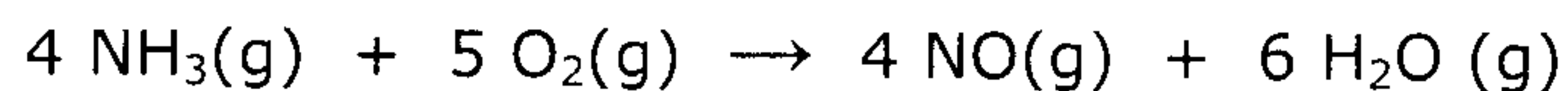


Show your work for each question. Please **BOX** your final answer.

1. Check one: I am an enrolled student.
 I am on the waitlist.

2. A chemist mixes 2.00 g sample of NH₃(g) with 4.00 g of O₂(g) and a reaction occurs according to the following chemical equation:



a) Which species is the limiting reactant? [2 points]

$$2.00 \text{g NH}_3 \times \frac{1 \text{ mole NH}_3}{17.034 \text{g NH}_3} \times \frac{5 \text{ moles O}_2}{4 \text{ moles NH}_3} \times \frac{32.00 \text{g O}_2}{1 \text{ mole O}_2} = 4.6965 \text{g O}_2 \text{ required}$$

* Only have 4.00g O₂ available!

O₂ is the limiting reactant.

* Note that you must consider the mole ratio that the O₂ and NH₃ react in!! (Not just the amounts available...)

b) How ^{many grams} much NO(g) can be produced? [2 points]

$$4.00 \text{g O}_2 \times \frac{1 \text{ mole O}_2}{32.00 \text{g O}_2} \times \frac{4 \text{ mole NO}}{5 \text{ mole O}_2} \times \frac{30.01 \text{g}}{1 \text{ mole NO}} = \boxed{3.00 \text{g NO}}$$

theoretical yield

c) If the reaction in this problem had a 79.8% yield, what was the actual yield of NO(g)? [2 points]

$$79.8\% \text{ of } 3.00 \text{g} = 0.798 \times 3.00 \text{g} = \boxed{2.394 \text{g NO}}$$

actual yield

3) A compound containing only carbon and hydrogen is analyzed using combustion analysis. When a 2.731 g sample is burned in the presence of excess oxygen, 4.232 g of H₂O are produced. What is the empirical formula of the compound? [3 points]

$$4.232 \text{ g H}_2\text{O} \times \frac{1 \text{ mol H}_2\text{O}}{18.016 \text{ g H}_2\text{O}} \times \frac{2 \text{ mol H}}{1 \text{ mol H}_2\text{O}} = 0.46980 \text{ mol H}$$

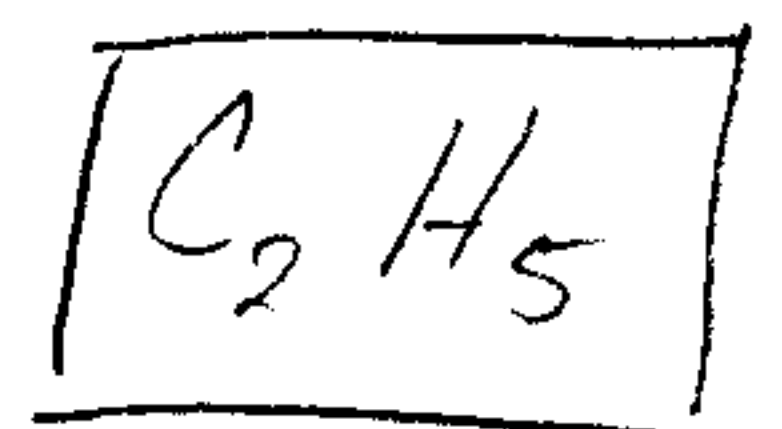
$$0.46980 \text{ mol H} \times \frac{1.008 \text{ g H}}{1 \text{ mol H}} = 0.473563 \text{ g H}$$

$$2.731 \text{ g compound} - 0.473563 \text{ g H} = 2.25744 \text{ g C}$$

$$2.25744 \text{ g C} \times \frac{1 \text{ mol C}}{12.01 \text{ g C}} = 0.187963 \text{ mol C}$$

$$0.46980 \text{ mol H} / 0.187963 = 2.499 \quad \begin{matrix} \nearrow \\ \times 2 \end{matrix} = 5 \text{ mol H}$$

$$0.187963 \text{ mol C} / 0.187963 = 1 \quad \searrow = 2 \text{ mol C}$$



3) A 5.83 gram sample of an unknown metal M reacts completely with carbon monoxide to form 16.96 grams of a metal carbonyl compound with the formula M(CO)₄. Identify the unknown metal M. [3 points]

$$5.83 \text{ g M}$$

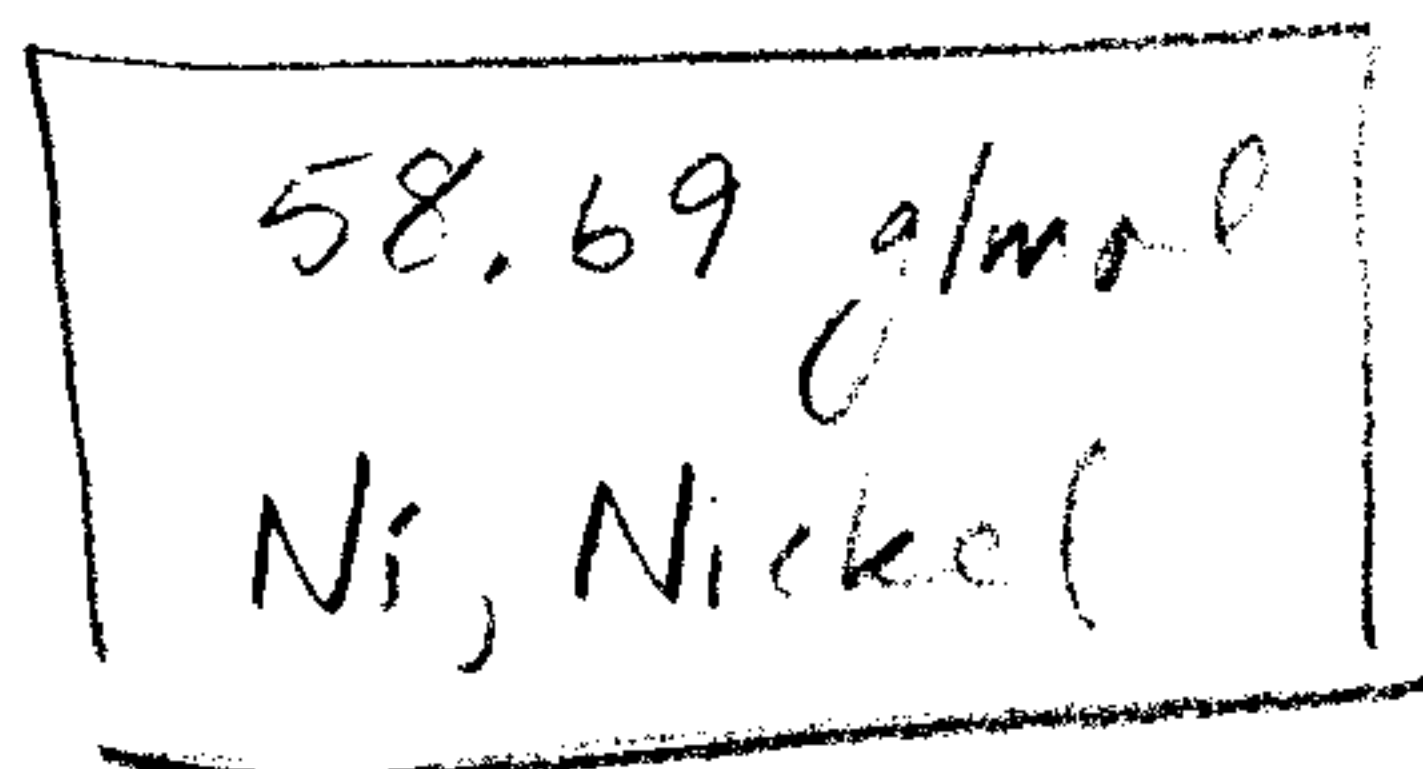
$$16.96 \text{ g M(CO)}_4$$

$$16.96 - 5.83 \text{ g} = 11.13 \text{ g CO (in the compound)}$$

$$11.13 \text{ g CO} \times \frac{1 \text{ mol CO}}{28.01 \text{ g CO}} \times \frac{1 \text{ mol M}}{4 \text{ mol CO}} = 0.0993395 \text{ mol M}$$

$$\text{molar mass of M} = \frac{5.83 \text{ g M}}{0.0993395 \text{ mol M}}$$

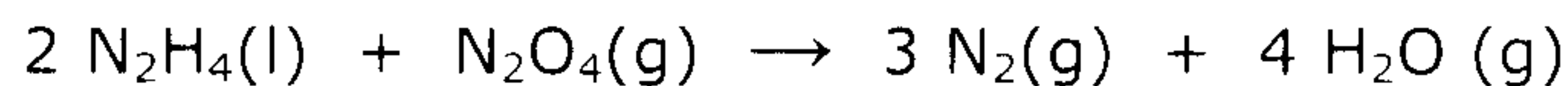
$$= 58.6876 \text{ g/mol}$$



Show your work for each question. Please **BOX** your final answer.

1. Check one: I am an enrolled student.
 I am on the waitlist.

2. A chemist mixes 3.00 g sample of $N_2H_4(l)$ with 2.00 g of $N_2O_4(g)$ and a reaction occurs according to the following chemical equation:



a) Which species is the limiting reactant? [2 points]

$$3.00g N_2H_4 \times \frac{1 \text{ mole } N_2H_4}{32.052g N_2H_4} \times \frac{1 \text{ mole } N_2O_4}{2 \text{ mole } N_2H_4} \times \frac{92.02g}{1 \text{ mole } N_2O_4} = 4.3064g N_2O_4 \text{ required}$$

* Only 2.00g N_2O_4 is available!

N_2O_4 is the limiting reactant

b) How ^{many grams} ~~much~~ $N_2(g)$ can be produced? [2 points]

$$2.00g N_2O_4 \times \frac{1 \text{ mole } N_2O_4}{92.02g N_2O_4} \times \frac{3 \text{ mole } N_2}{1 \text{ mole } N_2O_4} \times \frac{28.02g N_2}{1 \text{ mole } N_2} = \boxed{1.83g N_2}$$

theoretical yield

c) If the reaction in this problem had a 79.8% yield, what was the actual yield of N_2 ? [2 points]

$$79.8\% \text{ of } 1.83g = 0.798 \times 1.83g = \boxed{1.46g N_2}$$

actual yield

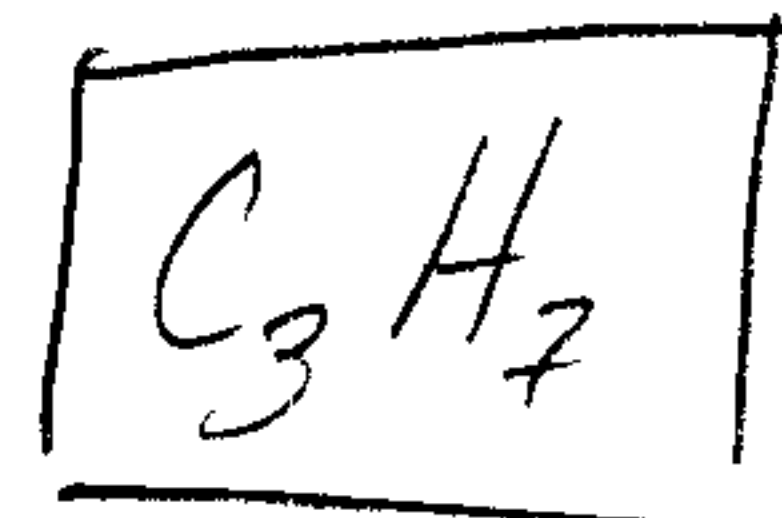
$$0.947269 \text{ mol H} \times \frac{1.008 \text{ g H}}{1 \text{ mol H}} = 0.954847 \text{ g H}$$

$$5.829 \text{ g compound} - 0.954847 \text{ g H} = 4.87415 \text{ g C}$$

$$4.87415 \text{ g C} \times \frac{1 \text{ mol C}}{12.01 \text{ g C}} = \underline{0.4058412 \text{ mol C}}$$

$$0.947269 \text{ mol H} / 0.4058412 = 2.334 \quad \left. \begin{array}{l} \\ \end{array} \right\} \times 3 = 7 \text{ mol H}$$

$$0.4058412 \text{ mol C} / 0.4058412 = 1 \quad \left. \begin{array}{l} \\ \end{array} \right\} \times 3 = 3 \text{ mol C}$$



4) A 7.95 gram sample of an unknown metal M reacts completely with carbon monoxide to form 33.64 grams of a metal carbonyl compound with the formula $\text{M}(\text{CO})_6$. Identify the unknown metal M. [3 points]

$$7.95 \text{ g M}$$

$$33.64 \text{ g M}(\text{CO})_6$$

$$33.64 \text{ g} - 7.95 \text{ g} = 25.69 \text{ g CO (in compound)}$$

$$25.69 \text{ g CO} \times \frac{1 \text{ mol CO}}{28.01 \text{ g CO}} \times \frac{1 \text{ mol M}}{6 \text{ mol CO}} = 0.152862 \text{ mol M}$$

$$\text{molar mass of M} = \frac{7.95 \text{ g M}}{0.152862 \text{ mol M}} = 52.0077 \text{ g/mol}$$

