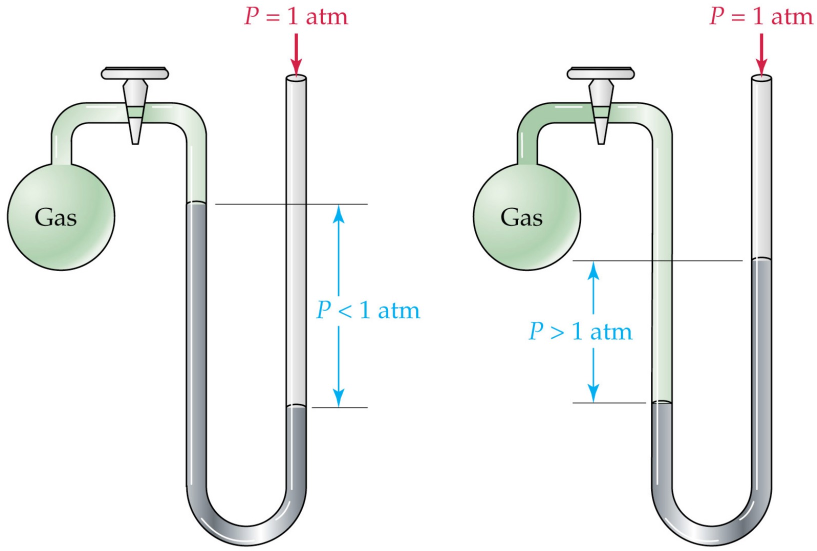
Explain the operation of a mercury barometer, an open end manometer, and a closed end manometer and be able to use the data obtained with these devises.

All of the instruments below operate on the same principle. They are liquid filled U shaped tubes in which the liquid is trapped and at least one surface is exposed to the atmosphere. If the pressure is different on the two end of the liquid column, that is P1 is different from P2, the liquid levels in the two arms of the U are different. The liquid level is higher on the low pressure end of the tube. Think of sucking on a soda straw to remember which side is higher the side with lower pressure. The difference in the liquid levels is proportion to the pressure difference and inversely proportional to the density of the material in the tube [$\Delta h \times d = \Delta P$]. In a closed end manometer and in a barometer (figures I and II) , the pressure in the closed end is almost zero. It is the vapor pressure of the liquid being used. Mercury is the most popular substance because it has a vapor pressure of 6×10^{-6} atm but other substances are used as well. Glycerol has a vapor pressure of 6×10^{-7} atm and dibutyl phalate's is 2×10^{-7} atm.



(a) (b)

Describe Boyle's Law

Robert Boyle observed that for a fixed amount of gas at constant temperature the product of volume and pressure is a constant. This means that the apparatus must not leak and also that no chemical change that produce or consume a gas may occur with in the container. There are no units specified for pressure of volume in Boyle's law. Any pressure unit is satisfactory. All pressures must be measured in the same units and so must be all volumes.

Discuss the significance of the absolute zero of temperature and be able to convert between Celsius and Kelvin temperature.

When Charles law is carefully considered, one concludes that a gas will occupy no volume once its Kelvin temperature has been lowered to zero. Charles law is not valid in the Celsius scale because at some point, one must divide by zero. It is important to remember that all temperatures in gas law problems must be solve in Kelvin.

Discuss Dalton's law of partial pressures and Amagat's law of partial volumes (remember, there are a lot of gas laws out there, know the principle, not the name!!)

Since ideal gas molecules do not attract or repel each other a mixture of several gases displays properties that are the sums of the individual gas properties. Each gas in a mixture acts as if the other gas were not present, unless a chemical reaction occurs. Thus, the total pressure is the sum of the partial pressures. The partial pressure is the pressure that the individual gas would exert if it were confined in the same volume at the same temperature as the mixture. In like fashion, the total gas volume is the sum of the partial volumes. The partial volume is the volume an individual gas would occupy if confined at the same pressure and temperature as the mixture. This is also true for moles. The total moles is the sum of the partial moles. The partial moles is the moles of the individual gas at constant pressure, volume and temperature. The additional feature of pressures and volume is valid only for ideal gases. For other states of matter —solids and liquids— only masses and amounts in moles can be summed to obtain the total mass and the total amount of the mixture.

State the postulates and the basic mathematical relationships of the kinetic molecular theory of gases.

The postulates are a set of assumptions on both the structure of gases and how gas molecules. interact. One form is

- Gases are composed of molecules and/or atoms
- Gas molecules have no volume, they are "point" masses
- Gas molecules neither attract nor repel each other. There are no forces between them
- Gas are in constant random motion

Deduce the simple gas laws form the kinetic molecular theory.

Consider Boyle's law as an example. A consequence of random motion of molecules is that molecules continually hit the sides of the container. Their average molecular speed and thus the average force exerted by each collision with the wall, depends only on the temperature. If the gas is now compressed into a smaller volume, each collision still has the same force, but there are many more collisions. If the volume is halved there are twice as many collisions and the pressure will double. You can produce the same type of explanation for all of the ideal gas relationships.