(9/10) Day 4: CH301

Kinetic theory of gases

How fast do gases move?

LM08 & LM09 - Due @ 9am

PM/RT = density

Molar volume = Amt of space occupied by 1 mol of gas

@ given T & P.

Understand the Kinetic molecular theory

- relationship betwn T & KE
- explain mass & temp affect velocity of gas particles
- recognize gas sample, particles distribution

avg Kinetic energy is felt affected by ▶ temp [redacted]

rms = root mean square

mix of 2 gases, particles w/ different masses will have ▶ same KE, diff velocities (rms)

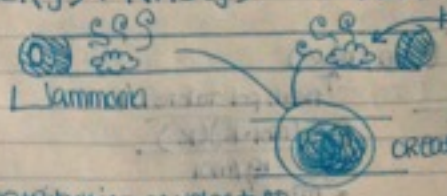
micro - quick

macro - significant size

What can we say about velocities of the N_2 gas molecules in room?

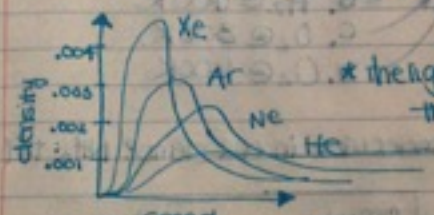
The molecules are moving @ a distribution of speeds in random direction.

$HCl(g) + NH_3(g) \longrightarrow NH_4Cl(s)$



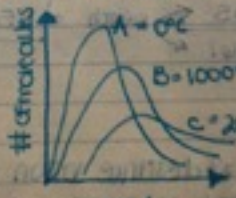
Distribution of velocities

Particles have a distribution of velocities



* the lighter molecule & smaller, the faster it goes

This is distribution for same molecule @ diff temp?

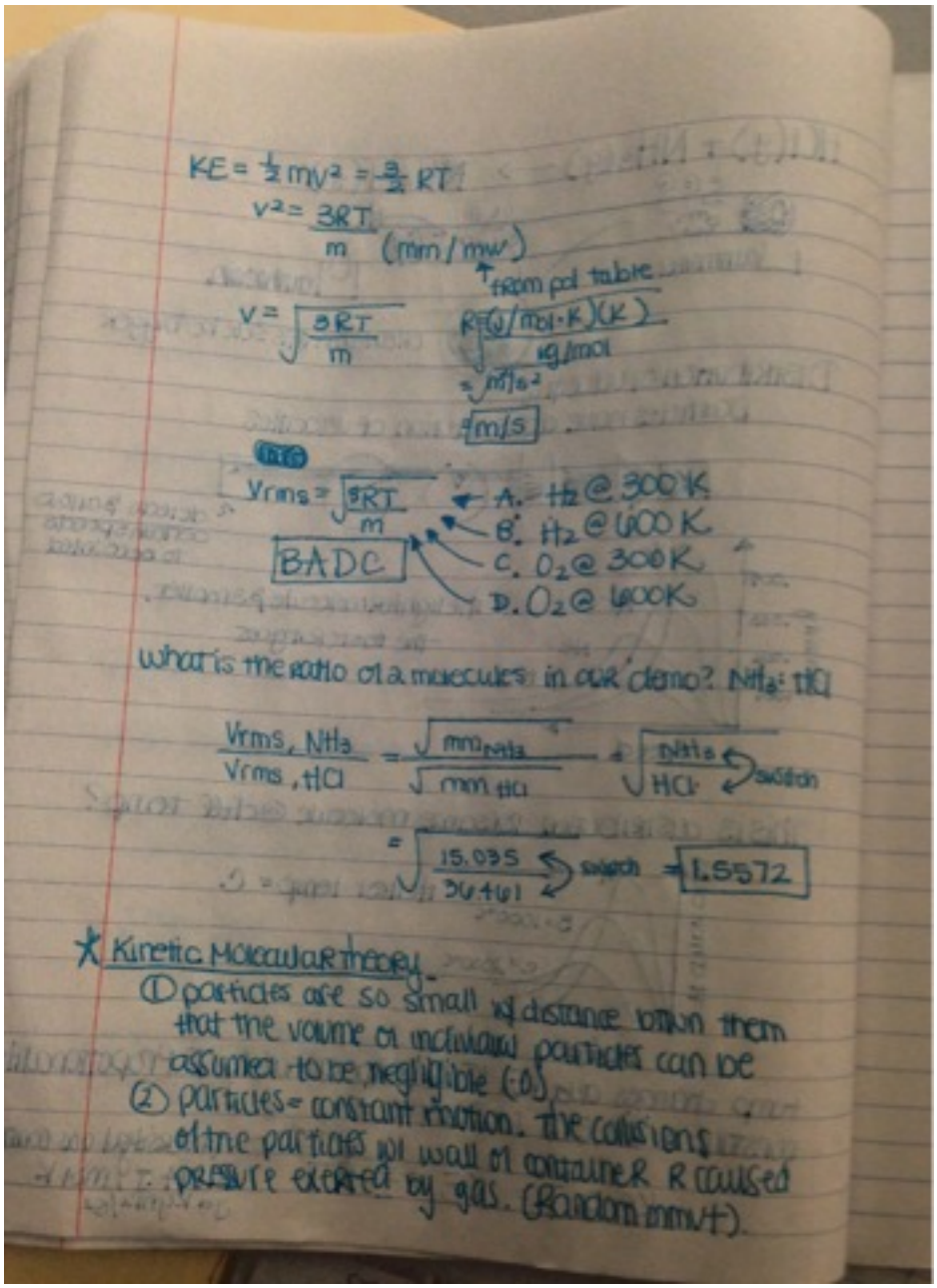


hotter temp = C

temp changes avg KE. KE is proportional to T Proportionality constant is the Gas constant R.

$KE \propto T = KE = \frac{3}{2} RT$ ← universal gas constant 8.314 J/mol K

$J = kgm^2/s^2$



$KE = \frac{1}{2}mv^2 = \frac{3}{2}RT$

$v^2 = \frac{3RT}{m}$ (mm/mv)

from pd table

$v = \sqrt{\frac{3RT}{m}}$ $\frac{R(J/mol \cdot K)(K)}{kg/mol} = \sqrt{m^2/s^2}$

$= m/s$

HW

$v_{rms} = \sqrt{\frac{3RT}{m}}$

BADC

A. H_2 @ 300 K
B. H_2 @ 600 K
C. O_2 @ 300 K
D. O_2 @ 600 K

what is the ratio of a molecules in our demo? $NH_3 : HCl$

$\frac{v_{rms}, NH_3}{v_{rms}, HCl} = \frac{\sqrt{mm_{NH_3}}}{\sqrt{mm_{HCl}}} = \sqrt{\frac{NH_3}{HCl}}$ switch

$= \sqrt{\frac{15.035}{36.461}}$ switch $= 1.5572$

★ Kinetic Molecular theory

① particles are so small w/ distance btwn them that the volume of individual particles can be assumed to be negligible (0)

② particles = constant motion. The collisions of the particles w/ wall of container R caused pressure exerted by gas. (Random mvmt).

③ particles = exert no force on each other ?
they do not attract or repel
④ Avg kinetic energy of collision of gas particles assumed directly proportional to Kelvin temp
(elastic collisions)

$P \propto T$

mass affects velocity, not pressure
pressure is proportional to # of collisions per second x "impact" of the collisions

$P \propto \sqrt{T}$ so $\sqrt{T} = T$

$P \propto n$

$P \propto 1/V$

$PV = nRT$

doesn't work / loss of assumption

Diffusion = gases disperse / spread out
Effusion = gases escape through small holes

Change pressure to turn into liquid