Chemistry ps 11-4 gas laws

name_____ period_____

1. Calculate the volume occupied by 0.650 moles of oxygen gas at 22°C and 740 mmHg.

2. Solve for the mass of 15 Liters of ethane C_2H_6 at 30°C and 12 atm

3. Calculate the volume occupied by 4.5 grams of NH_3 at 610 mm Hg and 68°C

4. Find the volume of 25 grams of CO_2 collected over water at 25°C and a total pressure of 725 mm Hg

5. Calculate the density of Freon gas CF_2Cl_2 at 680 mm Hg and 29°C

6. A sample of O_2 collected over water at 26 °C and 650 mm Hg occupies 220 mL. Calculate the volume of the dry gas at STP.

7. What volume of H2 will react with 3.5 mols of CO to form CH_3OH according to the equation: $CO\ (g) + 2\ H_2\ (g) \rightarrow CH_3OH\ (g)$

8. What is the density of NH_3 gas at STP ?

9. A gas sample with a mass of .066 grams occupies a volume of 89 mL at 50°C and 720 mm Hg. Solve for the formula weight of the gas

10. What volume will 0.089 mols of O_2 gas occupy at 689 mm Hg and 25°

11. Calculate the density of CH4 at 40oC and 600 mm Hg

12. At what temperature in degrees Celsius will 15 grams of Argon gas occupy 8.5 Liters under a pressure of 550 mm Hg

13. Air has a density of 1.2929 g/L at STP. Calculate the formula weight of air.

14. How many grams of N_2 are present in a sample of this gas that occupies 2.8 Liters at 35°C and 590 mm Hg

15. A gas is collected in a eudiometer. The water level in the tube is 75 mm higher than the level in the jar. The atmospheric pressure is 585 mm Hg and the temperature is 30oC. If the tube contains 0.005 moles of gas, what is the volume in the tube

Chemistry ps 11-4 gas laws

name KEY period____

1. Calculate the volume occupied by 0.650 moles of oxygen gas at 22°C (295 K) and 740 mmHg.

$$0.650 \text{ mol } O_2 \left| \frac{22.4 \text{ L } O_2 \text{ @ STP}}{1 \text{ mol } O_2} \right. = 14.56 \text{ L } O_2 \text{ at STP} \left(\frac{295 \text{ K}}{273 \text{ K}}\right)\left(\frac{760 \text{ mm Hg}}{740 \text{ mm Hg}}\right) = 16 \text{ L}$$

2. Solve for the mass of 15 Liters of ethane C_2H_6 at 30°C (303 K) and 12 atm

$$15 \text{ L}\left(\frac{273}{303}\right)\left(\frac{12 \text{ atm}}{1 \text{ atm}}\right) = 162.17 \text{ L @ STP} \left| \frac{1 \text{ mol}}{22.4 \text{ L @ STP}} \right. = 7.24 \text{ mol } C_2H_6 \left| \frac{30.06 \text{ g}}{1 \text{ mol } C_2H_6} \right.$$

$$218 \text{ g} \ (2 \text{ s.f.}) = 220 \text{ g}$$

3. Calculate the volume occupied by 4.5 grams of NH_3 at 610 mm Hg and 68°C (341 K)

$$4.5 \text{ g } NH_3 \left| \frac{1 \text{ mol } NH_3}{17.04 \text{ g } NH_3} \right. = 0.264 \text{ mol } NH_3 \left| \frac{22.4 \text{ L @ STP}}{1 \text{ mol } NH_3} \right. = 5.92 \text{ L @ STP}\left(\frac{341 \text{ K}}{273 \text{ K}}\right)\left(\frac{760 \text{ mm}}{610 \text{ mm}}\right)$$

$$= 9.2 \text{ L}$$

4. Find the volume of 25 grams of CO_2 collected over water at 25°C and a total pressure of 725 mm Hg (subtract water vapor pressure) From page 859 in text 25°C → 23.8 mm Hg water vapor pressure

$$25 \text{ g } CO_2 \left| \frac{1 \text{ mol } CO_2}{44 \text{ g } CO_2} \right. = .568 \text{ mol } CO_2 \left| \frac{22.4 \text{ L @ STP}}{1 \text{ mol } CO_2} \right. = 12.72 \text{ L at STP}\left(\frac{298 \text{ K}}{273 \text{ K}}\right)\left(\frac{760 \text{ mm Hg}}{701.2 \text{ mm Hg}}\right) = 15.0 \text{ L}$$

$725 \text{ mm} - 23.8 \text{ mm} \overset{?}{=} 701.2 \text{ mm Hg}$

5. Calculate the density of Freon gas CF_2Cl_2 at 680 mm Hg and 29°C (302 K)

$$1 \text{ mol } CF_2Cl_2 = 22.4 \text{ L @ STP}\left(\frac{302 \text{ K}}{273 \text{ K}}\right)\left(\frac{760 \text{ mm Hg}}{680 \text{ mm Hg}}\right) = 27.69 \text{ L}$$

$$1 \text{ mol } CF_2Cl_2 = 120.91 \text{ g } CF_2Cl_2$$

$$d = \frac{m}{V} = \frac{120.91 \text{ g}}{27.69 \text{ L}} = 4.37 \frac{\text{g}}{\text{L}}$$

From pg. 859
@ 26°C water vapor pressure
= 25.2 mm Hg

6. A sample of O_2 collected over water at 26 °C (299 K) and 650 mm Hg occupies 220 mL. Calculate the volume of the dry gas at STP.

650 mm Hg − 25.2 mm Hg = 624.8 mm Hg (pressure of dry gas only)

$$220\text{ mL}\left(\frac{273\text{ K}}{299\text{ K}}\right)\left(\frac{624.8\text{ mm Hg}}{760\text{ mm Hg}}\right) = 165\text{ mL}$$

7. What volume of H2 will react with 3.5 mols of CO to form CH_3OH according to the equation: $CO\ (g) + 2\ H_2\ (g) \rightarrow CH_3OH\ (g)$

3.5 mol → 7 mol H_2

$$7\text{ mol } H_2\left|\frac{22.4\text{ L}}{1\text{ mol } H_2}\right. = 156.8\text{ L } H_2 \text{ @ STP}$$

8. What is the density of NH_3 gas at STP ?

$d = \frac{m}{V}$

$$1\text{ mol } NH_3 = \frac{17\text{ g}}{22.4\text{ L}} = 0.76\ \frac{\text{g}}{\text{L}}$$

9. A gas sample with a mass of .066 grams occupies a volume of 89 mL at 50°C and 720 mm Hg. Solve for the formula weight of the gas

323 K

$$89\text{ ml}\left(\frac{273\text{ K}}{323\text{ K}}\right)\left(\frac{720\text{ mm Hg}}{760\text{ mm Hg}}\right) = 71.3\text{ mL @ STP} = .0713\text{ L}\left|\frac{1\text{ mol}}{22.4\text{ L @ STP}}\right.$$

$$= .00318\text{ mol} \qquad \frac{.066\text{ g}}{.00318\text{ mol}} = 20.7\ \frac{\text{g}}{\text{mol}} = 21\ \frac{\text{g}}{\text{mol}}$$

10. What volume will 0.089 mols of O_2 gas occupy at 689 mm Hg and 25°

$$.089\text{ mol}\left|\frac{22.4\text{ L @ STP}}{1\text{ mol}}\right. = 1.9936\text{ L @ STP}\left(\frac{298}{273}\right)\left(\frac{760\text{ mm Hg}}{689\text{ mm Hg}}\right) = 2.4\text{ L}$$

313°K

11. Calculate the density of CH_4 at 40oC and 600 mm Hg

$1\ mol\ CH_4 = 22.4\ L\ @\ STP \left(\frac{313\ K}{273\ K}\right)\left(\frac{760\ mm\ Hg}{600\ mm\ Hg}\right) = 32.53\ L$

$1\ mol\ CH_4 = 16\ g$

$d = \frac{m}{V} = \frac{16\ g}{32.53\ L} = .49\ \frac{g}{L}$

12. At what temperature in degrees Celsius will 15 grams of Argon gas occupy 8.5 Liters under a pressure of 550 mm Hg

$15\ g\ Ar \left/ \frac{1\ mol\ Ar}{39.95\ g\ Ar}\right. = .3754\ mol\ Ar \left/ \frac{22.4\ L\ @\ STP}{1\ mol\ Ar}\right. = 8.41\ L\ @\ STP \left(\frac{760}{550}\right)\left(\frac{X}{273}\right) = 8.5$

$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$ $\quad \frac{760\ 8.41}{273} = \frac{550\ 8.5}{X}$ $\quad X = 200°K = -73°C$ $\quad X = 200°K - 273 = -73°C$

760 (8.41) X = 550 (8.5) (273)

13. Air has a density of 1.2929 g/L at STP. Calculate the formula weight of air.

$\frac{1.2929\ g\ air}{1\ L\ air} \left/ \frac{22.4\ L\ air}{1\ mol}\right. = 28.96\ \frac{g}{mol}$

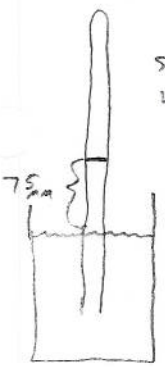
14. How many grams of N_2 are present in a sample of this gas that occupies 2.8 Liters at 35°C and 590 mm Hg

308

$2.8\ L\ (\text{not at STP})\left(\frac{273}{308}\right)\left(\frac{590}{760}\right) = 1.93\ L\ @\ STP \left/ \frac{1\ mol}{22.4\ L\ @\ STP}\right. = .0860\ mol\ N_2 \left/ \frac{28\ g\ N_2}{1\ mol\ N_2}\right. = 2.4\ g\ N_2$

308 → 273

590 → 760



15. A gas is collected in a eudiometer. The water level in the tube is 75 mm higher than the level in the jar. The atmospheric pressure is 585 mm Hg and the temperature is 30oC. If the tube contains 0.005 moles of gas, what is the volume in the tube

Subtract water-vapor pressure

$\frac{75}{13.6} = 5.51\ mm\ Hg$

$585\ mm\ Hg - 5.51\ mm\ Hg = 579.49\ mm\ Hg - 31.8\ mm\ Hg$ (page 859)

$.005\ mol \left/ \frac{22.4\ L}{1\ mol}\right. = .112\ L$

$.112\ L\ @\ STP \left(\frac{303\ K}{273\ K}\right)\left(\frac{760\ mm\ Hg}{547.69\ mm\ Hg}\right) = 0.172\ L = 172\ mL$ (2 s.f.) 170 ml