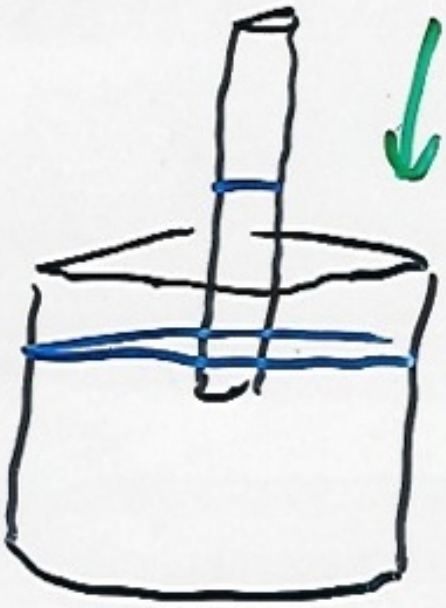
1



0.007 atm Mars

- the level of the water will not rise very high in the straw

3

$P = 1$

12 particles

at constant Temp. and Volume

→

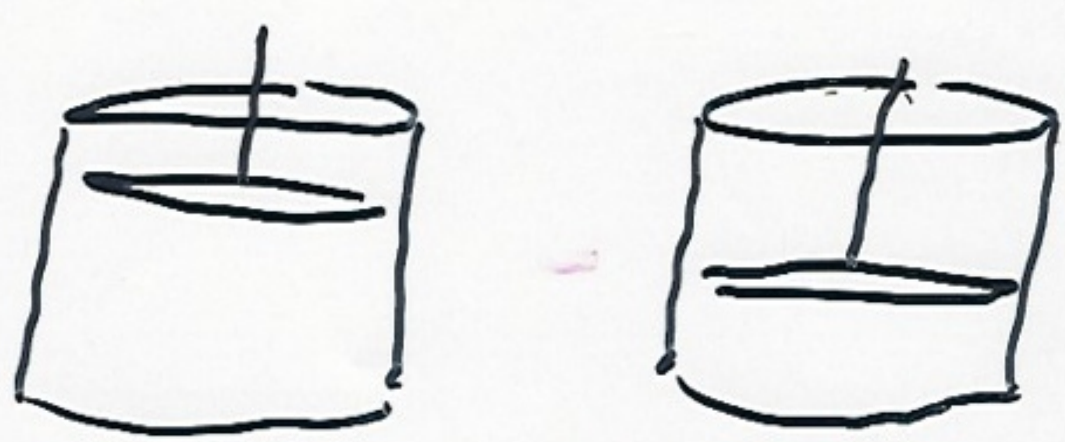
$P = \frac{1}{2}$

6 particles

4

$$2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}$$

at constant pressure and Temp.



less gas
less volume

4 b.

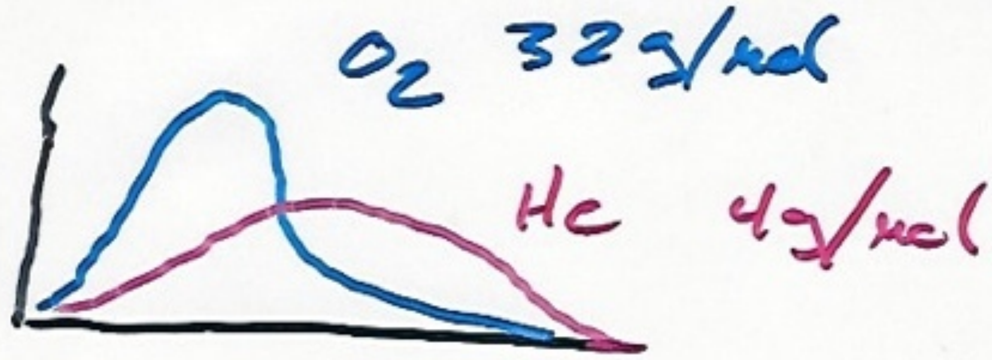
3 mols gas   2 mols gas

$$2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}$$

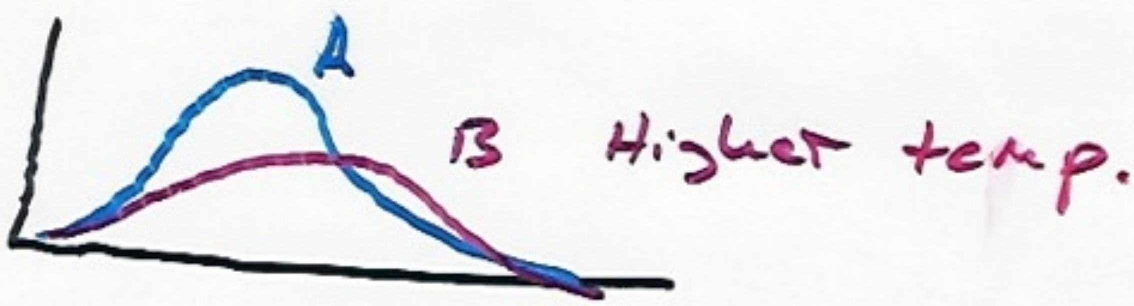
constant volume and Temp.

the pressure goes down

9

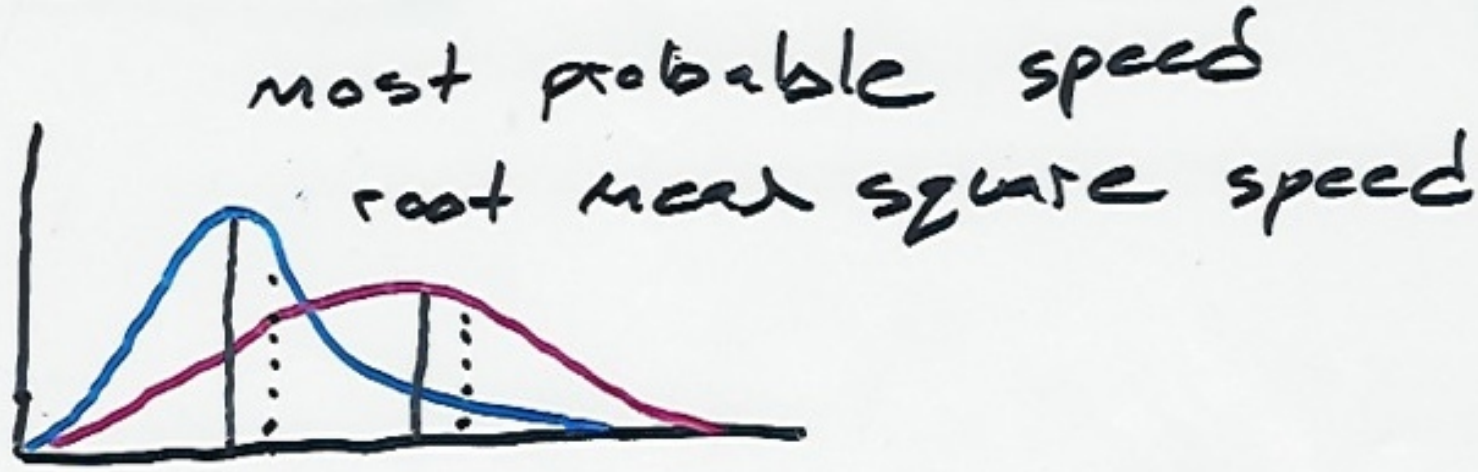


a. At the same Temp. He would have a greater ave speed.



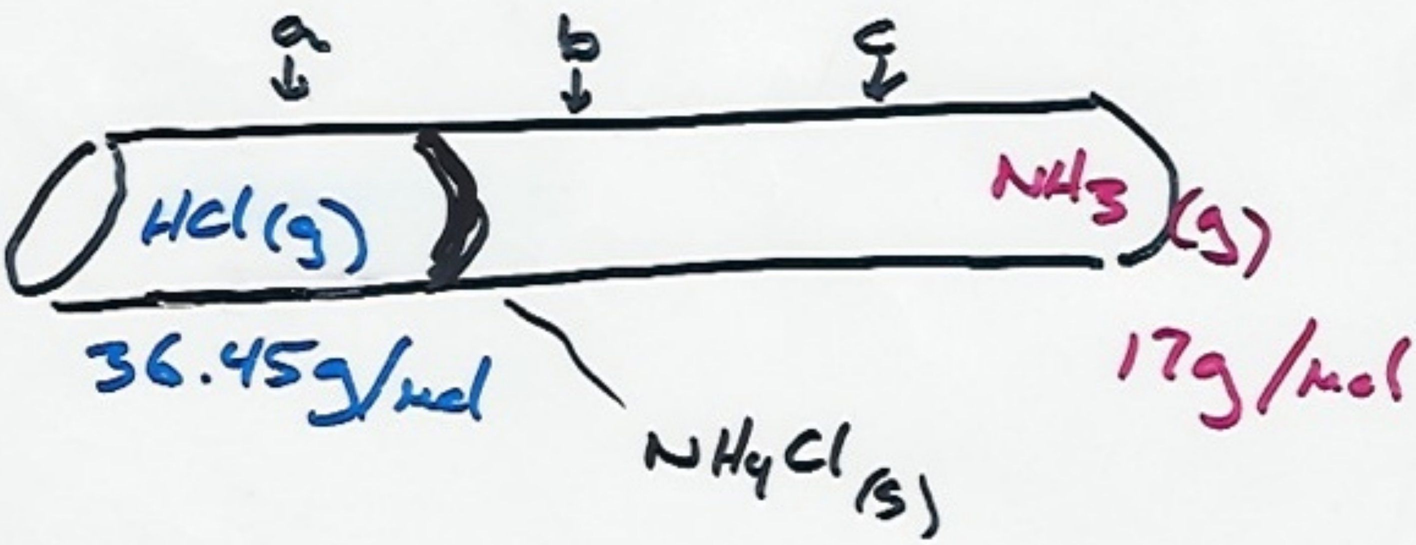
b. If curves A and B represent the same gas, curve B would represent a higher temp. More molecules moving at higher speeds.

9c.



more opportunity to go faster

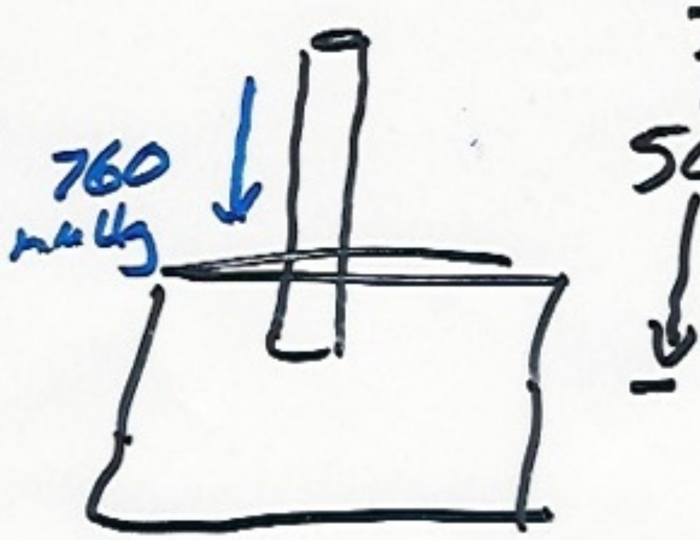
11



Ammonium chloride solid would form closer to the HCl(g) side of the tube because $NH_3(g)$ diffuses faster.

$$\frac{\text{Rate } NH_3}{\text{Rate } HCl} = \frac{\sqrt{MM_{HCl}}}{\sqrt{MM_{NH_3}}}$$

20



50cm = 500mm

The Hg would rise to the top of the tube.

22

a. $0.912\,atm \times \frac{760\,torr}{1\,atm}$

$= 693\,torr$

c. $655\,mmHg \times \frac{1\,atm}{760\,mmHg}$

$= 0.862\,atm$

d. $1.323 \times 10^5\,pa \times \frac{1\,kpa}{1000\,pa}$

$\times \frac{1\,atm}{101.3\,kpa} = 1.306\,atm$

25

$P_{gas} = P_{atm} - h_{Hg}$

$0.995\ atm \times \frac{760\ mmHg}{1\ atm} = 756.2\ mmHg$

i $P_{gas} = 756.2\ mmHg - 520\ mmHg$

$= 236.2\ mmHg \times \frac{1\ atm}{760\ mmHg} =$

$= 0.31\ atm$

ii $P_{gas} = 756.2\ mmHg + 670\ mmHg$

$= 1423.2\ mmHg \times \frac{1\ atm}{760\ mmHg}$

$= 1.87\ atm$

iii $P_{gas} = 756.2\ mmHg + 103\ mmHg$

$= 859.2\ mmHg \times \frac{1\ atm}{760\ mmHg} =$

$= 1.13\ atm$

28

$$752\ torr \times \frac{1\,atm}{760\ torr} = 0.989\,atm$$

$$273 + 21 = 294\ K$$

a. $PV = P_2V_2$

$$(0.989\,atm)(5.12\,L) = (1.88\,atm)(V_2)$$

$$V_2 = 2.69\,L$$

b. $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$$\frac{5.12\,L}{294\ K} = \frac{V_2}{623\,K} \qquad V_2 = 10.8\,L$$

30

$$N_2 + 3H_2 \rightarrow 2NH_3$$

1.2 L   3.6 L

$$3.6\,L\ H_2 \times \frac{2\,L\ NH_3}{3\,L\ H_2} = 2.4\,L\ NH_3$$

32

a. $T = 273k$

$P = 1atm$

b. $\frac{22.4L}{1mol}$ at STP

c. $V = \frac{nRT}{P}$

$$V = \frac{(1mol)\left(0.0821 \frac{L\,atm}{mol\,K}\right)(273+25)}{1atm}$$

$= 24.4L$

36

a. $V = \frac{nRT}{P}$

$$= \frac{(1.50\,mol)\left(0.0821\,\frac{L\,atm}{mol\,K}\right)(273 + (-6))}{1.25\,atm}$$

$V = 26.3\,L$

b. $T = \frac{PV}{nR} = \frac{(0.987\,atm)(0.478\,L)}{(3.33\times10^{-3}\,mol)\left(0.0821\,\frac{L\,atm}{mol\,K}\right)}$

$T = 1.73\times10^{3}\,K$

c. $P = \frac{nRT}{V}$

$$= \frac{(0.00245\,mol)\left(0.0821\,\frac{L\,atm}{mol\,K}\right)(273 + 138)}{0.413\,L}$$

$= 0.200\,atm$

36 d.

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

$$11.25\text{ kPa} \times \frac{1\text{ atm}}{101.3\text{ kPa}} = 0.111\text{ atm}$$

$$= \frac{(0.111\text{ atm})(126.5\text{ L})}{\left(0.0821\ \frac{\text{L atm}}{\text{mol K}}\right)(273+54)}$$

$$= 0.523\text{ mol}$$

39 a.

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

$$735\text{ torr} \times \frac{1\text{ atm}}{760\text{ torr}} = 0.967\text{ atm}$$

$$= \frac{(0.967\text{ atm})(2.25\text{ L})}{\left(0.0821\ \frac{\text{L atm}}{\text{mol K}}\right)(273+37)}$$

$$8.54 \times 10^{-2}\text{ mol} \times \frac{6.02 \times 10^{23}\text{ molec.}}{1\text{ mol}}$$

$$= 5.15 \times 10^{22}\text{ molecules}$$

39 b. $n = \frac{PV}{RT} = \frac{(1\,atm)(5 \times 10^3\,L)}{(0.0821\,\frac{L\,atm}{mol\,K})(273\,K)}$

$223\,mol \times \frac{28.98\,g\,air}{1\,mol} \times \frac{1\,kg}{1000\,g}$

$= 6.5\,kg\,air$

53

a. $\frac{n}{V} = \frac{P}{RT} = \frac{0.970\,atm}{(0.0821\,\frac{L\,atm}{mol\,K})(273+35)}$

$\frac{3.84 \times 10^{-2}\,mol}{L} \times \frac{46\,g}{1\,mol\,NO_2} = \frac{1.77\,g}{L}$

b. $n = \frac{PV}{RT}$ $\quad 685\,torr \times \frac{1\,atm}{760\,torr} = 0.901\,atm$

$= \frac{(0.901\,atm)(0.875\,L)}{(0.0821\,\frac{L\,atm}{mol\,K})(273+35)}$

$= \frac{2.50\,g}{3.12 \times 10^{-2}\,mol} = 80.2\,g/mol$

59

a. $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

$$24.5g\ C_6H_{12}O_6 \times \frac{1\ mol}{180g} \times \frac{6\ mol\ CO_2}{1\ mol\ C_6H_{12}O_6}$$

$$V = \frac{nRT}{P}$$

$$= \frac{(0.8166\ mol)(0.08121\ \frac{L\ atm}{mol\ K})(273 + 37)}{0.970\ atm}$$

$V = 21.4L$

b. $$50g\ C_6H_{12}O_6 \times \frac{1\ mol}{180g} \times \frac{6\ mol\ O_2}{1\ mol\ C_6H_{12}O_6}$$

$$= 1.67\ mol\ O_2$$

$$V = \frac{nRT}{P}$$

$$V = \frac{(1.67\ mol)(0.0821\ \frac{L\ atm}{mol\ K})(298\ K)}{1\ atm}$$

$V = 40.8L$

62

$$CaC_2 + 2H_2O \rightarrow Ca(OH)_{2(s)} + C_2H_{2(g)}$$

$$1.524g\ CaC_2 \times \frac{1mol}{64g} \times \frac{1mol\ C_2H_2}{1mol\ CaC_2} = 2.381\times10^{-2} mol\ C_2H_2$$

$$P_{total} - P_{H_2O} = P_{C_2H_2}$$

$$753\ torr - 21.07\ torr =$$

$$731.93\ torr \times \frac{1atm}{760\ torr} = 0.963\ atm$$

$$V = \frac{(0.02381\ mol)(0.0821\ \frac{L\ atm}{mol\ K})(273+23)}{0.963\ atm}$$

$$= 0.601\ L$$

66

$$51.2\,g\,O_2 \times \frac{mol}{32\,g} = 1.6\,mol\,O_2$$

$$32.6\,g\,He \times \frac{1\,mol}{4\,g} = 8.15\,mol\,He$$

$$P_{O_2} = \frac{(1.6\,mol)\left(0.0821\,\frac{L\,atm}{mol\,K}\right)(273+19)}{10.0\,L}$$

$$= 3.84\,atm$$

$$P_{He} = \frac{(8.15\,mol)\left(0.0821\,\frac{L\,atm}{mol\,K}\right)(273+19)}{10.0\,L}$$

$$= 19.5\,atm$$

$$P_T = P_{O_2} + P_{He}$$

$$= 3.84\,atm + 19.5\,atm$$

$$= 23.3\,atm$$

71

$$X_A = \frac{\text{moles A}}{\text{total moles}}$$

$$P_A = P_T X_A$$

$$\text{total moles} = 0.75\,\text{mol } N_2 + 0.30\,\text{mol } O_2 + 0.15\,\text{mol } CO_2$$

$$= 1.20\,\text{mol}$$

$$X_{N_2} = \frac{0.75\,\text{mol } N_2}{1.20\,\text{mol}} = 0.625$$

$$X_{O_2} = \frac{0.30\,\text{mol } O_2}{1.20\,\text{mol}} = 0.250$$

$$X_{CO_2} = \frac{0.15\,\text{mol } CO_2}{1.20\,\text{mol}} = 0.125$$

$$P_{N_2} = (2.15\,\text{atm})(0.625) = 1.3\,\text{atm } N_2$$

$$P_{O_2} = (2.15\,\text{atm})(0.250) = 0.54\,\text{atm } O_2$$

$$P_{CO_2} = (2.15\,\text{atm})(0.125) = 0.27\,\text{atm } CO_2$$

78 a. False, The average KE of a gas is proportional to temperature.

b. True

c. False, The molecules at a given temp. exhibit a distribution of kinetic energies.

d. True

e. False, Molecules exhibit a distribution of speeds at a given temperature.

84 a. $V = n\left(\frac{RT}{P}\right)$

The 2 systems have the same number of molecules at STP.

b. At STP N_2 is more dense.

$N_2 = 28\,g/mol$

$CH_4 = 16\,g/mol$

c. The averge KE of the 2 systems are equal.

d. CH_4 is lighter, therefore CH_4 effuses faster.

92

$$\text{Rate } O_2 = \frac{1L}{31s} = \frac{0.0322L}{s}$$

$$\text{Rate } x = \frac{1L}{105s} = \frac{0.0095L}{s}$$

$$\frac{\text{Rate } O_2}{\text{Rate } x} = \frac{\sqrt{MM_x}}{\sqrt{MM_{O_2}}}$$

$$\frac{0.0322L/s}{0.0095\ L/s} = \frac{\sqrt{x}}{\sqrt{32\ g/mol}}$$

$$x = 370\ g/mol$$

93 a. Gases do not behave in an ideal way at high pressures and low temperatures.

b. The 2 reasons gases do not behave in an ideal way are:

- gases take up space in their containers
- there are attractions between molecules

93

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

n should be constant under all conditions. If n is changing then the gas is not behaving ideally.

- Negative deviations are due to attractive forces
- positive deviations are due to the gas molecules taking up space in the container.

98 CCl_4 $T = (40 + 273)$

$n = 1.00\,mol$

$V = 33.3\,L$

a. $$P = \frac{(1.00\,mol)(0.0821\,\frac{L\,atm}{mol\,K})(273+40}{33.3\,L}$$

$= 0.772\,atm$

b. $$P = \frac{nRT}{V-nb} - \frac{an^2}{V^2}$$

$$= \frac{(1.00\,mol)(0.0821\,\frac{L\,atm}{mol\,K})(313\,K)}{33.3\,L - (1.00\,mol)(0.1383)} - \frac{20.4\,(1.00\,mol)^2}{(33.3)^2}$$

$= 0.7749 - 1.84 \times 10^{-2}$

$= 0.756\,atm$

98 CCl_4 $a = 20.4$

$b = 0.1388$

stronger intermolecular attractions causes the pressure to be less than the ideal gas.