Objective 1:

1. Define

2\. a. $P_1V_1 = P_2V_2$ Boyles Law states that at constant temperature, pressure and volume are inversely related.

b. $P_1 = 1.5\text{atm}$

$V_1 = 2.5L$

$P_2 = ?$

$V_2 = .75L$

Temperature is constant

$P_1V_1 = P_2V_2$

$1.5\text{atm} \cdot 2.5L = x \cdot .75L$

$V_2 = \boxed{5.0L}$

c. $P_1 = 315kPa$

$V_1 = 355mL$

$P_2 = 50kPa$

$V_2 = ?$

Temperature is constant

$P_1V_1 = P_2V_2$

$315kPa \cdot 355mL = 50kPa \cdot x$

$V_2 = \boxed{2240mL}$

3\. $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ Charles' Law states that the volume of a gas is directly proportional to the Kelvin temperature, if the pressure is constant.

b. $V_1 = 4789mL$

$T_1 = 485K$

$V_2 = ?$

$T_2 = 200K$

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $\frac{4789mL}{485K} = \frac{x}{200K}$

$V_2 = \boxed{1975mL}$

c. $V_1 = 45.0L$

$T_1 = 298K$

$V_2 = 12L$

$T_2 = ?$

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $\frac{45.0L}{298K} = \frac{12L}{x}$

$V_2 = \boxed{79.5K}$

Gas Law HW9

4\. a. $\frac{P_1}{T_1} = \frac{P_2}{T_2}$ Gay-Lussac's Law states that temperature and the pressure of a gas are directly related at constant volume.

b. $P_1 = 7.5\,atm$

$T_1 = 25 + 273$ $\frac{P_1}{T_1} = \frac{P_2}{T_2}$ $\frac{7.5\,atm}{298\,K} = \frac{X}{373\,K}$

$P_2 = ?$

$T_2 = 100 + 273$ $P_2 = \boxed{9.4\,atm}$

c. $P_1 = 6.3\,atm$ $1000\,kPa \times \frac{1\,atm}{101.3\,kPa} = 9.87\,atm$

$T_1 = 845\,K$

$P_2 = 1000\,kPa = 9.87\,atm$ $\frac{P_1}{T_1} = \frac{P_2}{T_2}$ $\frac{6.3\,atm}{845\,K} = \frac{9.87\,atm}{X}$

$T_2 = ?\ °C$

$T_2 = 1323.8\,K - 273 = \boxed{1051°C}$

5\. $\frac{V_1}{n_1} = \frac{V_2}{n_2}$ n = moles

b. $V_1 = 4500\,mL$ $\frac{V_1}{n_1} = \frac{V_2}{n_2}$ $\frac{4500\,mL}{10\,mol} = \frac{X}{15\,mol}$

$n_1 = 10\,mol$

$V_2 = ?$ $V_2 = \boxed{6750\,mL}$

$n_2 = 10\,mol + 5\,mol = 15\,mol$

Gashaw HW9

Objective 2

1. Define

2. a. $P_1 = 3.5\,atm$
   $V_1 = 5.2L$
   $T_1 = 35+273$
   $P_2 = ?$
   $V_2 = \frac{5.2}{2} = 2.6L$
   $T_2 = 400K$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad \frac{3.5\,atm \cdot 5.2L}{308K} = \frac{x \cdot 2.6L}{400K}$$

$P_2 = $ **9.1 atm**

b. $P_1 = 300kPa = 2.96atm$ $\quad 300kPa \times \frac{1atm}{101.3kPa} = 2.96\,atm$
   $V_1 = 50L$
   $T_1 = 23+273 = 296K$
   $P_2 = 3.9\,atm$
   $V_2 = ?$
   $T_2 = 315K$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad \frac{2.96atm \cdot 50L}{296K} = \frac{3.9atm \cdot x}{315K}$$

$V_2 = $ **40.4L**

c. $P_1 = 800atm$
   $V_1 = 2000L$
   $T_1 = ?$
   $P_2 = 101.3kPa = 1atm$
   $V_2 = 10^5L$
   $T_2 = 292K$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad \frac{800atm \cdot 2000L}{X} = \frac{1atm \cdot 10^5L}{292K}$$

$T_1 = $ **4672 K**

Gaslaw HW9

3\. a. $PV=nRT$

$P=5.2\,atm$

$V=6.8\,L$

$T=600\,K$

$n=?$

$5.2\,atm \cdot 6.8\,L = .0821\frac{L\cdot atm}{mol\cdot K} \cdot 600\,K \cdot n$

$n=$ **.72 mol**

b. $P=?$

$n=85\,g \times \frac{1\,mol\,N_2}{28\,g} = 3\,mol$

$T=50+273=323\,K$

$V=100\,L$

$PV=nRT$

$x \cdot 100\,L = 3.04\,mol \cdot .0821\frac{L\cdot atm}{mol\cdot K} \cdot 323\,K$

$P=$ **.81 atm**

c. $P=85\,kPa$

$V=1758\,mL \times \frac{1\,L}{1000\,mL}$

$T=?$

$n=5.0\,mol$

$PV=nRT$

$85\,kPa \cdot 1.758\,L = 5.0\,mol \cdot 8.31\frac{L\cdot kPa}{mol\cdot K} \cdot T$

$T=$ **3.6 K**

d. $P=300\,kPa$

$V=180\,L$

$n=?$

$T=40+273=313\,K$

$PV=nRT$

$300\,kPa \cdot 180\,L = n \cdot 8.31\frac{L\cdot kPa}{mol\cdot K} \cdot 313\,K$

$n=20.8\,mol\,SO_2$

$20.8\,mol\,SO_2 \times \frac{64\,g}{1\,mol} =$ **1331.2 g SO_2**

4. a. $P_{total} = P_1 + P_2 + P_3 \ldots$

Dalton's law of partial Pressure states that the total pressure inside the container is equal to the sum of the partial pressure due to each gas.

b. $V = 7.00L$

$T = 25 + 273 = 298K$

He $PV = nRT$ $P \cdot 7.00L = .477mol \cdot .0821 \cdot 298K$

$P_{He} = 1.68$ atm

Ne $PV = nRT$ $P \cdot 7.00L = .280mol \cdot .0821 \cdot 298K$

$P_{Ne} = .98$ atm

Ar $PV = nRT$ $P \cdot 7.00L = .110mol \cdot .0821 \cdot 298K$

$P_{Ar} = .38$ atm

$P_{total} = 1.68\text{atm} + .98\text{atm} + .38\text{atm} = \boxed{3.04\text{ atm}}$

c. $V = 15.0L$ $P_{total} = P_{Xe} + P_{O_2} + P_{H_2}$

$P_{total} = 210kPa$ $210kPa = 57.1kPa + 64.8kPa + P_{H_2}$

$T = 300K$ $P_{H_2} = \boxed{88.1\text{ kPa}}$

$45.2g\ Xe \times \frac{1mol}{131.29g} = .344\ mol\ Xe$

$PV = nRT$ $P \cdot 15.0L = .344mol \cdot 8.31 \cdot 300K$

$P_{Xe} = 57.1$ kPa

$12.5g\ O_2 \times \frac{1mol\ O_2}{32g} = .39\ mol\ O_2$

$PV = nRT$ $P \cdot 15.0L = .39mol \cdot 8.31 \cdot 300K$

$P_{O_2} = 64.8$ kPa

Gas Law HW9

5. $2C(s) + O_2(g) \rightarrow 2CO(g)$

P = 600 kPa
T = 180 + 273 = 453 K
V = ?
n = ?

$$PV = nRT$$
$$600\,kPa \cdot V = 6.25\,mol \cdot 8.31 \cdot 453\,K$$
$$V = \boxed{39.2\,L\,CO}$$

$$100\,g\,O_2 \times \frac{1\,mol\,O_2}{32\,g\,O_2} \times \frac{2\,mol\,CO}{1\,mol\,O_2} = 6.25\,mol\,CO = n$$

6. a. $2SCl_2(l) + O_2(g) \rightarrow 2SOCl_2(g)$

$$100\,g\,SCl_2 \times \frac{1\,mol\,SCl_2}{102.9\,g} \times \frac{2\,mol\,SOCl_2}{2\,mol\,SCl_2} \times \frac{118.9\,g}{1\,mol\,SOCl_2} = 115.5\,g\,SOCl_2$$

$$25\,g\,O_2 \times \frac{1\,mol\,O_2}{32\,g} \times \frac{2\,mol\,SOCl_2}{1\,mol\,O_2} \times \frac{118.9\,g}{1\,mol\,SOCl_2} = 185.8\,g\,SOCl_2$$

b. The theoretical yield is 115.5 g $SOCl_2$ which is .9718 mol $SOCl_2$

c. P = ?
V = 100 L
T = 655 K
n = .9718 mol

$$PV = nRT$$
$$P \cdot 100\,L = .97\,mol \cdot 655\,K \cdot .0821 \frac{L \cdot atm}{mol \cdot K}$$
$$P = \boxed{.52\,atm}$$

Gashaw HW9

7. $2\,GaI_3(s) \rightarrow 2\,Ga(s) + 3\,I_2(g)$

$200g\ GaI_3 \times \frac{1mol}{450.4g} \times \frac{3mol\ I_2}{2mol\ GaI_3} = .666\ mol\ I_2$

P = 2.2 atm

T = 600 + 273 = 873 K

n = .666 mol I_2

V = ?

$PV = nRT$

$2.2atm \cdot V = .666mol\ I_2 \cdot .0821 \cdot 873K$

V = **21.7 L I_2**