WKS
Solution Stoichiometry I

Name Answer Key
Period _____

1. How many mL of 0.25 M $Ca(OH)_2$ are needed to completely react with 10.0 mL of 0.25 M HCl? The balanced reaction is:

$$2HCl(aq) + Ca(OH)_2(aq) \rightarrow CaCl_2(aq) + 2H_2O(l)$$

$$?\ mL\ Ca(OH)_2 = 10.0\ \cancel{mL\ HCl} \times \frac{0.25\ \cancel{mol\ HCl}}{1000\ \cancel{mL\ HCl}} \times \frac{1\ \cancel{mol\ Ca(OH)_2}}{2\ \cancel{mol\ HCl}} \times \frac{1000\ mL\ Ca(OH)_2}{0.25\ \cancel{mol\ Ca(OH)_2}}$$

$0.0025\ mol\ HCl$ | $0.00125\ mol\ Ca(OH)_2$

$$= \boxed{5.00\ mL\ Ca(OH)_2}$$

2. What volume of 0.325 M Na_3PO_4 would be needed to fully react with 25.0 mL of 0.480 M $BaCl_2$ by the following balanced reaction?

$$2Na_3PO_4(aq) + 3BaCl_2(aq) \rightarrow 6NaCl(aq) + Ba_3(PO_4)_2(s)$$

$$?\ mL\ Na_3PO_4 = 25.0\ \cancel{mL\ BaCl_2} \times \frac{0.480\ \cancel{mol\ BaCl_2}}{1000\ \cancel{mL\ BaCl_2}} \times \frac{2\ \cancel{mol\ Na_3PO_4}}{3\ \cancel{mol\ BaCl_2}} \times \frac{1000\ mL\ Na_3PO_4}{0.325\ \cancel{mol\ Na_3PO_4}}$$

$0.0120\ mol\ BaCl_2$ | $0.00800\ mol\ Na_3PO_4$

$$= \boxed{24.6\ mL\ Na_3PO_4}$$

3. Calculate the volume of 0.2250 M $HC_2H_3O_2$ (acetic acid) solution needed to neutralize (use up) 25.19 mL of 0.4295 M NaOH in the following balanced reaction.

$$HC_2H_3O_2(aq) + NaOH(aq) \rightarrow NaC_2H_3O_2(aq) + H_2O(l)$$

$$?\ mL\ HC_2H_3O_2 = 25.19\ \cancel{mL\ NaOH} \times \frac{0.4295\ \cancel{mol\ NaOH}}{1000\ \cancel{mL\ NaOH}} \times \frac{1\ \cancel{mol\ HC_2H_3O_2}}{1\ \cancel{mol\ NaOH}} \times \frac{1000\ mL\ HC_2H_3O_2}{0.2250\ \cancel{mol\ HC_2H_3O_2}}$$

$0.01082\ mol\ NaOH$ | $0.01082\ mol\ HC_2H_3O_2$

$$= \boxed{48.08\ mL\ HC_2H_3O_2}$$

4. How many mL of 0.120 *M* $Pb(NO_3)_2$ are required to react with 75.0 mL of 0.280 *M* NaI according to the following equation? You must balance the equation first!

$$\_\_\_\ Pb(NO_3)_2\ (aq) + \_2\_\ NaI\ (aq) \rightarrow \_\_\_\ PbI_2\ (s) + \_2\_\ NaNO_3\ (aq)$$

$$?\ mL\ Pb(NO_3)_2 = 75.0\ mL\ NaI \times \frac{0.280\ mol\ NaI}{1000\ mL\ NaI} \times \frac{1\ mol\ Pb(NO_3)_2}{2\ mol\ NaI} \times \frac{1000\ mL\ Pb(NO_3)_2}{0.120\ mol\ Pb(NO_3)_2}$$

$0.0210\ mol\ NaI$ | $0.0105\ mol\ Pb(NO_3)_2$

$$= \boxed{87.5\ mL\ Pb(NO_3)_2}$$

5. How many mL of 0.280 M barium nitrate solution are required to fully react with 25.0 mL of 0.350 M aluminum sulfate solution to form solid barium sulfate and aluminum nitrate solution? Write and balance the reaction first.

$$3\ Ba(NO_3)_2\ (aq) + Al_2(SO_4)_3 \rightarrow 3\ BaSO_4\ (s) + 2\ Al(NO_3)_3\ (aq)$$

$$?\ mL\ Ba(NO_3)_2 = \underbrace{25.0\ mL\ Al_2(SO_4)_3 \times \frac{0.350\ mol\ Al_2(SO_4)_3}{1000\ mL\ Al_2(SO_4)_3}}_{0.00875\ mol\ Al_2(SO_4)_3} \times \underbrace{\frac{3\ mol\ Ba(NO_3)_2}{1\ mol\ Al_2(SO_4)_3}}_{0.0263\ mol\ Ba(NO_3)_2} \times \frac{1000\ mL\ Ba(NO_3)_2}{0.280\ mol\ Ba(NO_3)_2}$$

$$= \boxed{93.8\ mL\ Ba(NO_3)_2}$$

6. What volume of 0.325 M Na_3PO_4 would be needed to precipitate 25.00 g $Ba_3(PO_4)_2$ with excess $BaCl_2$ by the following balanced reaction?

$$2Na_3PO_4(aq) + 3BaCl_2(aq) \rightarrow 6NaCl(aq) + Ba_3(PO_4)_2(s)$$

$$?\ mL\ Na_3PO_4 = 25.00\ \cancel{g\ Ba_3(PO_4)_2} \times \underbrace{\frac{1\ \cancel{mol\ Ba_3(PO_4)_2}}{601.9\ \cancel{g\ Ba_3(PO_4)_2}}}_{0.04154\ mol\ Ba_3(PO_4)_2} \times \underbrace{\frac{2\ \cancel{mol\ Na_3PO_4}}{1\ \cancel{mol\ Ba_3(PO_4)_2}}}_{0.08307\ mol\ Na_3PO_4} \times \frac{1000\ mL\ Na_3PO_4}{0.325\ \cancel{mol\ Na_3PO_4}}$$

$$= \boxed{256\ mL\ Na_3PO_4\ (0.256\ L)}$$

7. How many grams of CaO are required for complete reaction with the HCl in 275 mL of a 0.523 M HCl solution? The balanced equation for the reaction is:

$$CaO(s) + 2\ HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l)$$

$$?\ g\ CaO = 275\ \cancel{mL\ HCl} \times \underbrace{\frac{0.523\ \cancel{mol\ HCl}}{1000\ \cancel{mL\ HCl}}}_{0.144\ mol\ HCl} \times \underbrace{\frac{1\ \cancel{mol\ CaO}}{2\ \cancel{mol\ HCl}}}_{0.0719\ mol\ CaO} \times \frac{56.1\ g\ CaO}{1\ \cancel{mol\ CaO}} = \boxed{4.03\ g\ CaO}$$

8. How many mL of 0.750 M cobalt (III) nitrate, when added to a sodium sulfate solution, are needed to precipitate 8.07 g of cobalt (III) sulfate? Balance the equation first.

$$\_2\_\ Co(NO_3)_3\ (aq) + \_3\_\ Na_2SO_4\ (aq) \rightarrow \_\_\_\ Co_2(SO_4)_3\ (s) + \_6\_\ NaNO_3\ (aq)$$

$$MM\ (Co_2(SO_4)_3) = 2 \times 58.93\ g + 3 \times 32.06\ g + 12 \times 16.00\ g = 406.0\ g/mol$$

$$?\ mL\ Co(NO_3)_3 = \underbrace{8.07\ g\ Co_2(SO_4)_3 \times \frac{1\ mol\ Co_2(SO_4)_3}{406.0\ g\ Co_2(SO_4)_3}}_{0.0199\ mol\ Co_2(SO_4)_3} \times \underbrace{\frac{2\ mol\ Co(NO_3)_3}{1\ mol\ Co_2(SO_4)_3}}_{0.0398\ mol\ Co(NO_3)_3} \times \frac{1000\ mL\ Co(NO_3)_3}{0.750\ mol\ Co(NO_3)_3}$$

$$= \boxed{53.0\ mL\ Co(NO_3)_3}$$