Nicholas Brown
000968160
HW#2, Due: 9/17/12

Questions #7 and #21 were graded
Excellent work: 20/20….Prof. Alam

Question #7

Given/Known:

$n = 2.00 - \boldsymbol{mol}$

$V = 5\boldsymbol{L} = \ 5\boldsymbol{L} \ * \frac{10^{-3}\boldsymbol{m^3}}{1\boldsymbol{L}} = 5 * 10^{-3}\ \boldsymbol{m^3}$

$P = 8.00\ \boldsymbol{atm} = \ 8.00\ \boldsymbol{atm} \ \ \frac{101{,}325\ \boldsymbol{Pa}}{1\ \boldsymbol{atm}} \ = 810{,}600\ \boldsymbol{Pa}$

$N = nN_a\ (Avogadro's\ Number, N_a, is\ 6.022 * 10^{23}\boldsymbol{mol^{-1}})$

Solution:

$K_{av} = \frac{1}{2} m_0 (v_{ave})^2$

$PV = \ \frac{2}{3}\ N\ \ \frac{1}{2} m_0 v^2$

So, combining these equations: $K_{av} = \ \frac{3PV}{2N}$

$$K_{av} = \frac{3 * (810600\ \boldsymbol{Pa}) * (5 * 10^{-3}\ \boldsymbol{m^3})}{2 * (2.00\ \boldsymbol{mol}) * (6.022 * 10^{23}\boldsymbol{mol^{-1}})} = 5.05 * 10^{-21}\ \frac{\boldsymbol{J}}{\boldsymbol{molecule}}$$

Question #11

Given/Known:

$Period = 1s$

$\#\ N_2\ molecules = 5.0 * 10^{23}\ \boldsymbol{molecules}$

$Area = 8.0\boldsymbol{cm^2} = 8.0 * 10^{-4}\ \boldsymbol{m}^2$

$v_m = 300\frac{\boldsymbol{m}}{\boldsymbol{s}}$

$Mass\ of\ N_2 = 4.65 * 10^{-26}\boldsymbol{kg}$

Solution:

$$F_{ave} = \frac{2m_o v}{\Delta t} = \frac{(2)(5.0 * 10^{23}\ \boldsymbol{molecules})(4.65 * 10^{-26}\boldsymbol{kg})(300\frac{\boldsymbol{m}}{\boldsymbol{s}})}{1s} = 14.0\boldsymbol{N}$$

$$P = \frac{F_{ave}}{Area} = \frac{14.0\boldsymbol{N}}{8.0 * 10^{-4}\ \boldsymbol{m^2}} = 17500\ \boldsymbol{Pa}$$

Question #13

Given/Known:

$C_p = \frac{7}{2}R$

$C_v = \frac{5}{2}R$

After warming

$P = 3P_o$

$V = 2V_o$

Solution:

Step One

$Q = nC_p\Delta T$

$n = \frac{PV}{RT}$

Combining these equations: $Q = \frac{PV}{RT}(C_p\Delta T)$

$Q_{Step\ 1} = \frac{7}{2} P_o 2V_o = 7P_oV_o$

Step Two

$Q = nC_v\Delta T$

So, $Q = \frac{PV}{RT}(C_v\Delta T)$

$Q_{Step\ 2} = \frac{5}{2} 3P_o 2V_o = 15P_oV_o$

$Q_{total} = 7P_oV_o + 15P_oV_o = \boldsymbol{22P_oV_o}$

Question #21

Given/Known:
$T_1 = 300K$
$V_2 = 2V_1$
$y = 1.4$

Solution:
$P_1V_1 = P_2V_2$
$PV^y = constant$
$P = \frac{nRT}{V}$

Combining these equations: $\frac{nRT}{V_1} V_1^y = \frac{nRT}{V_2} V_2^y$

$$\frac{\cancel{nR}T_1}{V_1} V_1^y = \frac{\cancel{nR}T_2}{V_2} V_2^y \rightarrow \frac{T_1}{V_1} V_1^y = \frac{T_2}{V_2} V_2^y \rightarrow T_1V_1^{y-1} = T_2V_2^{y-1}$$

$$T_1V_1^{y-1} = T_2(2V_1)^{y-1} \rightarrow T_1(1)^{y-1} = T_2(2)^{y-1}$$

$$(300K) = T_2(2)^{.4}$$

$$\boldsymbol{T_2 = 227K}$$