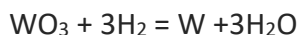


What is the % yield of a reaction in which 42.00g of tungsten(VI)oxide ( $\text{WO}_3$ ) reacts with excess hydrogen gas to produce metallic tungsten and 5.40mL of water? (assume the density of water is 1.00g/mL)

**Answer**



1. Find theoretical mass of metallic tungsten:

a) Find chemical amount of tungsten(VI)oxide ( $\text{WO}_3$ ):

$$n = m/M;$$

$$m(\text{WO}_3) = 42.00 \text{ g};$$

$$M(\text{WO}_3) = 184 + 16 \cdot 3 = 232 \text{ (g/mol)},$$

$$n(\text{WO}_3) = 42.00/232 = 0.18 \text{ (mole)}.$$

b) Find chemical amount of metallic tungsten:

According to equation 1 mole of  $\text{WO}_3$  gives 1 mole of metallic tungsten,

i.e.  $n(\text{WO}_3) = n(\text{W})$ ,

$$n(\text{W}) = 0.18 \text{ mole}.$$

c) Find theoretical mass of metallic tungsten:

$$m = M \cdot n;$$

$$m(\text{W}) = 0.18 \cdot 184 = 33.12 \text{ (g)},$$

$$m(\text{W})_{\text{theoretical}} = 33.12 \text{ g}.$$

2. Find actual mass of metallic tungsten:

a) Find chemical amount of water:

$$n = m/M;$$

$$m(\text{H}_2\text{O}) = \rho(\text{H}_2\text{O}) \cdot V(\text{H}_2\text{O});$$

$$m(\text{H}_2\text{O}) = 1 \cdot 5.40 = 5.40 \text{ (g)};$$

$$M(\text{H}_2\text{O}) = 1 \cdot 2 + 16 = 18 \text{ (g/mol)};$$

$$n(\text{H}_2\text{O}) = 5.40/18 = 0.3 \text{ (mole)}.$$

b) Find chemical amount of metallic tungsten:

According to equating  $n(\text{W}):n(\text{H}_2\text{O}) = 1:3$ ;

$$n(\text{H}_2\text{O}) = 0.3 \text{ mole},$$

$$n(\text{W}):0.3 = 1:3,$$

$$n(\text{W}) = 0.1 \text{ mole}.$$

c) Find actual mass of metallic tungsten:

$$m = M \cdot n;$$

$$m(\text{W}) = 184 \cdot 0.1 = 18.4 \text{ (g)}.$$

3. Find yield:

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

$$\eta = 18.4/33.12 = 0.5556 \text{ or } 55.56\%.$$

**Answer:** 55,56%.