

Given the following reaction: $2\text{KClO}_3 (\text{s}) \rightarrow 2\text{KCl} (\text{s}) + 3\text{O}_2 (\text{g})$

What mass of KClO_3 will produce 250 mL of O_2 gas, collected by water displacement, at an atmospheric pressure of 745 torr and a temperature of 30 °C? The vapor pressure of water at 30 °C is 31.8 torr.

Solution: We must calculate the volume of gas at STP. We assume that gas can be described by Dalton's law, and then pressure of gas is equal to difference between atmospheric pressure and vapor pressure of

water: $P = P_B - p_w = 745 - 31.8 = 713.2$ torr. According to the combined gas law, $\frac{P_0 \cdot V_0}{T_0} = \frac{P \cdot V}{T}$ where

$$P_0 = 760 \text{ torr}, T_0 = 273 \text{ K. Then, } V_0 = V \cdot \frac{P \cdot T_0}{P_0 \cdot T} = 250 \cdot \frac{713.2 \cdot 273}{760 \cdot (30 + 273)} = 211.4 \text{ mL} = 0.2114 \text{ L.}$$

Molar mass of KClO_3 is $M(\text{KClO}_3) = 39 + 35.5 + 16 \cdot 3 = 122.5$ g/mol.

According to the reaction equation we can make a proportion, where 22,4 L/mol is the STP molar volume:

$$\begin{array}{rcl} \text{KClO}_3 & - & \text{O}_2 \\ 2 \cdot 122.5 \text{ g/mol} & - & 3 \cdot 22.4 \text{ L/mol} \\ x \text{ grams} & - & 0.2114 \text{ L} \end{array}$$

$$\text{Then, } m(\text{KClO}_3) = x = \frac{2 \cdot 122.5 \cdot 0.2114}{3 \cdot 22.4} = 0.771 \text{ g;}$$

Answer: 0.771 g.