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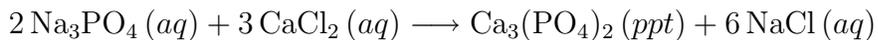
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Stoichiometry Marathon Problems

These two questions cover every topic in chapters 10 & 11, plus section 15.2. If I were to give a two-question test on these two chapters, it would look very much like this.

1. In a laboratory experiment 115 g of sulfur (S_8) was reacted with 89.6 ℓ of oxygen gas (O_2) at S.T.P., producing compound X . This compound contains 50% sulfur by mass, and its empirical formula is the same as its molecular formula.
 - (a) What is the chemical formula of compound X ?
 - (b) Which of the reactants was limiting?
 - (c) How many moles of the non-limiting reactant are left over?
 - (d) What is the mole fraction χ of compound X after the reaction is complete?
 - (e) What is the theoretical yield of X in grams?
 - (f) If 189 g of compound X was actually recovered, what was the percent yield of X ?

2. 0.75 ℓ of 2.5 M Na_3PO_4 is mixed with 1.25 ℓ of 2.0 M CaCl_2 . The reaction that occurs is given by the chemical equation:



- (a) Which reactant is limiting?
- (b) How many grams of $\text{Ca}_3(\text{PO}_4)_2$ are produced?
- (c) If 150. g of $\text{Ca}_3(\text{PO}_4)_2$ are recovered on the filter paper, what is the percent yield?
- (d) What is the concentration (molarity) of NaCl in the final solution. (Hint: you will need to add the volumes of the two solutions to find the final volume.)
- (e) How many liters of the final solution would you need in order to have 1.5×10^{24} molecules of NaCl ?

3. Compound X is a vanadium bromide compound that is composed of 17.5% vanadium and 82.5% bromine. 174 g of solid compound X is reacted with 0.83 ℓ of a 3.0 M solution of ammonium sulfate.
- (a) What is the formula for compound X ?
 - (b) Predict the products and identify which of the products would form a precipitate, based on your knowledge of intermolecular forces.
 - (c) Balance the equation.
 - (d) Identify the limiting reactant.
 - (e) Determine the theoretical yield of precipitate in moles.
 - (f) Determine the number of moles of the non-limiting reactant that will be left over.
 - (g) Determine the theoretical yield of precipitate in grams.
 - (h) When the above reaction is performed, the yield of precipitate is found to be 72%. How many grams of the precipitate were actually recovered?