Name ________________________________Chem 161, Section: _______Group Number: ______

ALE 20. Physical States of Matter, Gas Pressure and its Measurement

(Reference: Chapter 5 - *Silberberg 5th edition*)

Important!! For answers that involve a calculation you must show your work neatly using dimensional analysis with correct significant figures and units to receive full credit. No work, no credit. Report numerical answers to the correct number of significant figures. **CIRCLE ALL NUMERICAL RESPONSES**.

The Model: Gas Pressure

Figure 1. A "freeze frame" view of two containers of gas molecules in constant random motion.

Gas molecules move randomly in their containers, colliding with the walls of their containers causing "gas pressure." ***Pressure*** is defined as the force pushing on an area and is described by the equation:

$$P = \frac{F}{A}$$

Where…
- **P** is pressure (in kPa, kilopascal)
- **F** is force (in N, Newton)
- **A** is the area to which the force is applied (in m^2).

The more molecules collide with the wall and the faster the molecules are going when they strike the wall, the greater the force on the wall and therefore, the higher the pressure.

<u>Common Units of Pressure and their Relationships</u>

1 atm = 760 mm Hg = 760 torr = 101.325 kPa = 14.70 lb/in^2

<u>Note</u>**:** atm = atmospheres
mmHg = millimeters of mercury; 1 mmHg = 1 torr
Pa = Pascal: 1 Pa = 1 N/m^2 (note: Newton is a unit of force: F = ma)
1 kPa = 1 kilopascal = 1000 Pa

Key Questions

1. Use the pressure equation to explain why it would be more likely for an ice skater to fall through the ice on a lake than it would be for someone walking across the lake with regular shoes on.

2. Which container in Figure 1 has the highest pressure? *Explain*.

3. If you heated container #1 in figure 1, and container #2 remained at the same temperature, could you get the pressure in container #1 to equal the pressure in container #2? *Explain*

4. If container 2 was made of an elastic material and if I expanded container 2, could I make the two containers have equal gas pressures? *Explain*.

Section 5.1 An Overview of the Physical States of Matter

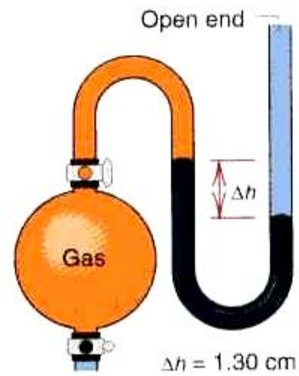
5. a.) Are the particles in a gas farther apart or closer together than the particles in a liquid?

   b.) Use your answer part a, above, to explain each of the following general observations:

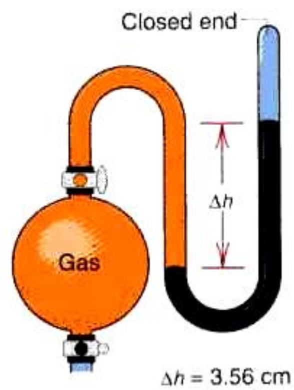
Observation	Explanation
i.) Gases are more compressible than liquids	
ii.) Gases have lower viscosities than liquids	
iii.) After thorough stirring, all gas mixtures are solutions	
iv.) The density of a substance in the gas state is lower than in the liquid state	

Sections 5.2 Gas Pressure and its Measurement

6. If the atmospheric pressure is 765.2 mmHg, determine the pressure in kilopascals of the gas contained in the open-ended manometer to the right. *Show your work!*



7. Calculate the pressure in pascals of the gas contained in the close-ended manometer to the right. *Show your work!*



8. Convert the following pressures into atmospheres. *Show work using dimensional analysis, correct sig figs and circle your answers*.
   a.) At the peak of Mt. Everest, atmospheric pressure is only 275 mmHg.

   b.) A cyclist fills her tires to 91 psi.

   c.) The surface of Venus has an atmospheric pressure of 9.15×10^6 Pa.

   d.) At 100 ft below sea level, a scuba diver experiences a pressure of 2.44×10^4 torr

9. Suppose you made a Torricelli barometer using water instead of mercury by filling with water a very long and narrow glass tube sealed at one end. After filling the tube with water you inverted it in a container of water as illustrated below in figure 1 to the right.

   a.) If the atmospheric pressure that day is 755 mmHg, how high in *millimeters* is the column of *water* in the tube? *Circle your answer and explain your reasoning*.

   Hint: d_{water} = 1.00 g/mL; $d_{mercury}$= 13.5 g/mL

   b.) Calculate the height of water in millimeters meters (**m**) and in feet (**ft**). *Show work using dimensional analysis, correct sig figs and circle your answers*.

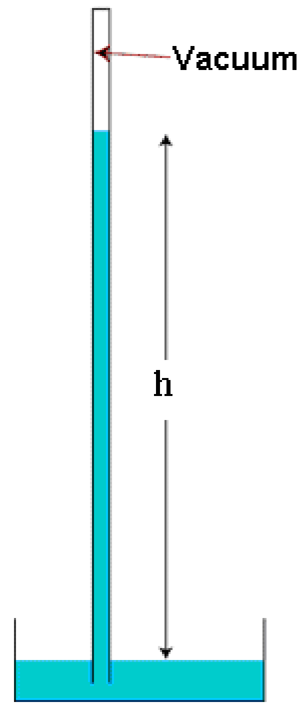


Figure 1. A Torricelli barometer containing water