Key

Honors Solutions Stoichiometry

1. What volume (in mL) of 0.25 M Na_2SO_4 solution is needed to precipitate all the barium, as $BaSO_4(s)$ from 12.5 mL of 0.15 M $Ba(NO_3)_2$ solution?

1 L = 1000 mL

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

$Ba(NO_3)_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaNO_3$

.15 M .25 M

12.5 mL V = ?

mol ratio

$$.15\ mol\ Ba(NO_3)_2 / L \;/\; 12.5\ mL \;/\; 1\ L / 1000\ mL \;/\; 1\ mol\ Na_2SO_4 / 1\ mol\ Ba(NO_3)_2 \;/\; L / .25\ mol = .0075\ L \text{ or } 7.5\ mL \text{ of } .25\ M\ Na_2SO_4$$

(molarity; molarity)

2. If 36.2 mL of 0.158 M $CaCl_2$ solution is added to 37.5 mL of 0.149 M Na_2CO_3, what mass of calcium carbonate, $CaCO_3$, will be precipitated? The reaction is ...

"LIMITED" Reaction

100.1 g/mol (.1 pt)

$CaCl_2 + Na_2CO_3 \rightarrow CaCO_3 + 2NaCl$

.158 M .149 M ? g

36.2 mL 35.5 mL

$$.158\ mol\ CaCl_2 / L \;/\; 36.2\ mL \;/\; 1\ L / 1000\ mL \;/\; 1\ mol\ CaCO_3 / 1\ mol\ CaCl_2 = .005719\ mol\ CaCO_3$$

$$.149\ mol\ Na_2CO_3 / L \;/\; 37.5\ mL \;/\; 1\ L / 1000\ mL \;/\; 1\ mol\ CaCO_3 / 1\ mol\ Na_2CO_3 = .0055875\ mol \;/\; 100.1\ g/mol = .559\ g\ CaCO_3$$

(smaller)

3. If 200.0 mL of 6.00 M $AgNO_3$ solution is combined with 500.0 mL of 2.00 M NaCl solution, what mass of solid AgCl is formed?

"LIMITED"

143.4 g/mol (.1 pt)

$NaCl_{(aq)} + AgNO_{3(aq)} \rightarrow AgCl_{(s)} + NaNO_{3(aq)}$

2.00 M 6.00 M ? g

500.0 mL 200.0 mL

$$2.00\ mol\ NaCl / L \;/\; 500.0\ mL \;/\; 1\ L / 1000\ mL \;/\; 1\ mol\ AgCl / 1\ mol\ NaCl = 1.002\ mol \;/\; 143.4\ g/mol = 143\ g\ AgCl$$

(smaller)

$$6.00\ mol\ AgNO_3 / L \;/\; 200.0\ mL \;/\; 1\ L / 1000\ mL \;/\; 1\ mol\ AgCl / 1\ mol\ AgNO_3 = 1.200\ mol$$

142.1 g/mol (.1 PT)
? g 12.5 mL
.150 M

$$Na_2SO_4 + Ba(NO_3)_2 \rightarrow BaSO_4 + 2\,NaNO_3$$

4. What mass (in grams) of solid sodium sulfate would need to be added to 12.5 mL of 0.150 M barium nitrate solution to precipitate all of the barium as the compound barium sulfate.

Need to match the moles of Na_2SO_4 with $Ba(NO_3)_2$

$$\frac{.150\ \text{mol}\ Ba(NO_3)_2}{L} \Big/ \frac{12.5\ mL}{1000\ mL} \Big/ \frac{1\ L}{1\ \text{mol}\ Ba(NO_3)_2} \Big/ \frac{1\ \text{mol}\ Na_2SO_4}{142.1\ g} = .226\ g\ Na_2SO_4$$

5. When a solution of lead (II) nitrate reacts with a potassium chromate solution a solid product, lead (II) chromate, forms according to the equation below.

If 2.54 g of $PbCrO_4$ forms from the mixing of 39.3 mL of 0.200 M K_2CrO_4 and 96.5 mL of the lead (II) nitrate solution, calculate the molarity of the lead (II) nitrate solution (assume both reactants will run-out simultaneously).

Balance!

$$Pb(NO_3)_2 + K_2CrO_4 \rightarrow PbCrO_4 + 2KNO_3$$

? M .200 M 2.54 g
96.5 mL 39.3 mL

$$\frac{.200\ \text{mol}\ K_2CrO_4}{L} \Big/ .0393\ L \Big/ \frac{1\ \text{mol}\ Pb(NO_3)_2}{1\ \text{mol}\ K_2CrO_4} \Big/ .0965\ L = .0815\ \frac{\text{mol}\ Pb(NO_3)_2}{L} = .0815\ M$$

6. A) How many grams of $Ba(NO_3)_2$ are required to precipitate all the sulfate ion present in 15.3 mL of 0.139 M sulfuric acid solution?

261.3 g/mol
$Ba(NO_3)_2$ + H_2SO_4 → $BaSO_4$ + 2 HNO_3
g? .139 M
.0153 L

$$\frac{.139\ \text{mol}\ H_2SO_4}{L} \Big/ .0153\ L \Big/ \frac{1\ \text{mol}\ Ba(NO_3)_2}{1\ \text{mol}\ H_2SO_4} \Big/ \frac{261.3\ g}{\text{mol}} = .556\ g\ Ba(NO_3)_2$$

B) Calculate the number of moles of all the remaining ions left in solution.

$$\frac{.139\ \text{mol}}{L} / .0153\ L = .002126\ \text{moles of}\ H_2SO_4$$

$2H^+$s + $(NO_3)_2$ $= \frac{.0042534\ \text{mols}}{.0153} = .278\ M\ H^+$

C) Calculate the concentration in M of all the remaing ions left in solution.

NO_3^- $M = .278$

H^+ $M = .278^2$

(Note: 2X molarity of the $Ba(NO_3)_2$)