Answer on Question #63967 - Chemistry - General Chemistry

Question:

How many liters of O2(g) measured at 295K and 763 Torr are consumed in the complete combustion of 2.55 L of dimethly either measured at 298K and 748 Torr.

$2CH_3OCH_3(g) + 6O_2(g) \rightarrow 4CO_2(g) + 6H_2O(l)$

Solution:

For this task we use the ideal gas law:
$PV=nRT$, where
P is the pressure of the gas, Pa. Conversion of Torr to Pa: 1 Torr = 133.3 Pa.
V is the volume of the gas, m^3; 1 L = $1*10^{-3}$ m^3;
n is the number of moles of gas, mol;
R is the universal gas constant = 8.31 J mol^{-1} K^{-1};
T is the absolute temperature of the gas, K.

First we find the number of moles of dimethyl ether that enters the reaction.
$n=PV/RT$
Do the calculation:
$n= (748*133.3)\ Pa * 2.55*10^{-3}\ m^3 / 8.31\ J\ mol^{-1}\ K^{-1} * 298\ K = 0.103\ moles.$

The reaction equation tells us that 2 moles of ether react with 6 moles of oxygen.
Thus we can find how many moles of oxygen (n_O) we need to burn our ether:
$n_O = 0.103\ mol * 6\ mol / 2\ mol = 0.309\ moles$

Then using the gas law again we can find the volume of needed oxygen:
$V_O=n_ORT_O/P_O$
Do the calculation:
$V_O= 0.309\ mol * 8.31\ J\ mol^{-1}\ K^{-1} * 295\ K / (763 * 133.3)\ Pa = 0.00745\ m^3 = 7.45\ L$

Answer:
7.45 liters of oxygen.