LAB 10-3

Lab 10-3 Avogadro's Hypothesis (the bag lab)

Name_____ period_____

Data:

Temperature _____C _____K

Atmospheric pressure _____mm Hg _____atm

Volume of bag _____L

Mass of empty bag assembly _____g

Mass of bag assembly + O_2 _____g

Mass of bag assembly + CO_2 _____g

Mass of bag assembly + N_2 _____g

Calculations:

1. Calculate the APPARENT mass of each gas (difference between full and empty bag)

   O_2_____

   CO_2_____

   N_2_____

2. Calculate the mass of air displaced by your bag. The density of air at STP is 1.2929 g/L. Use the volume of your bag in liter

3. Calculate the actual mass of each gas (apparent mass + air displaced)

   O_2_____

   CO_2_____

   N_2_____

4. Ratio of the actual mass of each gas to the actual mass of O2

   CO_2 / O_2 _____

   N_2 / O_2 _____

5. Ratio of the molecular weight of each gas to that of O2

   CO_2 / O_2 _____

   N_2 / O_2 _____

6. Avogadro's hypothesis states that equal volumes of gases at the same conditions of temperature and pressure contain the same number of molecules. Does your data support this?

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Lab 10-3 Avogadro's Hypothesis (the bag lab)

Name_____ period_____

Data:

Temperature 22 C 295 K

Atmospheric pressure 610 mm Hg .803 atm

→ Volume of bag 1.4 L

Mass of empty bag assembly 12.1395 g

Mass of bag assembly + O_2 12.2698 g

Mass of bag assembly + CO_2 12.812 g

Mass of bag assembly + N_2 12.1098 g

Calculations:

1. Calculate the APPARENT mass of each gas (difference between full and empty bag)

O_2 .1303

CO_2 .6725

N_2 −.0297

2. Calculate the mass of air displaced by your bag. The density of air at STP is 1.2929 g/L. Use the volume of your bag in liter

295 → 273 611 → 760

$$1.4\,L\left(\frac{273}{295}\right)\left(\frac{611}{760}\right) = 1.04\,L\ \text{@ STP} \;/\; \frac{1.2929\,g}{1\,L\ \text{air STP}} = 1.347\,g$$

3. Calculate the actual mass of each gas (apparent mass + air displaced)

apparent masses from #1

+ 1.347 g

O_2 1.4779

CO_2 2.0195 g

N_2 1.3173

4. Ratio of the actual mass of each gas to the actual mass of O2

CO_2 / O_2 1.37

N_2 / O_2 .892

5. Ratio of the molecular weight of each gas to that of O2

CO_2 / O_2 1.375

N_2 / O_2 .875

6. Avogadro's hypothesis states that equal volumes of gases at the same conditions of temperature and pressure contain the same number of molecules. Does your data support this?

Yes

Name_____

Period_____

LAB PROBLEM SET 11-2

1. Two flasks of equal volume are filled with different gases at the same conditions of temperature and pressure. The mass of a gas in flask A is 1.40g and the mass of the gas in flask B is 2.80g. If the molecular weight of gas A is 17.0g/mole, what is the molecular weight of the new gas?

2. A glass bulb from which air has been pumped weighs 150.300g. Pure oxygen is admitted to the bulb and the weight of the bulb + oxygen is 151.050g. The oxygen is pumped out and an unknown gas is added to the bulb. The bulb + the new gas has a mass of 152.360g. Calculate the molecular weight of the new gas.

3. A glass bulb weighs 108.11g after all the air has been removed from it. When filled with oxygen the bulb weighs 109.56g. When filled with the gas from the mouth of a volcano, the bulb weighs 111.01g at the same temperature and pressure as the oxygen. Which of the following is the correct formula for the volcanic gas?

CO_2 OCS $Si2H_6$ SO_2 NF_3 SO_3 S_8

4. An empty plastic bag and a stopper assembly has a mass of 22.56g. Filled with O_2 it weighs 22.71g. Filled with gas X it weighs 23.34g. The bag has a volume of 987mL and the temperature is 20°C and the pressure is 610mmHg. If the density of air is 1.2929g/L at STP, find the molecular weight of gas X.

5. An empty bag assembly has a mass of 52.34g at 30°C and 675mmHg. When filled with N_2 it has a mass of 52.30g. When filled with gas X it has a mass of 52.56g. The volume of the bag is 865mL and the density of air at STP is 1.2929g/L.

a. Find the molecular weight of gas X using Avogadro's hypothesis.

b. Find the molecular weight of gas X using molar volume and the gas laws.

c. Find the molecular weight of gas X using PV=nRT

6. Given: mass of empty bag assembly 36.78g
mass of bag filled with N_2 36.61g
mass of bag filled with gas X 36.92g
volume of bag at 20°C and 600mm Hg 1.250L

Find the molecular weight of gas X using Avogadro's hypothesis:

Name_____

Period_____

LAB PROBLEM SET 11-2

1. Two flasks of equal volume are filled with different gases at the same conditions of temperature and pressure. The mass of a gas in flask A is 1.40g and the mass of the gas in flask B is 2.80g. If the molecular weight of gas A is 17.0g/mole, what is the molecular weight of the new gas?

$\frac{1.40\ g}{2.80\ g} = \frac{17.0\ g/mol}{X}$ $X = 34.0\ g/mol$

2. A glass bulb from which air has been pumped weighs 150.300g. Pure oxygen is admitted to the bulb and the weight of the bulb + oxygen is 151.050g. The oxygen is pumped out and an unknown gas is added to the bulb. The bulb + the new gas has a mass of 152.360g. Calculate the molecular weight of the new gas.

151.050 g − 150.300 = .75 g O_2 152.360 g − 150.300 g = 2.06 g X

$\frac{2.06X}{.75\ O_2} = \frac{X}{32\ g/mol} = 88\ g/mol$

3. A glass bulb weighs 108.11g after all the air has been removed from it. When filled with oxygen the bulb weighs 109.56g. When filled with the gas from the mouth of a volcano, the bulb weighs 111.01g at the same temperature and pressure as the oxygen. Which of the following is the correct formula for the volcanic gas?

CO_2 OCS $Si2H_6$ SO_2 NF_3 SO_3 S_8

109.56 − 108.11 = 1.45 g O_2 111.01 − 108.11 = 2.9 g

$\frac{1.45\ g\ O_2}{2.9\ g\ X} = \frac{32\ g/mol}{X\ g/mol}$ $X = 64\ g/mol$

4. An empty plastic bag and a stopper assembly has a mass of 22.56g. Filled with O_2 it weighs 22.71g. Filled with gas X it weighs 23.34g. The bag has a volume of 987mL and the temperature is 20°C and the pressure is 610mmHg. If the density of air is 1.2929g/L at STP, find the molecular weight of gas X.

$.987\ L \left(\frac{273}{293}\right)\left(\frac{610}{760}\right) = .738122\ L \times 1.2929 \frac{g\ air}{L\ air\ @STP} = .9543\ g$ air displaced

22.71 − 22.56 = .15 g O_2 + .9543 = 1.1043 g O_2

23.34 − 22.56 = .78 g X + .9543 = 1.7343 g X

$\frac{1.7343\ g\ X}{1.1043\ g\ O_2} = \frac{X}{32}$ $X = 50\ g/mol$

$\frac{1.1149\,g\,X}{.8549\,g\,N_2} = \frac{\text{molar mass } X}{28\ g/mol}$ $X = 36.5\ g/mol$

5. An empty bag assembly has a mass of 52.34g at 30°C and 675mmHg. When filled with N_2 it has a mass of 52.30g. When filled with gas X it has a mass of 52.56g. The volume of the bag is 865mL and the density of air at STP is 1.2929g/L.

a. Find the molecular weight of gas X using Avogadro's hypothesis.

52.30 − 52.34 = −.04 g N_2

+ .8949 g

.8549 g N_2

52.56 − 52.34 = .22 g X

+ .8949 g = 1.1149 g

$.865\,L\left(\frac{273}{303}\right)\left(\frac{675}{760}\right) = .692\,L\ @\ STP$

303 → 273 K; 675 → 760 mm Hg

$\frac{.692\,L\ @\ STP}{1\,L} \left|\frac{1.2929\,g}{}\right. = .8949\ g$ air displaced

1.1149 g / mol

b. Find the molecular weight of gas X using molar volume and the gas laws.

$\frac{.692\,L\ @\ STP}{22.4\,L} \left|\frac{mol}{}\right. = .0309\ mol\ X = 36.1\ g/mol$

c. Find the molecular weight of gas X using PV=nRT

$= 36.1\ g/mol$

$n = \frac{PV}{RT} = \frac{675\ mm\,Hg \cdot .865\,L}{62.4 \cdot 303\ K} = .03088\ mol \times \frac{1.1149\,g}{.03088\ mol}$

6. Given: mass of empty bag assembly 36.78g

mass of bag filled with N_2 36.61g

mass of bag filled with gas X 36.92g

volume of bag at 20°C and 600mm Hg 1.250L

293 K

Find the molecular weight of gas X using Avogadro's hypothesis:

36.61 − 36.78 = −.17 g N_2

+ 1.1887 g

= 1.0187968 g

36.92 − 36.78 = 0.14 g

+ 1.1887968 g

= 1.3287968 g

$1.2506\,L\left(\frac{273}{293}\right)\left(\frac{600}{760}\right) = .91948\,L\ @\ STP$

$\frac{.91948\,L}{1\,L\ air} \left|\frac{1.29299\,g}{}\right. = 1.1887968\,g_{air}$

$\frac{1.0187968}{1.3287968} = \frac{28}{X}$ $X = 36.5\ g/mol$