol
Final Amt (final moles x MM) or Concentration (final mols/ total volume)	0	<u>3 mol</u> 15 L = 0.2 mol Sr(NO₃)₂ / L		1130.4 g	<u>18 mol</u> 15 L = 1.2 mol Ag(NO₃) / L

Mass = 1130.4 g SrF₂

Concentrations

F⁻ = 0 is part of the limiting reagent

$$\text{NO}_3^- = \frac{0.2 \text{ mol Sr(NO}_3)_2}{1 \text{ L}} \times \frac{2 \text{ mol NO}_3^-}{1 \text{ mol Sr(NO}_3)_2} = 0.4 \text{ M} + \frac{1.2 \text{ mol Ag(NO}_3)}{1 \text{ L}} \times \frac{1 \text{ mol NO}_3^-}{1 \text{ mol Ag(NO}_3)} = 1.2 \text{ M} = 1.6 \text{ M}$$

$$\text{Ag}^+ = \frac{1.2 \text{ mol Ag(NO}_3)}{1 \text{ L}} \times \frac{1 \text{ mol Ag}^+}{1 \text{ mol Ag(NO}_3)} = 1.2 \text{ M}$$