Mixed Gas Laws Worksheet #2

1) How many moles of gas occupy 98 L at a pressure of 2.8 atmospheres and a temperature of 292°K?

a) What law is this? Ideal

b) Solve the problem

P = 2.8 atm
V = 98 L
n = ?
R = 0.0821
T = 292 K

$PV = nRT$

$(2.8 atm)(98 L) = x(0.0821)(292 K)$

$x = 11 mol$

2) If 5.0g of O_2 are placed in a 30.0 L tank at a temperature of 25°C, what will the pressure be?

a) What law is this? Ideal

b) Solve the problem

P = ?
V = 30.0 L
n = 0.16 mol
R = 0.0821
T = 298 K

$5.0 g \left| \frac{1 mol}{32.00 g} \right. = 0.16 mol$

$PV = nRT$

$x(30.0 L) = (0.16 mol)(0.0821)(298 K)$

$x = 0.13 atm$

3) A balloon is filled with 35.0 L of helium in the morning when the temperature is 20.0°C. By noon the temperature has risen to 45.0°C. What is the new volume of the balloon?

a) What law is this? Charle's

b) What is the relationship? direct

c) Predict whether the variable asked for will increase or decrease. increase

d) Solve the problem

	1	2
P		
V	35.0 L	x
T	293.0 K	318.0 K

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

$\frac{(35.0 L)}{293.0 K} = \frac{x}{318.0 K}$

$x = 38.0 L$

4) A 35 L tank of oxygen is at 315 K with an internal pressure of 190 atmospheres. How many moles of gas does the tank contain?

a) What law is this? Ideal

b) Solve the problem

P = 190 atm
V = 35 L
n = x
R = 0.0821 $\frac{L atm}{mol K}$
T = 315 K

$PV = nRT$

$(190 atm)(35 L) = x\left(0.0821 \frac{L atm}{mol K}\right)(315 K)$

$x = 260 moles$

5) A balloon that can hold 85 L of air is inflated with 3.5 moles of gas at a pressure of 1.0 atmosphere. What is the temperature in °C of the balloon?

a) What law is this? ideal

b) Solve the problem

P = 1.0 atm
V = 85 L
n = 3.5 mol
R = 0.0821 $\frac{L atm}{mol K}$
T = x

$PV = nRT$

$(1.0 atm)(85 L) = (3.5 mol)(0.0821)(x)$

$x = 3.0 \times 10^2 K$

6) $CaCO_3$ decomposes at 1200°C to form CO_2 gas and CaO. If 25 L of CO_2 are collected at 1200°C, what will the volume of this gas be after it cools to 25°C?

a) What law is this? Charle's

b) What is the relationship? direct

c) Predict whether the variable asked for will increase or decrease. decrease

d) Solve the problem

	1	2
P		
V	25L	X
T	1473K	298K

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

$$\frac{(25L)}{1473K} = \frac{X}{298K}$$

$X = 5.1\ L$

7) A helium balloon with an internal pressure of 1.00 atm and a volume of 4.50 L at 20.0°C is released. What volume will the balloon occupy at an altitude where the pressure is 0.600 atm and the temperature is –20.0°C?

a) What law is this? Combined

b) Solve the problem

	1	2
P	1.00 atm	0.600atm
V	4.50L	X
T	293.0K	253.0K

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

$$\frac{(1.00atm)(4.50L)}{(293.0K)} = \frac{(0.600atm)(X)}{253.0K}$$

$X = 6.48\ L$

8) There are 135 L of gas in a container at a temperature of 260°C. If the gas was cooled until the volume decreased to 75 L, what would the temperature of the gas be?

a) What law is this? Charle's

b) What is the relationship? direct

c) Predict whether the variable asked for will increase or decrease. decrease

d) Solve the problem

	1	2
P		
V	135L	75L
T	533K	X

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

$$\frac{(135L)}{533K} = \frac{75L}{X} = 3.0 \times 10^2\ K$$

9) A 75 L container holds 62 moles of gas at a temperature of 215°C. What is the pressure in atmospheres inside the container?

a) What law is this? Ideal

b) Solve the problem

$PV = nRT$

$P = X$
$V = 75L$
$n = 62\ mol$
$R = 0.0821\ \frac{latm}{molK}$
$T = 488K$

$$X(75L) = (62\ mol)\left(0.0821\ \frac{latm}{molK}\right)(488K)$$

$X = 33\ atm$

6.0 L of gas in a piston at a pressure of 1.0 atm are compressed until the volume is 3.5 L. What is the new pressure inside the piston?

a) What law is this? Boyle's

b) What is the relationship? inverse

c) Predict whether the variable asked for will increase or decrease. increase

d) Solve the problem

	1	2
P	1.0 atm	X
V	6.0 L	3.5 L
T		

$P_1V_1 = P_2V_2$

$(1.0\text{atm})(6.0\text{ L}) = x(3.5\text{L})$

$x = 1.7\text{ atm}$

11) A gas canister can tolerate internal pressures up to 210 atmospheres. If a 2.0 L canister holding 3.5 moles of gas is heated to 1350°C, will the canister explode?

a) What law is this? ideal

b) Solve the problem

P

V = 2.0 L

n = 3.5 mol

R = 0.0821

T = 1623 K

$PV = nRT$

$x(2.0\text{L}) = (3.5\text{mol})(0.0821\ \frac{\text{Latm}}{\text{mol K}})(1623\text{ K})$

$x = 230\text{ atm}$

12) Put the following gases in order of increasing rate of diffusion: H_2, F_2, Cl_2, CO_2, CO

a) What law is this? Dalton's law

b) What is the relationship? ↑ mass = ↓ Rate of diffusion, inverse

c) Solve the problem

H_2, F_2, Cl_2, CO_2, CO

2.016 38.00 70.90 44.01 28.01

→ Cl_2, CO_2, F_2, CO, H_2

13. An unknown gas effuses 1.35 times faster than NO, what is the molar mass of the gas?

a) What law is this? Dalton's law

b) What is the relationship? inverse

c) Predict whether the variable asked for will increase or decrease. decrease

d) Solve the problem

$$1.35 = \frac{\sqrt{30.01}}{\sqrt{x}}$$

$x = 16.5\text{ g/mol}$

14. What is the density of CO at 45.0°C and 3.0atm?

a) What law is this? ideal w/ density + Molar mass

b) Solve the problem

D = X

M = 28.01 g/mol

P = 3.0 atm

R = 0.0821 $\frac{L atm}{mol\ K}$

T = 318.0K

$D = \frac{(28.01)(3.0)}{(0.0821)(318.0K)}$

D = 3.2 g/L

15. What is the molar mass of a gas that has a density of 12.5g/L at 25.0°C and 102.0kPa?

a) What law is this? ideal w/ density and MM

b) Solve the problem

D = 12.5 g/L

M = X

P = 102.0 kPa

R = 8.314 $\frac{L\ kPa}{mol\ K}$

T = 298.0 K

$12.5\frac{g}{L} = \frac{(x)(102.0\ kPa)}{(8.314\ \frac{L\ kPa}{mol\ K})(298.0\ K)}$

x = 304 g/mol

16. What is the relative rate of diffusion for the gas in the previous question as compared to carbon dioxide under the conditions?

a) What law is this? graham's law

b) What is the relationship? inverse

c) Predict whether the variable asked for will increase or decrease. decrease

d) Solve the problem

$\frac{\sqrt{304}}{\sqrt{44.01}} = 2.63$

CO_2 will diffuse 2.63 time faster than the gas from problem 15.

17. What is the total pressure of a mixture of gas containing 4.0atm of N_2, 203.1kPa of H_2, 770mm Hg of Ar?

a) What law is this? Dalton's law

b) Solve the problem

$P_{total} = ?$

$P_{N_2} = 4.0\ atm$

$P_{H_2} = 203.1\ kPa \left| \frac{1\ atm}{101.3\ kPa} \right. = 2.005\ atm$

$P_{Ar} = 770\ mm\ Hg \left| \frac{1\ atm}{760\ mm\ Hg} \right. = 1.0\ atm$

$P_{total} = 4.0\ atm + 2.005\ atm + 1.0\ atm$

= 7.0 atm