

Pg. 301 #1

$$\frac{715 \text{ mm Hg}}{x} = \frac{760 \text{ mm Hg}}{1 \text{ atm}}$$

$$x = 0.941 \text{ atm}$$

$$\frac{715 \text{ mm Hg}}{x} = \frac{760 \text{ mm Hg}}{29.9 \text{ in Hg}}$$

$$x = 28.1 \text{ in Hg}$$

$$\frac{715 \text{ mm Hg}}{x} = \frac{760 \text{ mm Hg}}{14.7 \text{ psi}}$$

$$x = 13.8 \text{ psi}$$

Pg. 302 #3

$$\frac{28 \text{ mm Hg}}{x} = \frac{760 \text{ mm Hg}}{1 \text{ atm}}$$

$$x = 0.0368 \text{ atm}$$

$$\frac{6000. \text{ cm Hg}}{x} = \frac{76.0 \text{ cm Hg}}{1 \text{ atm}}$$

$$x = 78.9 \text{ atm}$$

$$\frac{795 \text{ torr}}{x} = \frac{760 \text{ torr}}{1 \text{ atm}}$$

$$x = 1.05 \text{ atm}$$

$$\frac{5.00 \text{ kPa}}{x} = \frac{101.325 \text{ kPa}}{1 \text{ atm}}$$

$$x = 0.0493 \text{ atm}$$

Pg. 302 #5

$$625 \text{ torr} = 0.822 \text{ atm} = 625 \text{ mm Hg}$$

$$P_1V_1 = P_2V_2$$

$$(0.822)(0.525) = (1.5)V_2$$

$$V_2 = 0.288 \text{ L}$$

$$P_1V_1 = P_2V_2$$

$$(625)(0.525) = (455)V_2$$

$$V_2 = 0.721 \text{ L}$$

Pg. 302 #7

$$P_1V_1 = P_2V_2$$

$$(0.75)(0.521) = P_2(0.776)$$

$$P_2 = 0.50 \text{ atm}$$

Pg. 302 #9

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$-25^\circ\text{C} = 248.15\text{ K}$$

$$\frac{6.00}{248.15} = \frac{V_2}{273.15}$$

$$V_2 = 6.60\text{ L}$$

$$-25^\circ\text{C} = 248.15\text{ K}$$

$$\frac{6.00}{248.15} = \frac{V_2}{100.}$$

$$V_2 = 2.42\text{ L}$$

Pg. 302 #11,13

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$27^\circ\text{C} = 300.15 \text{ K}$$

$$\frac{(740)(0.410)}{300.15} = \frac{(760)V_2}{273.15}$$

$$V_2 = 0.363 \text{ L}$$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$18^\circ\text{C} = 291.15 \text{ K}$$

$$2.0^\circ\text{C} = 275.15 \text{ K}$$

$$4.0 \text{ torr} = 0.0053$$

$$\frac{(0.950)(1400.)}{291.15} = \frac{(0.0053)V_2}{275.15}$$

$$V_2 = 240 \text{ 000 L}$$

Pg. 302 #15

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$25^\circ\text{C} = 298.15^{\text{torr}}$$

$$\frac{(1)(0.775)}{273.15} = \frac{P_2(0.615)}{298.15}$$

$$P_2 = 1.38 \text{ atm}$$

Pg. 302 #17

$$P_{total} = P_{nitrogen} + P_{vapor}$$

At 22°C, vapor pressure is 19.8 torr

$$P_{total} = P_{nitrogen} + P_{vapor}$$

$$721 = P_{nitrogen} + 19.8$$

$$P_{nitrogen} = 701 \text{ torr}$$

Pg. 303 #27

$$PV = nRT \qquad n = \frac{PV}{RT}$$

$$n = \frac{PV}{RT} = \frac{(1 \text{ atm})(0.725 \text{ L})}{(0.0821)(273.15 \text{ K})} = 0.0323 \text{ mol}$$

$$0.0323 \text{ mol} \times \frac{17.0 \text{ g}}{1 \text{ mol NH}_3} = 0.549 \text{ g}$$

Pg. 303 #29

$$PV = nRT \quad n = \frac{PV}{RT}$$

$$n = \frac{PV}{RT} = \frac{(1 \text{ atm})(1.00 \text{ L})}{(0.0821)(273.15 \text{ K})} = 0.0446 \text{ mol}$$

$$0.0446 \text{ mol} \times \frac{6.022 \times 10^{23} \text{ molecules}}{1 \text{ mol } \text{NH}_3} = 2.69 \times 10^{22} \text{ molecules}$$

Pg. 303 #31

$$PV = nRT \qquad V = \frac{nRT}{P}$$

$$V = \frac{nRT}{P} = \frac{\left(\frac{10.0 \text{ g}}{71.0 \text{ g/mol}}\right)(0.0821)(273.15 \text{ K})}{(1 \text{ atm})} = 3.16 \text{ L}$$

or because it's at STP:

$$\frac{n_1}{V_1} = \frac{n_2}{V_2} \qquad \frac{\frac{10.0}{71.0}}{V} = \frac{1}{22.414} \qquad V = 3.16 \text{ L}$$

Pg. 303 #33

$$d = \frac{m}{V} = \frac{\text{molar mass}}{\text{molar volume}}$$

$$\text{Xe} : \frac{131.3}{22.414} = 5.86 \frac{\text{g}}{\text{L}}$$

$$\text{F}_2 : \frac{38.0}{22.414} = 1.70 \frac{\text{g}}{\text{L}}$$

$$\text{C}_2\text{H}_6 : \frac{30.0}{22.414} = 1.34 \frac{\text{g}}{\text{L}}$$

Pg. 303 #39

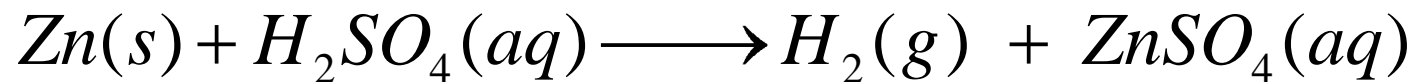
$$PV = nRT \quad V = \frac{nRT}{P}$$

$$V = \frac{nRT}{P} = \frac{(5.00 + 0.500)(.0821)(273.15)}{1} = 123 \text{ L}$$

Knowing that conditions are STP, and that 1 mol of gas occupies 22.414 L, Avogadro's Law could also be used.

$$\frac{n_1}{V_1} = \frac{n_2}{V_2} \quad \frac{1}{22.414} = \frac{(5.00 + 0.500)}{V_2}$$

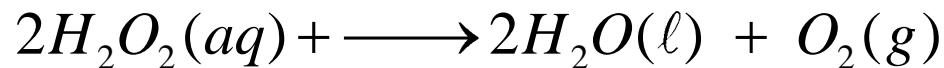
Pg. 303 #43



$$52.7 \text{ g Zn} \times \frac{1 \text{ mol Zn}}{65.4 \text{ g Zn}} \times \frac{1 \text{ H}_2}{1 \text{ Zn}} \times \frac{22.414 \text{ L}}{1 \text{ mol H}_2} = 18.1 \text{ L}$$

$$0.525 \text{ L H}_2 \times \frac{1 \text{ mol H}_2}{22.414 \text{ L}} \times \frac{1 \text{ mol H}_2\text{SO}_4}{1 \text{ mol H}_2} = 0.0234 \text{ mol H}_2\text{SO}_4$$

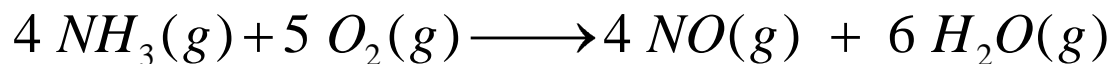
Pg. 303 #44



$$50.0 \text{ g } H_2O_2 \times \frac{1 \text{ mol } H_2O_2}{34.02 \text{ g } H_2O_2} \times \frac{1 O_2}{2 H_2O_2} \times \frac{22.414 \text{ L}}{1 \text{ mol } O_2} \times \frac{1000 \text{ mL}}{1 \text{ L}} = 16500 \text{ mL}$$

$$225 \text{ mL } O_2 \times \frac{1 \text{ L}}{1000 \text{ mL}} \times \frac{1 \text{ mol } O_2}{22.414 \text{ L}} \times \frac{2 \text{ mol } H_2O_2}{1 \text{ mol } O_2} = 0.0201 \text{ mol } H_2O_2$$

Pg. 303 #45



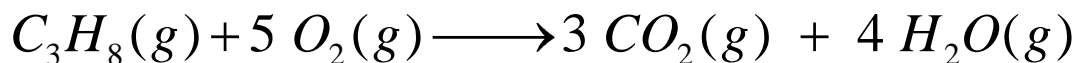
$$2.5 \text{ L NH}_3 \times \frac{1 \text{ mol NH}_3}{22.414 \text{ L NH}_3} \times \frac{5 \text{ mol O}_2}{4 \text{ mol NH}_3} \times \frac{22.414 \text{ L}}{1 \text{ mol O}_2} = 3.1 \text{ L O}_2$$

$$25 \text{ L NH}_3 \times \frac{1 \text{ mol NH}_3}{22.414 \text{ L NH}_3} \times \frac{6 \text{ mol H}_2\text{O}}{4 \text{ mol NH}_3} \times \frac{18.0 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = 30. \text{ g H}_2\text{O}$$

$$25 \text{ L NH}_3 \times \frac{1 \text{ mol NH}_3}{22.414 \text{ L NH}_3} \times \frac{4 \text{ mol NO}}{4 \text{ mol NH}_3} \times \frac{22.414 \text{ L}}{1 \text{ mol NO}} = *25 \text{ L NO}*$$

$$25 \text{ L O}_2 \times \frac{1 \text{ mol O}_2}{22.414 \text{ L O}_2} \times \frac{4 \text{ mol NO}}{5 \text{ mol O}_2} \times \frac{22.414 \text{ L}}{1 \text{ mol NO}} = 20. \text{ L NO}$$

Pg. 303 #46



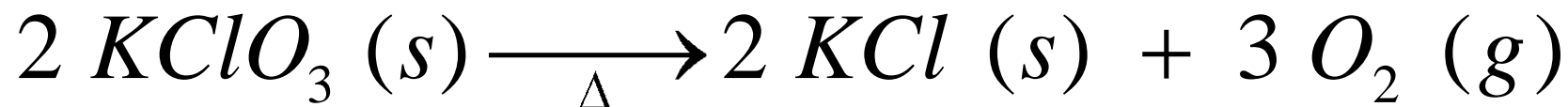
$$7.2 L C_3H_8 \times \frac{1 \text{ mol } C_3H_8}{22.414 L C_3H_8} \times \frac{5 \text{ mol } O_2}{1 \text{ mol } C_3H_8} \times \frac{22.414 L}{1 \text{ mol } O_2} = 36 L O_2$$

$$35 L C_3H_8 \times \frac{1 \text{ mol } C_3H_8}{22.414 L C_3H_8} \times \frac{3 \text{ mol } CO_2}{1 \text{ mol } C_3H_8} \times \frac{44.0 \text{ g}}{1 \text{ mol } CO_2} = 210 \text{ g } CO_2$$

$$15 L C_3H_8 \times \frac{1 \text{ mol } C_3H_8}{22.414 L C_3H_8} \times \frac{4 \text{ mol } H_2O}{1 \text{ mol } C_3H_8} \times \frac{22.414 L}{1 \text{ mol } H_2O} = 60. L H_2O$$

$$15 L O_2 \times \frac{1 \text{ mol } O_2}{22.414 L O_2} \times \frac{4 \text{ mol } H_2O}{5 \text{ mol } O_2} \times \frac{22.414 L}{1 \text{ mol } H_2O} = *12 L H_2O*$$

Pg. 303 #47



$$525 \text{ g KCl} \times \frac{1 \text{ mol KCl}}{74.6 \text{ g KCl}} \times \frac{3 \text{ O}_2}{2 \text{ KCl}} \times \frac{22.414 \text{ L}}{1 \text{ mol O}_2}$$


$$= 236 \text{ L}$$

Pg. 303 #48



$$1.50 \text{ kg } C_6H_{12}O_6 \times \frac{1000 \text{ g}}{1 \text{ kg}} \times \frac{1 \text{ mol } C_6H_{12}O_6}{180.0 \text{ g } C_6H_{12}O_6} \times \frac{6 \text{ CO}_2}{2C_6H_{12}O_6} \times \frac{22.414 \text{ L}}{1 \text{ mol } CO_2}$$

$$= 560. \text{ L}$$



Pg. 304 #49

In a liquid, molecules have virtually no room between them, therefore it is a compact state of matter. Since a gas is largely empty space, the space between gas molecules accounts for the large volume.

Pg. 304 #50

In the cold winter weather, gas volume will decrease making the tires smaller. To keep them at their normal volume, more air is added to the tire. This air should be let out in the spring since the warmer temperatures may cause the tire to be overinflated. This is an example of Charles's Law.

Pg. 304 #54

$$PV = nRT \qquad V = \frac{nRT}{P}$$

$$V = \frac{nRT}{P} = \frac{(1 \text{ mol})(0.0821)(273.15 \text{ K})}{(1 \text{ atm})} = 22.4 \text{ L}$$

Pg. 304 #55

$$PV = nRT \quad V = \frac{nRT}{P}$$

$$V = \frac{nRT}{P} = \frac{(0.2 \text{ mol})(0.0821)(321.15 \text{ K})}{\left(\frac{80 \text{ cm Hg}}{76 \text{ cm Hg}}\right)} = 5 \text{ L}$$

$$V = \frac{nRT}{P} = \frac{\left(\frac{4.2 \text{ g NH}_3}{17.0 \frac{\text{g}}{\text{mol}} \text{ NH}_3}\right)(0.0821)(262.15 \text{ K})}{(0.65 \text{ atm})} = 8.2 \text{ L}$$

$$V = \frac{nRT}{P} = \frac{\left(\frac{21 \text{ g SO}_3}{80.1 \frac{\text{g}}{\text{mol}} \text{ SO}_3}\right)(0.0821)(328.15 \text{ K})}{\left(\frac{110 \text{ kPa}}{101.325 \text{ kPa}}\right)} = 6.5 \text{ L}$$

Pg. 304 #58ab

$$PV = nRT \quad n = \frac{PV}{RT} \quad 790 \text{ torr} = 1.04 \text{ atm}$$

$$n = \frac{PV}{RT} = \frac{(1.04 \text{ atm})(2.0 \text{ L})}{(0.0821)(298.15 \text{ K})} = 0.085 \text{ mol gas}$$

$$0.65 \text{ g } O_2 \times \frac{1 \text{ mol}}{32.0 \text{ g}} = 0.020 \text{ mol } O_2 \quad 0.58 \text{ g } CO_2 \times \frac{1 \text{ mol}}{44.0 \text{ g}} = 0.013 \text{ mol } CO_2$$

$$0.085 \text{ mol gas} - 0.020 \text{ mol } O_2 - 0.013 \text{ mol } CO_2 = 0.052 \text{ mol } N_2$$

$$0.052 \text{ mol } N_2 \times \frac{28.0 \text{ g}}{1 \text{ mol}} = 1.5 \text{ g } N_2$$

Pg. 304 #58c

$$P_{\text{oxygen}} = \frac{0.020 \text{ mol } O_2}{0.085 \text{ mol gas}} \times 790 \text{ torr} = 190 \text{ torr}$$

$$P_{\text{carbon dioxide}} = \frac{0.013 \text{ mol } CO_2}{0.085 \text{ mol gas}} \times 790 \text{ torr} = 120 \text{ torr}$$

$$P_{\text{nitrogen}} = \frac{0.052 \text{ mol } N_2}{0.085 \text{ mol gas}} \times 790 \text{ torr} = 480 \text{ torr}$$

Pg. 304 #61

$$PV = nRT \quad n = \frac{PV}{RT} \quad 13 \text{ psi} = 0.88 \text{ atm}$$

$$n = \frac{PV}{RT} = \frac{(0.88 \text{ atm})(2.24 \text{ L})}{(0.0821)(293.15 \text{ K})} = 0.082 \text{ mol gas}$$

$$0.082 \text{ mol gas} \times \frac{29 \text{ g}}{\text{mol}} = 2.4 \text{ g gas}$$

$$n = \frac{PV}{RT} = \frac{(0.88 \text{ atm})(2.24 \text{ L})}{(0.0821)(303.15 \text{ K})} = 0.079 \text{ mol gas}$$

\therefore 0.003 mol gas (0.087 g) must be released to maintain 2.24 L.

Pg. 304 #62

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$20^\circ\text{C} = 293.15 \quad 1 \text{ atm} = 76 \text{ cm Hg}$$

$$\frac{(65)(1.75)}{293.15} = \frac{(76)(2.00)}{T_2}$$

$$T_2 = 391.73 \text{ K} = 118.5^\circ\text{C}$$

Pg. 304 #63

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$27^\circ\text{C} = 300.15 \text{ K}$$

$$\frac{V}{300.15} = \frac{2V}{T_2}$$

$$(300.15)(2V) = VT_2$$

$$\frac{(300.15)(2V)}{V} = T_2$$

$$600.30 \text{ K} = 327.15^\circ\text{C} = T_2$$

Pg. 304 #64

If the volume is doubled when heated, that means the temperature was also doubled. This is because volume and temperature are directly related. In the second step it asks to reduce the volume to its original size, or decrease it by one half using a change in pressure. Since the volume will be cut in half when the pressure is doubled, the final pressure will be 1480 torr.

Pg. 304 #65

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$\frac{(700.)(.250)}{295.15} = \frac{(500.)(.250)}{T_2}$$

$$T_2 = 210.82 \text{ K} = -62.33^\circ\text{C}$$

Pg. 305 #66

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

$$71.0^\circ F = 21.7^\circ C = 294.82 K$$

$$\frac{30.}{294.82} = \frac{44}{T_2}$$

$$T_2 = 432 K = 159^\circ C = 319^\circ F$$

Pg. 305 #67

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$\frac{(1)(.800)}{273.15} = \frac{P_2 (.250)}{303.15}$$

$$P_2 = 3.55 \text{ atm}$$

Pg. 305 #68

$$PV = nRT \quad n = \frac{PV}{RT} \quad 400. \text{ torr} = 0.526 \text{ atm}$$

$$n = \frac{(0.526 \text{ atm})(0.600 \text{ L})}{(0.0821)(313.15 \text{ K})} = 0.0122 \text{ mol } N_2O$$

$$0.0122 \text{ mol } N_2O = 7.39 \times 10^{21} \text{ molecules} = 2.22 \times 10^{22} \text{ atoms}$$

at STP :

$$\frac{n_1}{V_1} = \frac{n_2}{V_2} \quad \frac{0.0122}{V} = \frac{1}{22.414} \quad V = 0.273 \text{ L}$$

Pg. 305 #69

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

$$25^\circ C = 298.15 K \quad 212^\circ F = 100^\circ C = 373.15 K$$

$$\frac{32}{298.15} = \frac{P_2}{373.15}$$

$$P_2 = 40. \text{ psi} \quad 40. \text{ psi} < 60 \text{ psi}$$

No it will not burst!

Pg. 305 #72

$$PV = nRT \quad n = \frac{PV}{RT}$$

$$1.00 \text{ m}^3 = (10 \text{ dm})(10 \text{ dm})(10 \text{ dm}) = 1000 \text{ L}$$

$$n = \frac{(1.00 \text{ atm})(1000 \text{ L})}{(0.0821)(273.15 \text{ K})} = 44.6 \text{ mol}$$

or because it's at STP:

$$\frac{n_1}{V_1} = \frac{n_2}{V_2} \quad \frac{n}{1000} = \frac{1}{22.414} \quad V = 44.6 \text{ mol}$$

Pg. 305 #74

$$d = \frac{1.78 \text{ g}}{L}$$

At STP, the volume of 1 mol of this gas will be 22.414 L:

$$1.78 = \frac{m}{22.414}$$

$$m = 39.9 \text{ g (Ar)}$$

Pg. 305 #75bd

$$PV = nRT \quad V = \frac{nRT}{P}$$

$$n = \frac{PV}{RT} = \frac{(600.)(16.0)}{(62.4)(300.15)} = 0.513 \text{ mol}$$

$$0.513 \text{ mol } CH_4 = 8.20 \text{ g}$$

$$PV = nRT \quad PV = \frac{m}{mm} RT \quad mm = \frac{mRT}{PV}$$

$$\frac{(2.58)(0.0821)(300.15)}{(1.00)(1.00)} = 63.5 \frac{\text{g}}{\text{mol}}$$

Pg. 305 #76



$$1.0 \text{ mol } \text{C}_2\text{H}_2 \times \frac{1 \text{ C}_2\text{H}_4\text{F}_2}{1 \text{ C}_2\text{H}_2} = 1.0 \text{ mol } \text{C}_2\text{H}_4\text{F}_2$$

$$5.0 \text{ mol } \text{HF} \times \frac{1 \text{ C}_2\text{H}_4\text{F}_2}{2 \text{ HF}} = 2.5 \text{ mol } \text{C}_2\text{H}_4\text{F}_2$$

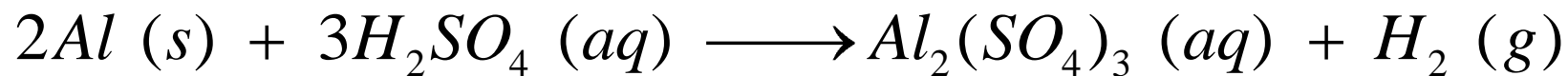
C_2H_2 is the limiting reactant, therefore 1.0 mol of $\text{C}_2\text{H}_4\text{F}_2$ is produced.

$$1.0 \text{ mol } \text{C}_2\text{H}_2 \times \frac{2 \text{ HF}}{1 \text{ C}_2\text{H}_2} = 2.0 \text{ mol } \text{HF} \text{ consumed}$$

3.0 mol of gas remains in the flask after the reaction is complete.

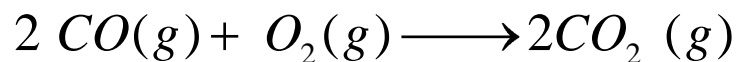
$$P = \frac{nRT}{V} = \frac{(3.0)(0.0821)(273.15)}{10.0} = 6.7 \text{ atm}$$

Pg. 305 #77



$$8.30 \text{ mol Al} \times \frac{3 \text{ mol } H_2}{2 \text{ mol Al}} \times \frac{22.414 \text{ L}}{1 \text{ mol } H_2} = 280 \text{ L}$$

Pg. 305 #81a



$$10. \text{ mol CO} \times \frac{2 \text{ mol CO}_2}{2 \text{ mol CO}} = 10. \text{ mol CO}_2$$

$$8.0 \text{ mol O}_2 \times \frac{2 \text{ mol CO}_2}{1 \text{ mol O}_2} = 16 \text{ mol CO}_2$$

CO is the limiting reactant:

$$10. \text{ mol CO} \times \frac{1 \text{ mol O}_2}{2 \text{ mol CO}} = 5.0 \text{ mol O}_2 \text{ needed} / 3.0 \text{ mol excess}$$

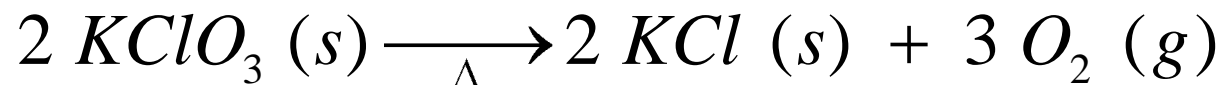
At the conclusion, there will be 0 mol of CO, 3.0 mol O₂, and 10. mol CO₂

Pg. 305 #81b



$$P = \frac{nRT}{V} = \frac{(13 \text{ mol})(0.0821)(273.15 \text{ K})}{(10. \text{ L})} = 29 \text{ atm}$$

Pg. 305 #82



$$0.250 \text{ L O}_2 \times \frac{1 \text{ mol O}_2}{22.414 \text{ L}} \times \frac{2 \text{ KClO}_3}{3 \text{ O}_2} \times \frac{122.6 \text{ g}}{1 \text{ KClO}_3}$$

$$= 0.912 \text{ g}$$

$$\frac{0.912 \text{ g}}{1.20 \text{ g}} = 76.0\%$$