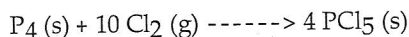


Please read all the questions VERY carefully before answering. Ask your instructor if you do not understand. No outside paper is allowed. The last page is a periodic table with constants. Total points = $64 + (24 * 3) = 72 = 136$

SHORT ANSWER. Please write the set-up equation first, then put the raw data with units before calculating. Write the word or phrase that best completes each statement or answers the question.

- 1) Phosphorus (P_4) reacts with chlorine gas, Cl_2 to produce PCl_5 according to the following reaction: _____ 1)



- a) How many grams of PCl_5 is formed from 95.0 g of P_4 (3 pts.).

$$\frac{95.0 \text{ g } P_4}{(4 \times 30.974) \text{ g } P_4} \times \frac{1 \text{ mol } P_4}{1 \text{ mol } P_4} \times \frac{4 \text{ mol } PCl_5}{1 \text{ mol } P_4} \times \frac{208.239 \text{ g } PCl_5}{1 \text{ mol } PCl_5} \approx 639 \text{ g } PCl_5$$

- b) How many grams of PCl_5 is formed from 235.2 g of Cl_2 gas (3 pts.).

$$\frac{235.2 \text{ g } Cl_2}{(2 \times 35.453) \text{ g } Cl_2} \times \frac{1 \text{ mol } Cl_2}{10 \text{ mol } Cl_2} \times \frac{4 \text{ mol } PCl_5}{1 \text{ mol } Cl_2} \times \frac{208.239 \text{ g } PCl_5}{1 \text{ mol } PCl_5} \approx 276.3 \text{ g } PCl_5$$

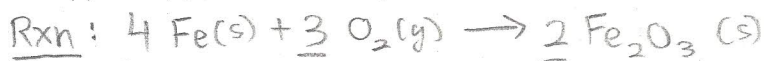
- c) Which is the limiting agent if 95.0 g of P_4 and 235.2 g of Cl_2 gas was used in the rxn. (2 pts.)

$235.2 \text{ g } Cl_2$ is the limiting reagent, because it produced the smallest yield, therefore running out first. ✓

- d) Calculate the % yield of PCl_5 if one obtains 120.0 g PCl_5 in the above reaction (2 pts.)

$$\% \text{ yield} = \frac{\text{Actual yield}}{\text{Theoretical yield}} \times 100\% = \frac{120.0 \text{ g } PCl_5}{276.3 \text{ g } PCl_5} \times 100\% \approx 43.43\%$$

- 2) Iron, $Fe(s)$ reacts with oxygen gas, $O_2(g)$ to produce $Fe_2O_3 (s)$. Calculate how many grams of (a) Fe and (b) O are necessary to make 23.7 g of Fe_2O_3 (4 pts. each, total 8 pts)



$$\bullet \text{ Mass Fe needed} = (23.7 \text{ g } Fe_2O_3) \times \left(\frac{1 \text{ mol } Fe_2O_3}{159.687 \text{ g } Fe_2O_3} \right) \times \left(\frac{4 \text{ mol } Fe}{2 \text{ mol } Fe_2O_3} \right) \times \left(\frac{55.845 \text{ g } Fe}{1 \text{ mol } Fe} \right)$$

$$\approx 16.6 \text{ g } Fe. \quad \checkmark$$

$$\bullet \text{ Mass O needed} = (23.7 \text{ g } Fe_2O_3) \times \left(\frac{1 \text{ mol } Fe_2O_3}{159.687 \text{ g } Fe_2O_3} \right) \times \left(\frac{3 \text{ mol } O_2}{2 \text{ mol } Fe_2O_3} \right)$$

$$\times \left(\frac{2 \text{ mol } O}{1 \text{ mol } O_2} \right) \times \left(\frac{15.999 \text{ g } O}{1 \text{ mol } O} \right) \approx 7.12 \text{ g } O. \quad \checkmark$$

