PAL Worksheet – Chem 6A

Properties of gases and gas laws

I. Properties of gases

A. Gas pressure

1. What determines gas pressure?

2. List three different units of gas pressure.

3. The pressure of a gas is measured to be 1.13 atm. What is this pressure in mm Hg? (1 atm = 760 mm Hg, exactly).

4. A typical normal blood pressure is measured as 120 mm Hg/75 mm Hg. What are these values in atm?

5. Barometric pressure is often measured in units of millibars (mbar). If the barometric pressure preceding a storm is measured at 978 mbar, what is the pressure in mm Hg? 1 atm = 1,013 mbar, exactly.

B. Pressure, volume and temperature - concepts

1. Consider a gas in a closed container that has a plunger (like a syringe). If the plunger is pressed to reduce the volume of the gas, what will happen to the gas pressure? Explain your answer in terms of the effect of the reduced volume on the individual gas particles. Use a drawing of before and after the plunger is moved to explain what happens to the gas particles and how this relates to the change in pressure.

2. Consider a gas in a closed container. If heat is applied to the container, what will happen to the gas pressure? Explain your answer in terms of the effect of the increased temperature on the individual gas particles. Use a before and after drawing to illustrate what happens to the gas particles and how this relates to the change in pressure.

3. Now consider a gas in a ballon. What will happen to the volume of the balloon if the temperature is decreased? Imagine putting a balloon in the freezer. What will happen to the gas pressure? Explain the effect of temperature on both gas pressure and volume supported by a drawing showing what happens to the gas particles when the temperature decreases.

II. Gas Laws

A. Boyle's law (P, V)

1. What is Boyle's law and what is the equation that describes it?

2. A gas in an expandable 225 mL container at 1.5 atm experiences an increase in volume to 575 mL. What is the new pressure of the gas? Does your value for the new pressure make sense? Explain, in terms of what the gas particles are doing.

3. A young woman's lung capacity is about 4.0 L of air. Upon exhalation, the lung volume decreases to 3.6 L. Lung volume is controlled by the diaphragm. When the diaphragm contracts (pulls downward), the lung volume expands. When the diaphragm relaxes (moves upward against the lungs), the lung volume decreases. Knowing that the gas pressure outside the lungs is 1.0 atm, use the lung volume difference to explain why we spontaneously inhale air when the diaphragm contracts.

4. Divers who surface too fast undergo a condition called "the bends" which occurs when nitrogen bubbles in the blood expand too fast. A diver at 100 ft is experiencing a pressure of 3.0 atm. She has a nitrogen bubble in her brachial artery with a volume of 5.0 μL. What is the volume of the bubble at the surface, where the pressure is 1.0 atm?

B. <u>Amonton's Law</u> (P, T)

1. The gas in an oxygen cylinder at 6.6 atm is heated by a fire from 25°C to 375°C. If the pressure exceeds 25 atm, the cylinder will explode, causing a lot of damage and possibly death. Will the cylinder explode at 375°C?

2. The pressure in a gas cylinder originally at 25°C decreases from 12.2 atm to 3.7 atm. What temperature was the cylinder cooled to (in °C)?

C. Charles's Law (V, T)

1. A gas in an expandable container with an initial volume of 5.42 L is heated from 20.0°C to 45.5°C. What is the new volume?

2. A balloon with helium has a volume of 250 mL at 298 K. It is placed in liquid nitrogen at a temperature of -196°C. What is the new volume of the gas?

D, Combined gas law.

1. A 1250 L hot air ballon at 1.00 atm, 40.0°C ascends to an elevation of 10,000 feet where the air pressure is 0.697 atm and -0.501°C. What is the new volume?

2. How expandable or collapsible do you think a hot air ballon is? What might be the best way to manage the ballon volume as the ballon ascends?