PROBLEM SET – 1-1

DEFINITIONS AND PROPERTIES OF GASES

1. Calculate the followings:

a) The molar volume of an ideal gas at 20 ^oC and 1.000 bar
b) The density of N_2 at 20 ^oC and 0.967 bar
c) The volume of one mole of an ideal gas at *i)* 0^oC & 1 atm; *ii)* 25^oC & 1 atm; *iii)* 100^oC & 1 atm.
d) For a certain hydrocarbon gas, 20.0 mg exerts a pressure of 24.7 torr in a 500 cm^3 vessel at 25 ^oC. Find the molecular weight of the gas.
e) The density of gaseous HBr at 0^oC and 1 atm is 3.64-44 g/l. Find the volume that would be occupied by one mole of HBr under these conditions.

2. The mole fraction of main components of dry air at sea level are 0.78 for nitrogen, 0.21 for oxygen, 0.0093 for argon and 0.0003 for carbon dioxide. Find the partial pressure of each of these gases in dry air at 1.00 atm and 20 ^oC.

3. Calculate the pressure in atmospheres exerted by 2.00 moles of chlorobenzene vapor confined to 10.0 liters at 25^oC,

a) using the ideal gas law
b) using the van der Waals' equation of state. (a = 25.43 L^2.atm.mole^{-2} ; b = 0.1453 L.mole^{-1})

4. The following data for the density of a gas at 300 K are given:

P (atm)	0.4000	0.8000	1.000
Density (g/lt)	1.512	3.088	3.900

Find the molecular weight of the gas as accurate as possible.

5. For a gas described by the Berthelot equation,

$$P = \frac{RT}{\bar{V} - b} - \frac{a}{T\bar{V}^2}$$

Express a, b, and R in terms of critical constants and write the equation of state in terms of reduced variables.

6. For 1.00 mole of N_2 gas at 0 ^oC, the following volumes are observed as a function of pressure:

P, atm	1.0000	3.0000	5.0000
V, cm^3	22405	7461.4	4473.1

Calculate and plot PV/nT vs P for these points and extrapolate to P=0 to evaluate R.

7. The virial equation that has been given for one mole of methane at 20 ^oC is,

$$P\bar{V}/RT = 1- 2.0236 \times 10^{-3}P + 3.723 \times 10^{-6} P^2$$

Calculate the compressibility factor for methane at 20 ^oC and 150 atm.