Formula Stoichiometry and Mass Change in a Reaction

Anhydrous sodium sulfate, Nas_2SO_4, absorbs water vapor and is converted to the *deca*hydrate, $Na_2SO_4 \cdot 10\ H_2O$. How much would the mass of 3.50 g of anhydrous Na_2SO_4 increase if converted completely to the decahydrate?

Solution:

This problem asks only to convert mass of Na_2SO_4 to mass of $Na_2SO_4 \cdot 10\ H_2O$.

By inspection, the quantity (in moles) of Na_2SO_4 is the same as $Na_2SO_4 \cdot 10\ H_2O$.

$$M_{Na_2SO_4} = 142.04 \frac{g}{mol} \qquad M_{Na_2SO_4 \cdot 10\ H_2O} = 322.19 \frac{g}{mol}$$

$$n_{Na_2SO_4 \cdot 10\ H_2O} = \left(3.50\ g\ Na_2SO_4 \Big/ 142.04 \frac{g\ Na_2SO_4}{mol\ Na_2SO_4} \right) \times \frac{1\ mol\ Na_2SO_4 \cdot 10\ H_2O}{1\ mol\ Na_2SO_4} = 0.02464\ mol\ Na_2SO_4 \cdot 10\ H_2O$$

$$m_{Na_2SO_4 \cdot 10\ H_2O} = 0.02464\ mol\ Na_2SO_4 \cdot 10\ H_2O \times 322.19 \frac{g\ Na_2SO_4 \cdot 10\ H_2O}{mol\ Na_2SO_4 \cdot 10\ H_2O} = \boxed{7.94\ g\ Na_2SO_4 \cdot 10\ H_2O}$$

Mass increase is 4.44 g