7.1 Key

7. $3\ BaCl_{2\,(aq)} + 2\ Na_3PO_{4\,(aq)} \text{ --------> } Ba_3(PO_4)_{2(s)} + 6\ NaCl_{(aq)}$

a. If 56.3 grams of barium chloride react with excess sodium phosphate, how many grams of barium phosphate will form?

$$(56.3\text{g } BaCl_2)\left(\frac{1\text{mole}}{208.236\text{ g}}\right)\left(\frac{1\text{ mole } Ba_3(PO_4)_2}{3\text{ mole } BaCl_2}\right)\left(\frac{601.93279\text{g}}{1\text{mole}}\right) = 54.2474\text{g} \rightarrow \boxed{54.2}$$

b. Learn the formula for % yield: $\%\text{ yield} = \frac{\text{actual (lab) value}}{\text{expected (stoichiometry) value}} \times 100\%$

c. Suppose that when the reaction in (a) is done in lab, only 53.3 grams of barium phosphate precipitate are actually collected. What was the percent yield for the reaction?

$$\frac{53.3\text{g}}{54.2474\text{g}} \times 100 = \boxed{98.3\ \%}$$

d. What mass of sodium phosphate is needed to produce 100.0 grams of sodium chloride in the reaction?

$$(100.0\text{g } NaCl)\left(\frac{1\text{mole}}{58.44289\text{g}}\right)\left(\frac{2\text{moles } Na_3PO_4}{6\text{ mole } NaCl}\right)\left(\frac{163.94076\text{g}}{1\text{mole}}\right) = \boxed{93.50\text{ g}}$$

e. If 1.0 moles of sodium phosphate react, how many moles of barium phosphate will form?

$$(1.0\text{ moles } Na_3PO_4)\left(\frac{1\text{mole } Ba_3(PO_4)_2}{2\text{ moles } Na_3PO_4}\right) = \boxed{0.50\text{ moles } Ba_3(PO_4)_2}$$

8. $4\ C_3H_5N_3O_{9\,(l)} \text{ -------> } 12\ CO_{2\,(g)} + 10\ H_2O_{(g)} + 6\ N_{2\,(g)} + O_{2\,(g)} + \text{heat}$

a. What mass of nitroglycerine are needed to produce 50.0 grams of oxygen gas?

$$(50.0\text{g } O_2)\left(\frac{1\text{mole}}{31.9988\text{g}}\right)\left(\frac{4\text{ moles } C_3H_5N_3O_9}{1\text{mole } O_2}\right)\left(\frac{227.0872\text{g}}{1\text{mole}}\right) = 1419.3 \rightarrow \boxed{1420}$$

b. If 450 grams of nitroglycerine decompose, how many moles of carbon dioxide gas will be produced?

$$(450\text{g } C_3H_5N_3O_9)\left(\frac{1\text{mole}}{227.0872\text{g}}\right)\left(\frac{12\text{ mole } CO_2}{4\text{ moles } C_3H_5N_3O_9}\right) = \boxed{5.9\text{ moles } CO_2}$$

9. $3\ Cu_{(s)} + 8\ HNO_{3\,(aq)} \text{ -------> } 3\ Cu(NO_3)_{2\,(aq)} + 4\ H_2O_{(l)} + 2\ NO_{(g)}$

a. If 1.0×10^{22} copper atoms react, what mass of NO gas can form?

$$(1.0\times10^{22}\text{ Cu atoms})\left(\frac{1\text{mole}}{6.02\times10^{23}\text{ atoms}}\right)\left(\frac{2\text{mole } NO}{3\text{ mole Cu}}\right)\left(\frac{30.0061\text{g}}{\text{mole}}\right) = 0.33229 \rightarrow \boxed{0.33}$$

b. Suppose that the actual mass of NO collected in (a) is only 0.31 grams. Calculate the % yield.

$$\frac{0.31}{0.33229} \times 100 = \boxed{93\ \%}$$ (was 93.29 before rounding)

c. If 10.0 grams of copper react, what mass of water can form in the reaction?

$$(10.0\text{g Cu})\left(\frac{1\text{mole}}{63.546\text{g}}\right)\left(\frac{4\text{ moles } H_2O}{3\text{moles Cu}}\right)\left(\frac{18.0152\text{g}}{1\text{mole}}\right) = \boxed{3.78\text{g } H_2O}$$