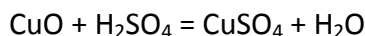


A student reacted 2.4 grams of copper (II) oxide (CuO) with hot sulfuric acid. She made 5.21 g of copper (II) sulfate (CuSO₄). Calculate the percent yield.

Solution



1. Find chemical amount of copper (II) oxide (CuO):

$$n = m/M;$$

$$M(\text{CuO}) = 64 + 16 = 80 \text{ (g/mol)};$$

$$n(\text{CuO}) = 2.4/80 = 0.03 \text{ (mole)}.$$

2. Find chemical amount of copper (II) sulfate (CuSO₄):

according to equation 1 mole of CuO gives 1 mole of CuSO₄, i.e. $n(\text{CuSO}_4) = n(\text{CuO})$;

$$n(\text{CuSO}_4) = 0.03 \text{ mole}.$$

3. Find theoretical mass of CuSO₄:

$$m = M \cdot n;$$

$$M(\text{CuSO}_4) = 64 + 32 + 16 \cdot 4 = 160 \text{ (g/mol)};$$

$$m(\text{CuSO}_4) = 160 \cdot 0.03 = 4.8 \text{ (g)};$$

$$m_{\text{theoretical}} = 4.8 \text{ g}.$$

4. Actual mass of CuSO₄:

$$m(\text{CuSO}_4) = 5.21 \text{ g}.$$

We can see that actual mass of CuSO₄ (5.21 g) is more than theoretical mass of CuSO₄ (4.8 g) what is impossible. Therefore a mistake could be in the task.

- a) For example, if mass of copper (II) oxide (CuO) is 4.2, the task could have a solution:

$$n(\text{CuO}) = 4.2/80 = 0.0525 \text{ (mole)};$$

$$n(\text{CuO}) = n(\text{CuSO}_4) = 0.0525 \text{ (mole)};$$

$$m_{\text{theoretical}}(\text{CuSO}_4) = 160 \cdot 0.0525 = 8.4 \text{ (g)}.$$

Theoretical mass of CuSO₄ (8.4 g) is more than actual mass of CuSO₄ (5.21 g), therefore we could find the percent yield:

$$\eta = m_{\text{actual}}/m_{\text{theoretical}};$$

$$\eta(\text{CuSO}_4) = 5.21/8.4 = 0.62 \text{ or } 62 \text{ \%}.$$

- b) Also the task could have a solution if the actual mass of CuSO₄ is less than theoretical (4.8 g). For example, if $m_{\text{actual}}(\text{CuSO}_4) = 4.6 \text{ g}$ the percent yield is:

$$\eta(\text{CuSO}_4) = 4.6/4.8 = 0.96 \text{ or } 96 \text{ \%}.$$

Answer: a mistake in the task has place. The answers could be a) 62%; b) 96 %.