Chemistry-4311
September 5, 2014

Quiz #1 **Name** Key

1. Matching (Use a letter only once)

In the van der Waals eq. $(P + an^2/V^2)(V - nb) = nRT$, the "a" term corrects for the j of the gas molecules.

N_2 gas molecules behave more non-ideally than CH_3OH gas molecules; yes or no. c

The Boltzmann constant k_B equals e.

According to the kinetic theory of gases, the average translational energy for a mole of N_2 molecules is f.

The ideal gas law equation is d.

a. volume
b. $mv^2/2$
c. no
d. $PV = nRT$
e. R/N_A
f. $3RT/2$
g. yes
h. $P/V = nRT$
i. R/T
j. attractive forces

(2) 2. Starting with the ideal gas law equation, show that $P = dRT/M$, where d is the density and M the molar mass.

$n = \frac{w}{M}$ where w is the mass

$w/V = d$

$PV = nRT$

$PV = \frac{w}{M}RT$

$P = \frac{w}{V}\frac{RT}{M} = \frac{dRT}{M}$

(1) 3. The mass of one atom of the carbon-12 isotope is 12 amu. What is the mass of this atom in grams?

1 atom = 12 amu

1 mole = 12 grams

$1 \text{ atom} = \frac{12 \text{ grams/mole}}{6.02 \times 10^{23} \text{ atoms/mole}}$

$= 1.99 \times 10^{-23}$ g

(2) 4. A 1 atm gas mixture contains 12.0 grams of N_2 and 19.0 grams of O_2; $M_O = 16.0$ g and $M_N = 14.0$ g.

a. What are the mole fractions of N_2 and O_2?

(1/2) $n_{N_2} = 12.0/28.0 = 0.429$

$n_{O_2} = 19.0/32.0 = 0.594$

$n_{Total} = 0.429 + 0.594 = 1.023$

$x_{N_2} = 0.429/1.023 = 0.419$

$x_{O_2} = 0.594/1.023 = 0.581$

b. What are the partial pressures of N_2 and O_2?

(1/2) $P_{N_2} = x_{N_2} P_{total} = 0.419 \times 1 \text{ atm} = 0.419 \text{ atm}$

$P_{O_2} = x_{O_2} P_{total} = 0.581 \times 1 \text{ atm} = 0.581 \text{ atm}$