Answer on Question #48206 - Chemistry – Other

Question

Aqueous sulfuric acid will react with solid sodium hydroxide to produce aqueous sodium sulfate and liquid water. Suppose 8.8 g of sulfuric acid is mixed with 6.48 g of sodium hydroxide. Calculate the maximum mass of water that could be produced by the chemical reaction. Be sure your answer has the correct number of significant digits.

Answer: Balanced reaction equation is:

$H_2SO_{4(aq)} + 2NaOH_{(s)} = Na_2SO_{4(aq)} + 2H_2O_{(l)}$

Molar masses of the reactants equal:

$$M(H_2SO_4) = 98 \text{ g/mol}, \quad M(NaOH) = 40 \text{ g/mol}$$

Number of moles of the reactants are:

$$n(H_2SO_4) = \frac{m(H_2SO_4)}{M(H_2SO_4)} = \frac{8.8}{98} = 0.090\ mol$$

$$n(NaOH) = \frac{m(NaOH)}{M(NaOH)} = \frac{6.48}{40} = 0.16\ mol$$

Then we make a proportion:

1 mole of H_2SO_4 reacts with 2 moles of NaOH

0.090 moles of H_2SO_4 – *x* moles of NaOH

$$x = \frac{0.090 \cdot 2}{1} = 0.18\ moles\ of\ NaOH\ should\ react\ with\ 0.090\ moles\ of\ H_2SO_4$$

There are only 0.16 moles of sodium hydroxide, therefore it is the limiting reactant.

We need to make another proportion to calculate the maximum mass of H_2O that could be produced by the chemical reaction:

2 moles of NaOH produce 2 moles of H_2O

0.16 moles of NaOH – *x* moles of H_2O

$$x = \frac{0.16 \cdot 2}{2} = 0.16\ moles\ of\ H_2O\ could\ be\ produced$$

The mass of H_2O equals:

$$m(H_2O) = n(H_2O) \cdot M(H_2O) = 0.16 \cdot 18 = 2.9\ g$$

Answer: 2.9 g of H_2O