Name________________________________ date_________ per_____

Properties of Air Activity

In this activity, you will observe the effect of pressure on the temperature of air, and find out about the mass of this invisible gas! You will use a pump to add air into a small soda bottle and see what happens to the bottle and the air.

Information: Molecules of atmospheric gases are so small that there are huge numbers in even in a small container. We need a different way to count them, so we use a unit called a **mole**.

1 mole = 6.02×10^{23} atoms or molecules! A *mole* of air masses 28.99 grams.

The Ideal Gas Law formula helps us calculate gas problems with temperature and pressure:

Ideal Gas Law: PV = nRT

where **P** = Pressure, **V**= Volume, **n** = number of **moles** of gas, **R** =0.08206 atm•L/mol•K (the gas law constant), **T** = temperature in °K

materials:

- triple beam balance
- liquid crystal thermometer
- 0.6 Liter plastic soda bottle (clean and dry!)
- Fizz-keeper pump.

Part I : <u>Data collection</u>.

1. Place the thermometer strip inside the bottle and tighten the cap.
   Mass the empty soda bottle with thermometer and pump in place _____ g.
   Read the thermometer strip and record the room temperature to the nearest **0.5** °C _____ °C.

2. Pump up the bottle, counting the number of pumps. Record the mass of the soda bottle after each set of 50 pumps. Put in a total of 200 pumps. Record temperature immediately after pumping, ***then*** do the mass. Record your data in the table below:

Number of times pumped	Temperature in ° C	mass in grams
after 50 pumps		
after 100 pumps		
after 150 pumps		
after 200 pumps		

3. Without removing the pump completely, quickly allow the gas to escape from the bottle.
   Immediately record the temperature and mass Temperature__________° C mass_________g

Part II : <u>analysis and calculations</u>

1. Convert the final temperature after the 200th pump was pushed to degrees Kelvin by adding 273°
   ___________°C + 273° = _______°K

2. Find the mass of air added to the bottle after each set of 50 pumps.

Number of times pumped	total mass	mass of empty bottle (tare)	mass of air added
after 50 pumps			
after 100 pumps			
after 150 pumps			
after 200 pumps			

3. Convert your room temperature from Part I step 1 to the Kelvin scale by adding 273° to your Celsius temperature: __________°C + 273 = __________°K

4. The air pressure in the classroom is approximately 1.0 Atmosphere (atm). We can rearrange the ideal gas law formula to solve for the *number of moles* of gas in your container ***before*** pumping:

n = PV/RT = __________ moles

(1 atm X 0.60 L) ÷ (0.08206 atm•L/mol•K **X** ______°K)

note: all you have to do is add in the temperature from step 3 above, then do the calculation

Finding the pressure of the gas in your bottle:

5. After 200 pumps, how many grams of air were added to the bottle: __________ g

6. How many moles of air did you add to the bottle by pumping it up?
(divide the mass from step 5 by 28.97 g/mole) __________mol

Add the moles of air in your empty bottle from step 4: **+** __________ mol

So, what is the ***total*** moles in your bottle after pumping? __________ mol

7. Rearrange the ideal gas law formula so that it solves for Pressure (P)

P =

8. Using the formula you worked out above, plug in your total moles from step 6, Temperature in °K from step 1, volume of the bottle (0.6 L) and the constant for R and find out the pressure in your bottle after 200 pumps:

Show your work:

P = __________ atm

9. How many molecules of air gases did you add to the bottle after 200 pumps?
Multiply the moles you added by 6.02 x 10^{23} molecules/mole:

_________ moles X 6.02 x 10^{23} molecules/mole = __________________ molecules

Questions:

1. As you pumped up the bottle, the mass in the bottle increased. Briefly explain why this happens.

2. Why can't you see all that mass of air that you placed in the bottle?

3. What happens to the temperature inside the bottle as you pump it up? (check your data)

4. If you left the bottle alone, pressurized for 2 hours, the temperature inside would change.
   a. What temperature would the gas in the bottle eventually get to if left alone?

   b. Do you think that the mass would also change if you leave the top tightly in place?

5. What happened to the temperature of the gas inside the bottle when the pressure was quickly relieved in step 3 of part I?

6. In the atmosphere, what weather feature would you expect to notice on days when the air pressure is above normal?

   What would you expect to happen to the weather if the air pressure suddenly drops?

7. Atmospheric pressure is usually reported in " inches of Mercury". Normal sea level air pressure is 29.96 in. Hg. (= 1.0 atm or 14.7 lbs/in^2). What is today's air pressure? ______________in. Hg.