Answer on Question #63569 - Chemistry - Other

Task:

What is the maximum mass of S_8 that can be produced by combining 90.0 g of each reactant?
$8SO_2+16H_2S \rightarrow 3S_8+16H_2O$

Solution:

We can convert the masses of SO_2 and H_2S to moles using molecular weights:

$$moles\ of\ SO_2 = 90.0g \times \frac{1mol\ SO_2}{64.054g\ SO_2} = 1.405\ mol\ SO_2;$$
$$moles\ of\ H_2S = 90.0g \times \frac{1mol\ H_2S}{34.082g\ H_2S} = 2.6407\ mol\ H_2S;$$

We calculate the actual molar ratio of the reactants, and then compare the actual ratio to the stoichiometric ratio from the balanced reaction.

$$Actual\ ratio = \frac{moles\ of\ H_2S}{moles\ of\ SO_2} = \frac{2.6407\ mol\ H_2S}{1.405\ mol\ SO_2} = \frac{1.8795\ mol\ H_2S}{1\ mol\ SO_2}$$

The actual ratio tells us that we have 1.8795 mol of H_2S for every 1 mol of SO_2. In comparison, the stoichiometric ratio from our balanced reaction is below:

$$Stoichiometric\ ratio = \frac{16\ mol\ H_2S}{8\ mol\ SO_2} = \frac{2\ mol\ H_2S}{1\ mol\ SO_2}$$

This means we need at least 2 moles of H_2S for every mole of SO_2. Since our actual ratio is smaller than our stoichiometric ratio, we have less H_2S than we need to react with each mole of SO_2. Therefore, H_2S is our limiting reagent and SO_2 is in excess.

Then,

$$\max imum\ mass\ of\ S_8 = \frac{3\ mol\ S_8 \times 256.472g\ S_8 \times 90.0g\ H_2S \times 1\ mol\ H_2S}{1\ mol\ S_8 \times 16\ mol\ H_2S \times 34.082g\ H_2S} = 126.987g\ S_8 \approx 127g\ S_8.$$

Answer: 127 g is the maximum mass of S_8.