Ideal Gas HW #2 #7-9, 15-17 | Fecha:

(7) Flask $V = 300\ mL$ ($\nearrow .003\ m^3$) w/ air at $P = 5.00 \times 10^5\ Pa$ $T = 300\ K$
Flask loses molecules at $3.00 \times 10^{19} \cdot s^{-1}$. After how much time will $P_2 = \frac{P_1}{2}$

<u>Initial</u>

A) Solve for $n_1 = \frac{P_1 V}{RT} = \frac{(5.00 \times 10^5 \frac{N}{m^2})(3 \times 10^{-3}\ m^3)}{(8.31 \frac{J}{K\,mol})(300\ K)} = 0.60\ moles$

B) Convert to molecules (N_1)

$.60\ moles \times \frac{6.02 \times 10^{23}\ molecules}{mole} = 3.61 \times 10^{23}\ molecules$

<u>Final</u>

C) Solve for $n_2 = \frac{P_2 V}{RT} = \frac{(2.50 \times 10^5 \frac{N}{m^2})(3 \times 10^{-3}\ m^3)}{(8.31 \frac{J}{K\,mol})(300\ K)} = 0.30\ moles$

D) Convert to molecules (N_2)

$0.30\ moles \times \frac{6.02 \times 10^{23}\ molecules}{1\ mole} = 1.81 \times 10^{23}\ molecules$

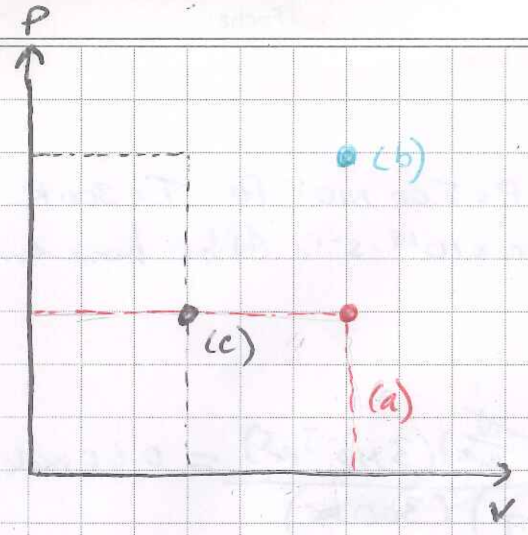
E) 1.80×10^{23} molecules (lost) $\times \frac{1\ s}{3.00 \times 10^{19}\ molecules} = 6000\ s$ = **10 mins**

— over —

Constant Temp = 600 K

Fecha:

(8)



(a) Volume doubles (T constant) $V_2 = 2P_1$

$P_1V_1 = P_2V_2$ $\quad P_1V_1 = P_2 \cdot 2V_1$ $\quad P_2 = \frac{P_1}{2}$

b) Volume doubles (P constant) $V_2 = 2V_1$

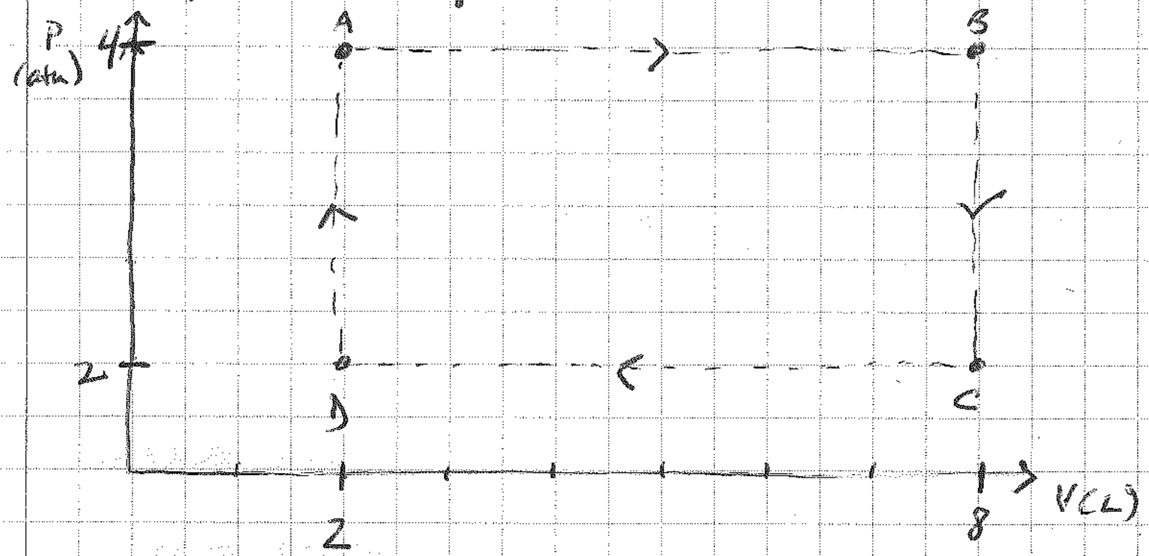
$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $\quad \frac{V_1}{T_1} = \frac{2V_1}{T_2}$

c) Pressure cuts in half $P_2 = \frac{P_1}{2}$

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$ $\quad \frac{P_1}{T_1} = \frac{P_1}{2T_2}$ $\quad T_2 = \frac{T_1}{2}$

Fecha:

(4) Fixed quantity of an ideal gas at T = 300K goes through several P & V changes.



(a) Find temp of gas at each corner.

B. $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $T_2 = \frac{V_2}{V_1} \cdot T_1 = \frac{8}{2}(300K) = 1200K$

C. $\frac{P_1}{T_1} = \frac{P_2}{T_2}$ $T_2 = \frac{P_2}{P_1} \cdot T_1 = \frac{2}{4}(1200K) = 600K$

D. $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $T_2 = \frac{V_2}{V_1} \cdot T_1 = \frac{2}{8}(600K) = 150K$

(b) Internal energy is greatest at (B).

Fecha:

(15) Balloon w/ $V = 404\,m^3$ filled w/ He (mass = 70.0 kg)
Temp. inside balloon = 17.0°C P = ?

$n = 70{,}000\,g \times \frac{1\ \text{mole He}}{4.00\,g} = 17{,}500$ moles

$P = \frac{nRT}{V} = \frac{(17{,}500)(8.31 \frac{m^2 kg}{s^2 K\,mole})(290\,K)}{404\,m^3} = \boxed{104{,}389\ Pa} = \boxed{104.4\ kPa}$

(16) Flask $V = 5.0 \times 10^{-4}\,m^3$ full of air at T = 300K and P = 150 kPa

(a) n = ? $n = \frac{PV}{RT} = \frac{(150{,}000\,Pa)(5.0 \times 10^{-4}\,m^3)}{(8.31 \frac{m^2}{kg^2 K \cdot mol})(300\,K)} = \boxed{.030\ \text{moles}}$

(b) $.030\ \text{moles} \times \frac{6.02 \times 10^{23}\ \text{molecules}}{1\ \text{mole}} = \boxed{1.81 \times 10^{22}\ \text{molecules}}$

(c) mass of air = $.030\ \text{moles} \times \frac{29\,g}{1\ \text{mole}}$ $\boxed{0.87\,g}$

(17) Molar mass of He is 4.00 g

(a) V = ? for 1 mole of He at STP $V = \frac{nRT}{P} = \frac{(1)(8.31)(273)}{(1.013 \times 10^5)} = \boxed{22.4\,L}$
$V = .022\,m^3$

(b) Density of He at STP = $\frac{\text{mass}}{\text{Volume}} = \frac{4.00\,g}{.022\,m^3} \approx \boxed{182\,\frac{g}{m^3}} = .182\,\frac{kg}{m^3}$

(c) Density of O at STP = $\frac{\text{mass}}{\text{Volume}} = \frac{32.00\,g}{.022\,m^3} = \boxed{1455\,\frac{g}{m^3}} = 1.46\,\frac{kg}{m^3}$