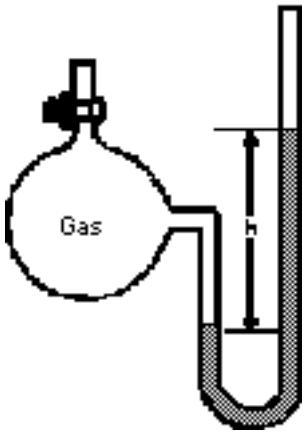
Name:_____

Test #5: Kinetic Molecular Theory

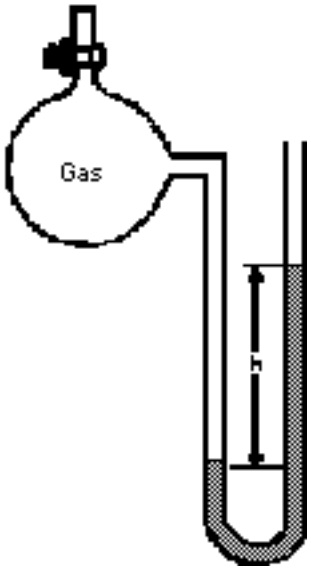
Conversions:
1 atm=760.0 mM Hg=760.0 Torr=14.70 psi=1.013 Bars=1033 cM water=101.325 kPa

1. The molar volume of a gas is the volume occupied by one mol of the gas. Obviously this volume is not constant but is a function of pressure and temperature. At STP this value is 22.4 L. Calculate the molar volume of an ideal gas at room temperature, 23 °C, and 740 mM Hg of pressure?

2. Professor Dy Sprosium adds hydrogen to an evacuated bulb like the one shown to the right and stops when the difference in the heights of the mercury columns, **h**, is 205 mM. Examine the figure carefully and determine the pressure of the gas in the bulb in torrs and atmospheres? (Note: The atmospheric pressure and temperature when the measurement was taken were 740 torr and 28 °C.)



3. At the same time and in the same laboratory Dy's assistant Mo Lybdenum adds helium to an evacuated bulb like the one shown to the right and stops when the difference in the heights of the mercury columns, **h**, is 205 mM. Determine the pressure of the gas in the bulb in torrs and atmospheres? If this pressure is different from that determined in question 2, suggest a reason why?



4. Samples of HCl and $(C_2H_5)_2NH_2$ were placed into opposite ends of a 100 cm glass tube. At what distance from the HCl end of the tube will the two gases meet and react?

5. In 1898 Ramsay and Travers discovered and isolated an unknown gas from the atmosphere. The concentration of the gas in the atmosphere is about 1 ppm. At STP the density of this gas was 3.741 G/L. Determine the molecular weight of the gas. The name given to the gas comes from the Greek word for "hidden". What is the identity of the gas?

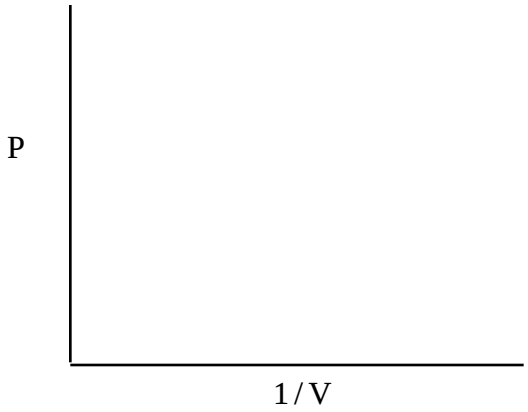
6. In 1766 Cavendish prepared hydrogen by passing steam through a red hot gun barrel. The reaction was: $H_2O + Fe \text{ ------> } Fe_3O_4 + H_2$

   What volume of hydrogen at a pressure of 783 torr and a temperature of 21 °C can be prepared from the reaction of 10 grams of water.

7. During the production of wine dextrose is converted to ethanol and carbon dioxide through the action of yeast. The reaction is: $C_6H_{12}O_6$ ------> $C_2H_5OH + CO_2$
The carbon dioxide is allowed to escape through a tube or vent to the atmosphere. While Little Red Riding Hood was making some "medicinal" wine for her grandmother the vent became plugged and the carbon dioxide was trapped in the 1 liter space above the fermenting grape juice. What pressure would result, at 740 mM Hg and 25 °C, from the fermentation of one gram of dextrose.

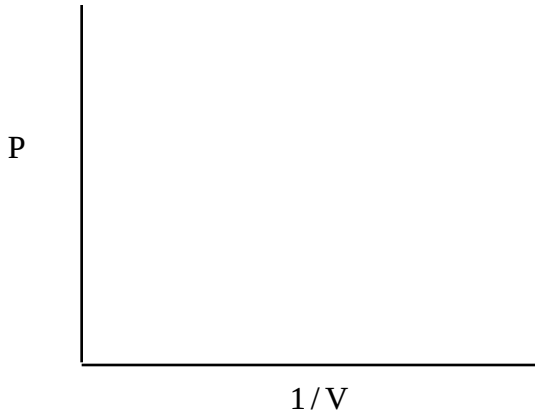
8. Within a tenth of a second of the Creative Event (CE) the laws of physics and chemistry, as we know of them, were "crystallized". One of the outcomes of these laws was the familiar ideal gas equation: PV=nRT. Lets assume that there exists another universe where the laws of chemistry and physics ended up being different after the CE. In this universe the ideal gas law turned out to be: PVT=nR. Sketch the following plots for both universes. After sketching your plot give the value of the slope for <u>all linear plots</u>.

a) Pressure vs 1/Volume at constant temperature.



Our Universe

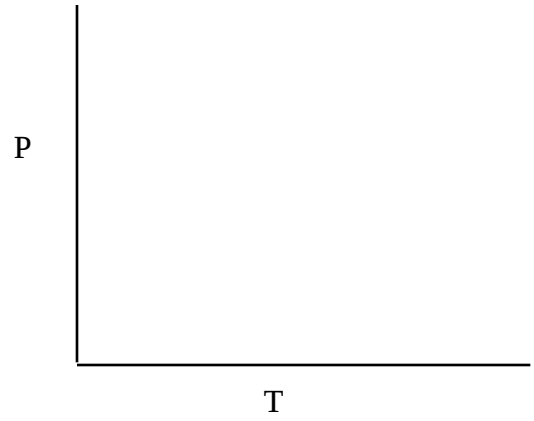
slope=_____



The New Universe

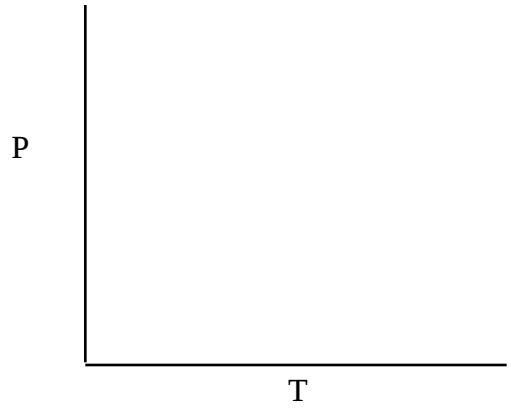
slope=_____

b) Pressure vs Temperature.



Our Universe

slope=_____



The New Universe

slope=_____

One Step Beyond

In our universe kinetic energy is directly proportional to the temperature. That is, KE=kT, where k is a constant. Would this still hold true for the new universe referenced in question 8 above? If you decide that a different relationship would exist between kinetic energy and temperature, what would it be?