Pg. 301 #1

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

$$x = 0.941\ atm$$

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

$$x = 28.1\ in\ Hg$$

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

$$x = 13.8\ psi$$

Pg. 302 #3

$$\frac{28\ mm\ Hg}{x} = \frac{760\ mm\ Hg}{1\ atm} \qquad x = 0.0368\ atm$$

$$\frac{6000.\ cm\ Hg}{x} = \frac{76.0\ cm\ Hg}{1\ atm} \qquad x = 78.9\ atm$$

$$\frac{795\ torr}{x} = \frac{760\ torr}{1\ atm} \qquad x = 1.05\ atm$$

$$\frac{5.00\ \text{kPa}}{x} = \frac{101.325\ \text{kPa}}{1\ atm} \qquad x = 0.0493\ atm$$

Pg. 302 #5

$$625\ torr = 0.822\ atm = 625\ mm\ Hg$$

$$P_1V_1 = P_2V_2$$

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

$$V_2 = 0.288\ L$$

$$P_1V_1 = P_2V_2$$

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

$$V_2 = 0.721\ L$$

Pg. 302 #7

$$P_1V_1 = P_2V_2$$

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

$$P_2 = 0.50\ atm$$

Pg. 302 #9

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

$$-25°C = 248.15\ K$$

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

$$V_2 = 6.60\ L$$

$$-25°C = 248.15\ K$$

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

$$V_2 = 2.42\ L$$

Pg. 302 #11,13

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

$$27°C = 300.15\ K$$

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

$$V_2 = 0.363\ L$$

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

$$18°C = 291.15\ K$$

$$2.0°C = 275.15\ K$$

$$4.0\ torr\ =\ 0.0053$$

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

$$V_2 = 240\ 000\ L$$

Pg. 302 #15

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

torr

$$25°C = 298.15$$

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

$$P_2 = 1.38\ atm$$

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

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

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

$$0.0323\ mol \times \frac{17.0\ \text{g}}{1\ mol\ NH_3} = 0.549\ \text{g}$$

Pg. 303 #29

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

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

$$0.0446\ mol \times \frac{6.022\times10^{23}\text{ molecules}}{1\ mol\ NH_3} = 2.69\times10^{22}\text{ molecules}$$

Pg. 303 #31

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

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

or because it's at STP:

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

Pg. 303 #33

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

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

$$F_2: \ \frac{38.0}{22.414} = 1.70\,\tfrac{g}{L}$$

$$C_2H_6: \ \frac{30.0}{22.414} = 1.34\,\tfrac{g}{L}$$

Pg. 303 #39

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

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

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

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

Pg. 303 #43

$$Zn(s) + H_2SO_4(aq) \longrightarrow H_2(g) \ + \ ZnSO_4(aq)$$

$$52.7\ g\ Zn \times \frac{1\ mol\ Zn}{65.4\ g\ Zn} \times \frac{1\ H_2}{1\ Zn} \times \frac{22.414\ L}{1\ mol\ H_2} = 18.1\ L$$

$$0.525\ L\ H_2 \times \frac{1\ mol\ H_2}{22.414\ L} \times \frac{1\ mol\ H_2SO_4}{1\ mol\ H_2} = 0.0234\ mol\ H_2SO_4$$

Pg. 303 #44

$$2H_2O_2(aq) + \longrightarrow 2H_2O(\ell) \;+\; O_2(g)$$

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

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

Pg. 303 #45

$$4\ NH_3(g) + 5\ O_2(g) \longrightarrow 4\ NO(g)\ +\ 6\ H_2O(g)$$

$$2.5\ L\ NH_3 \times \frac{1\ mol\ NH_3}{22.414\ L\ NH_3} \times \frac{5\ mol\ O_2}{4\ mol\ NH_3} \times \frac{22.414\ L}{1\ mol\ O_2} = 3.1\ L\ O_2$$

$$25\ L\ NH_3 \times \frac{1\ mol\ NH_3}{22.414\ L\ NH_3} \times \frac{6\ mol\ H_2O}{4\ mol\ NH_3} \times \frac{18.0\ g\ H_2O}{1\ mol\ H_2O} = 30.\ g\ H_2O$$

$$25\ L\ NH_3 \times \frac{1\ mol\ NH_3}{22.414\ L\ NH_3} \times \frac{4\ mol\ NO}{4\ mol\ NH_3} \times \frac{22.414\ L}{1\ mol\ NO} = *25\ \ L\ NO*$$

$$25\ L\ O_2 \times \frac{1\ mol\ O_2}{22.414\ L\ O_2} \times \frac{4\ mol\ NO}{5\ mol\ O_2} \times \frac{22.414\ L}{1\ mol\ NO} = 20.\ \ L\ NO$$

Pg. 303 #46

$$C_3H_8(g) + 5\ O_2(g) \longrightarrow 3\ CO_2(g)\ +\ 4\ H_2O(g)$$

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

$$35\ L\ C_3H_8 \times \frac{1\ mol\ C_3H_8}{22.414\ L\ C_3H_8} \times \frac{3\ mol\ \mathrm{CO_2}}{1\ mol\ C_3H_8} \times \frac{44.0\ \mathrm{g}}{1\ mol\ \mathrm{CO_2}} = 210\ g\ \mathrm{C}O_2$$

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

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

Pg. 303 #47

$$2\ KClO_3\ (s) \xrightarrow[\Delta]{} 2\ KCl\ (s) + 3\ O_2\ (g)$$

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

$$= 236\ \text{L}$$

Pg. 303 #48

$$2C_6H_{12}O_6(s) + 6O_2(g) \xrightarrow[\Delta]{} 6\ CO_2(g)\ +\ 6H_2O(\ell)$$

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

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

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

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

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

Pg. 304 #55

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

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

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

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

Pg. 304 #58ab

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

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

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

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

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

Pg. 304 #58c

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

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

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

Pg. 304 #61

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

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

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

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

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

Pg. 304 #62

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

$$20°C = 293.15 \qquad 1\, atm = 76\, cm\, Hg$$

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

$$T_2 = 391.73\, K = 118.5°C$$

Pg. 304 #63

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

$$27°C = 300.15\ K$$

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

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

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

$$600.30\ K = 327.15°C = T_2$$

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

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

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

$$T_2 = 210.82\ K = -62.33°C$$

Pg. 305 #66

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

$$71.0°F = 21.7°C = 294.82\ K$$

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

$$T_2 = 432\ K = 159°C = 319°F$$

Pg. 305 #67

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

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

$$P_2 = 3.55\ atm$$

Pg. 305 #68

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

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

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

$$at\ STP:$$

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

Pg. 305 #69

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

$$25°C = 298.15\ K \qquad 212°F = 100°C = 373.15\ K$$

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

$$P_2 = 40.\ psi \qquad 40.\ psi \ < \ 60\ psi$$

$$No\ it\ will\ not\ burst!$$

Pg. 305 #72

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

$$1.00\ \text{m}^3 = (10\ \text{dm})(10\ \text{dm})(10\ \text{dm}) = 10\bar{0}0\ L$$

$$n = \frac{(1.00\ atm)(10\bar{0}0\ L)}{(0.0821)(273.15\ K)} = 44.6\ mol$$

or because it's at STP:

$$\frac{n_1}{V_1} = \frac{n_2}{V_2} \qquad \frac{n}{10\bar{0}0} = \frac{1}{22.414} \qquad V = 44.6\ mol$$

Pg. 305 #74

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

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

$$1.78 = \frac{m}{22.414} \qquad m = 39.9\ g\ (Ar)$$

Pg. 305 #75bd

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

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

$$0.513\ mol\ CH_4 = 8.20\ g$$

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

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

Pg. 305 #76

$$C_2H_2\ (g)\ +\ 2\ HF\ (g) \longrightarrow C_2H_4F_2\ (g)$$

$$1.0\ mol\ C_2H_2 \times \frac{1\ C_2H_4F_2}{1\ C_2H_2} = 1.0\ mol\ C_2H_4F_2$$

$$5.0\ mol\ HF \times \frac{1\ C_2H_4F_2}{2\ HF} = 2.5\ mol\ C_2H_4F_2$$

C_2H_2 is the limiting reactant, therefore 1.0 mol of $C_2H_4F_2$ is produced.

$$1.0\ mol\ C_2H_2 \times \frac{2\ HF}{1\ C_2H_2} = 2.0\ mol\ HF\ consumed$$

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

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

Pg. 305 #77

$$2Al\ (s)\ +\ 3H_2SO_4\ (aq) \longrightarrow Al_2(SO_4)_3\ (aq)\ +\ H_2\ (g)$$

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

Pg. 305 #81a

$$2\ CO(g) + O_2(g) \longrightarrow 2CO_2\ (g)$$

$$10.\ mol\ \text{CO} \times \frac{2\text{ mol } CO_2}{2\text{ mol } CO} = 10.\ mol\ \text{CO}_2$$

$$8.0\ mol\ O_2 \times \frac{2\text{ mol } CO_2}{1\text{ mol } O_2} = 16\ mol\ \text{CO}_2$$

CO is the limiting reactant:

$$10.\ mol\ CO \times \frac{1\ mol\ O_2}{2\ mol\ CO} = 5.0\ mol\ O_2\ needed / 3.0\ mol\ excess$$

At the conclusion, there will be 0 mol of CO, 3.0 mol O_2, and 10. mol CO_2

Pg. 305 #81b

$$2\,CO(g) + O_2(g) \longrightarrow 2CO_2\,(g)$$

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

Pg. 305 #82

$$2\ KClO_3\ (s) \xrightarrow[\Delta]{} 2\ KCl\ (s)\ +\ 3\ O_2\ (g)$$

$$0.250\ L\ O_2 \times \frac{1\ mol\ O_2}{22.414\ L} \times \frac{2\ KClO_3}{3\ O_2} \times \frac{122.6\ g}{1\ KClO_3}$$

$$= 0.912\ g$$

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