Chapter 5
Gases

Objectives: 12 Science, Strand III, L.O. 2

5.1 Pressure

Barometer: Gas pressure (or air pressure) is caused by the collisions of particles over a surface area. Measured with a devise called a barometer (invented in 1608 by Evangelista Torricelli). Compare a flexible walled evacuated capsule used in portable aneroid barometers. A long ,glass capillary tube is filled with Hg and inverted. The height of the column is equal to the pressure of the air.
Units of Pressure: *standard* 1 atmosphere = 760 torr = 760 mmHg = 29.92 in Hg = 101.325 kPa
Manometer: Devise used to measure the pressure of a confined gas.

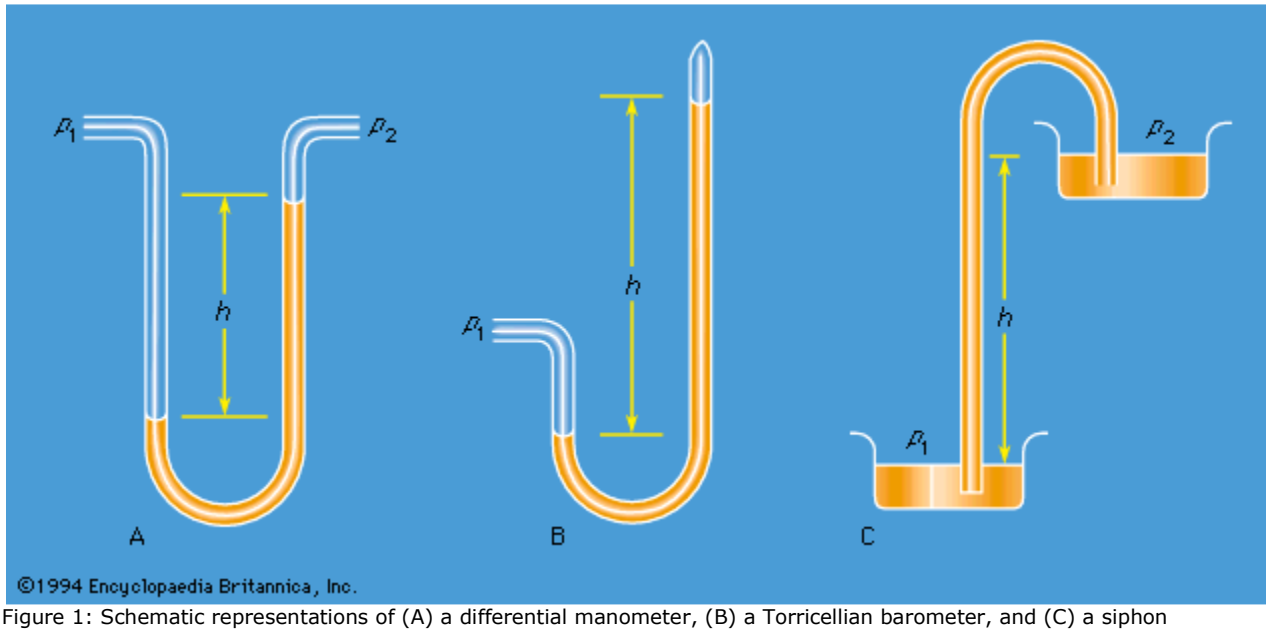


Figure 1: Schematic representations of (A) a differential manometer, (B) a Torricellian barometer, and (C) a siphon

In Class Practice: Conversion of Sept. 14, 2008 Wind Storm (29.44 in Hg to kPa, atm, torr, and mm Hg)

Pre Gas Law, In-Class Discussion
P. 217 (Active Learning Questions) #2 (c.), 4, 5 (e.), 6, 7(adding moles!), 8(2:1) less volume by ½), 9(d.) P.218 Questions #17 (13.6x higher), 18 (lower pressure), 19(last graph incorrect), 20(If balloon expands then ΔP more significant than ΔT), 24 a. (iii & vii > ii. &vi), b. (all same), c. (vii)

5.2 Gas Laws; Boyle, Charles, and Avogadro

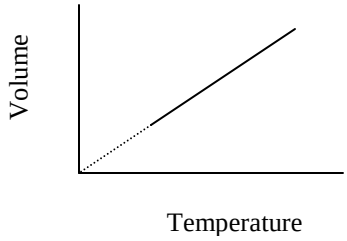
Scientific Laws: A Law give a similar result for a given predicament. Laws do not explain but express a relationship, usually mathematical. Universal truths.
Ideal Gas: strictly obeys the Gas Laws (i.e., no intermolecular attractions, point masses, elastic collisions, etc.) Most gases obey this at low pressures.

Boyle's Law: "*At constant temperature, the volume of a gas is inversely proportional to its pressure*"
Relationship: $PV = k$, or $P_1V_1 = P_2V_2$
Or where the rearranged $V = k\,(1/P)$ fits y=mx+b (b=0) and m (the slope) = k gives a straight line.
Used to predict the new volume of a gas.

Charles Law: *"At constant pressure, the volume of a gas is directly related to its absolute temperature"*

$\frac{V}{T} = k$ or $\frac{V_1}{T_1} = \frac{V_2}{T_2} = k$, so that V = *k* T fits y=mx + b, and b = absolute zero. The slope extrapolates to absolute 0 or -273ºC = 0 Kelvin.

Illustrate with graph V vs. T that a doubling of Celsius temperature does not double the volume of the gas. Or each 1ºC increase increases the volume only by 1/273rd of original volume.



Point 1: (V= 10 L, T= 25ºC)
Point 2: (V= ? L , T = 50ºC)

Avogadro's Law: *"At the same conditions temperature and pressure, equal volumes of gases have the same number of moles."*

V = a n, at constant pressure and temperature, the volume of a gas is directly proportional to the number of moles.

In Class Practice: P. 220 #46

Other: If 200.0g of Cl_2 gas are contained in a 5.0 gallon tank at 75 F and 18.2 PSI, what mass of nitrogen gas can also be held under these same conditions?

5.3 The Ideal Gas Law

Using the three gas laws mentioned earlier we can assemble these into one equation:

The Universal Gas Law: $V = R\left(\frac{Tn}{P}\right)$, or PV = n*R*T, where *R* is the universal gas constant

R = 0.08206 L · atm · mol^{-} · K^{-}

Used to describe a particular state of a gas at a given time. Describes its *ideal* pressure, volume, temperature, and number of moles of **any** *ideal* gas.

Or R = $\left(\frac{P_1V_1}{n_1T_1}\right) = \left(\frac{P_2V_2}{n_2T_2}\right)$

In Class Practice: P. 220 #48

Homework Practice: P. 219 # 29, 31, 34, 35, 36, 39, 40, 42, 43, 45, 50, 98, 101, 102