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Workshop #5: Stoichiometry

Show calculation setups and answers for all problems below.

1. How many molecules are there in a 600.0 g sample of $\text{Na}_3\text{PO}_4(\text{s})$? How many Na^+ ions are present?

2. A compound of copper and sulfur was produced in the lab by heating copper and sulfur together in a crucible. The following data was collected:

Mass of crucible and cover	28.71 g
Mass of crucible, cover, and copper	30.25 g
Mass of crucible, cover, and copper-sulfur compound	30.64 g

Determine the empirical formula of this compound.

3. Isopentyl acetate ($\text{C}_7\text{H}_{14}\text{O}_2$), the compound responsible for the scent of bananas, can be produced commercially. Calculate the percent composition of $\text{C}_7\text{H}_{14}\text{O}_2$.

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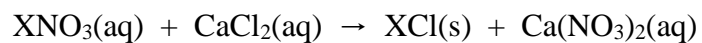
4. A compound consisting of mainly cetyl palmitate is comprised entirely of carbon, hydrogen, and oxygen. Combustion of a 2.3836 g sample of cetyl palmitate produced 6.9807 g of CO₂ and 2.8575 g of H₂O. Determine the empirical formula of the compound. If the formula weight of the compound is 480.9 g/mol, what is the molecular formula of this compound?
5. Washing soda, a compound used to prepare hard water for laundry, is a hydrate whose formula can be written as Na₂CO₃ · xH₂O. When a 2.558 g sample of washing soda is heated at 125 °C, all the water of hydration is lost, leaving behind 0.948 g of the anhydrous salt. Determine the value of x.

6. Liquid mercury and bromine gas will react under appropriate conditions to produce solid mercury(II) bromide.
- Write the balanced chemical equation for this process.
 - What is the maximum mass of HgBr_2 that can be produced from the reaction of 10.0 g Hg and 9.00 g Br_2 ?
 - Determine the remaining mass of each reactant (if any) available upon conclusion of the reaction.
 - If 15.3 g of mercury(II) bromide is produced in this reaction, determine the percentage yield of product.
7. Silicon nitride (Si_3N_4), a valuable ceramic, is made by the direct combination of silicon and nitrogen at high temperature.
- Write the balanced chemical equation for this process.
 - How many grams of silicon must react with excess nitrogen to prepare 125 g silicon nitride if the yield of the reaction is 85.0%?

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8. Consider the following unbalanced reaction:



If 30.8 g of CaCl_2 produced 79.6 g of XCl , determine the identity of X. Quantify your response. Random guessing will not earn any credit for this problem!