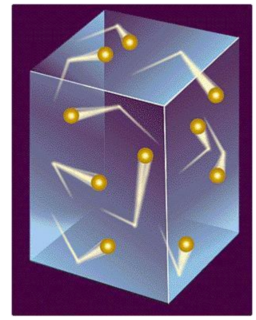
Gases

State of Matter

Form	Fluid (Flows)
Compressibility	Very High
Shape	Variable (Fills Closed Container)
Volume	Variable (Fills Closed Container)
Particle Movement	Random, Independent



Kinetic (Moving) Theory of Gases

Gases are composed of molecules in constant motion
Gas molecules move in random directions
Molecules of a gas collide frequently with each other & with vessel walls
(why gases mix to uniformity & fill all portions of the containment vessel)
Gas molecules move with an average velocity at a given temperature.
(the average energy of molecules in a gas is the same for all substances)
Distance between gas molecules >> than size of the individual molecules
(why gases can be compressed)
Molecules are perfectly elastic … no energy is lost when molecules collide
(If not-elastic, the temperature of a gas mix would always decrease with time)

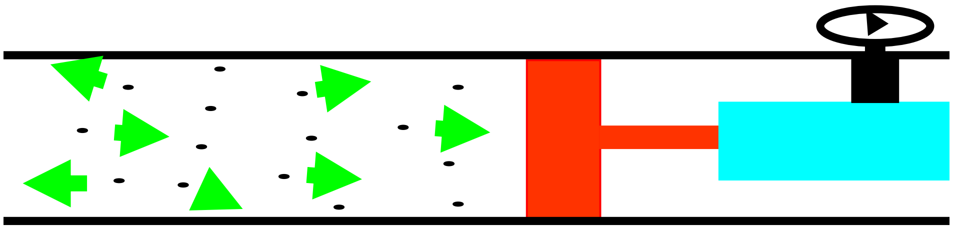
Molecular Explanation For Properties

Property		**Gas Molecules:**
Compressibility		Widely spaced
Low density		Widely spaced
Mixable		Widely spaced In constant, random motion
Fills container		In constant, random motion
Uniform pressure		In constant, random motion No energy loss collisions

Gas behavior is described in terms of:

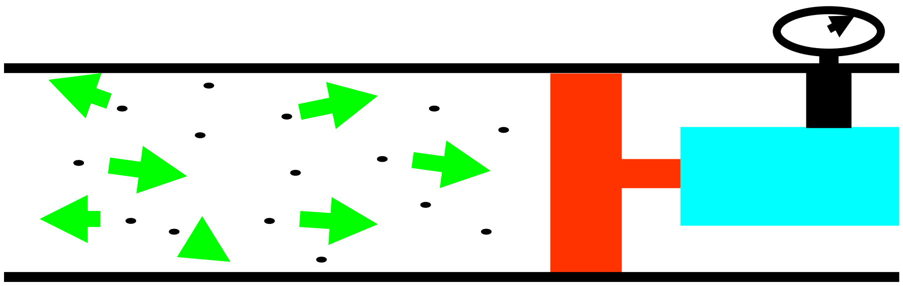
Volume	(V)
Pressure	(P)
Temperature	(T)
Quantity (moles)	(n)

Pressure is result of molecular impact on container walls



Pressure = force/area

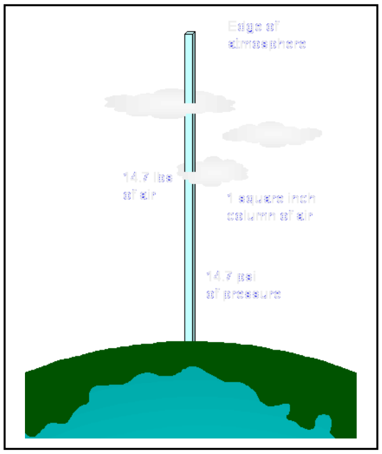
Increased pressure results from more impacts/time from higher energy molecules



PRESSURE

UNITS:

Related to atmosphere (atm)



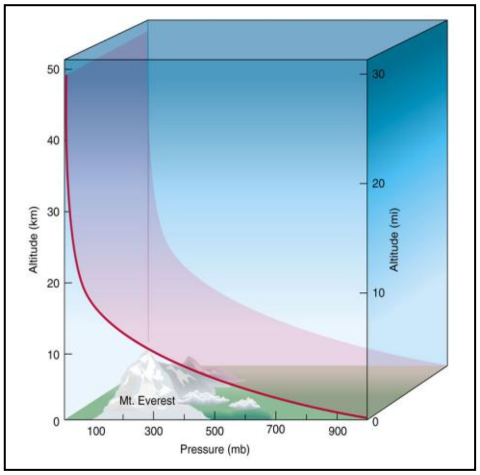
mm Hg (torr)
inches Hg
inches H_2O
atm

Related to force

pounds/in^2 (psi)
pascal (Pa)

"Per" Expressions

1mm Hg = 1 torr
1 atm = 760 mmHg
1 atm = 14.7 psi



Complete the following table of pressure measurements:

mmHg	torr	atm
465		
		2.41
	836	

Conversions:

465 torr x $\frac{1\ \text{mHg}}{\mathbf{1\ torr}}$ = 465 mmHg

2.41 atm x $\frac{760\ \text{torr}}{1\ \text{atm}}$ = 1830 torr

836 torr x $\frac{1\ \text{atm}}{760\ \text{torr}}$ = 1.10 atm

465 mmHg x $\frac{1\ \text{atm}}{760\ \text{mmHg}}$ = 0.612 atm

Completed Table

mmHg	torr	atm
465	465	0.612
1830	1830	2.41
836	836	1.10

Gauge vs. Absolute Pressure

Gauges have a zero point

Gauge zero point is really = atmospheric pressure

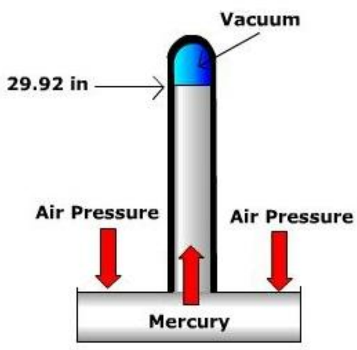
Absolute Pressure

Absolute pressure = pressure of gauge + atmospheric pressure

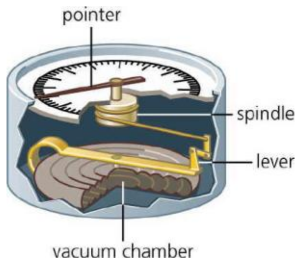
Barometer

Measures atmospheric pressure (weight)

Mercury



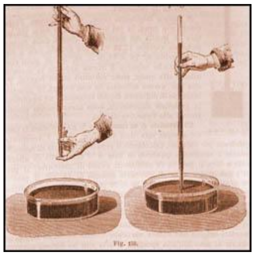
Aneroid



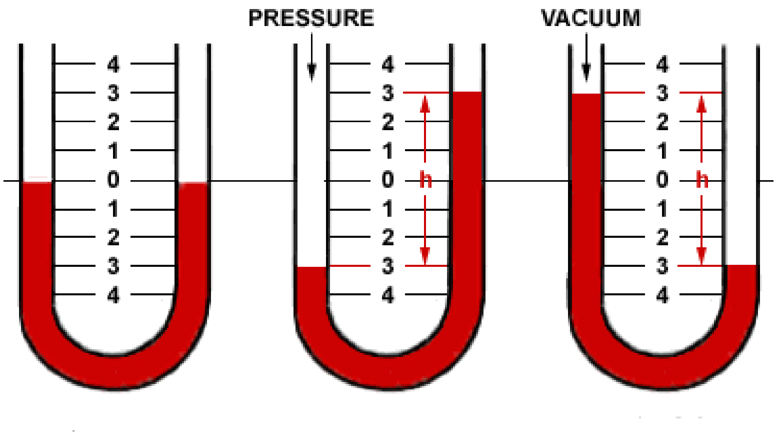
Evangelista Torricelli

Italian scientist
Invented the barometer in 1644
first man to create a sustained vacuum

Pressure unit torr in his honor



Manometer



U- Shaped tube connected to apparatus
Measures difference in column height as pressure

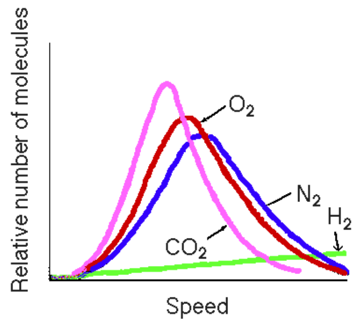
TEMPERATURE

The *average* kinetic energy (K.E.) of molecules

K.E. = energy of motion

= 1/2 mass(velocity)^2

As velocity (speed) slows, K.E. decreases & temperature falls.



At constant temperature, larger molecules move slower

Temperature Scales

Fahrenheit (^{o}F) **(Daniel Fahrenheit)**

Dutch scientist 1724 mercury column in closed tube

Three points

0 = coldest that could be reached with water, ice, sea salt

32 = water/ice mixture with no salt

96 = arm pit temperature

On this scale, water boils at 212

(water freezing and boiling points 180 units apart)

Celsius (Centigrade, ^{o}C) **(Anders Celsius)**

Swedish Astronomer 1742 international scientific scale

Two points

100 = freezing point of water

0 = boiling point of water

100 equal units between the two points

Order reversed in 1744 by Carolus Linnaeus

"Absolute " Temperature Scales

William Thompson (Lord Kelvin) 1848

Proposed a scale based on absolute zero as zero point

Uses the Centigrade (1/273 gas volume change) degree

Makes all temperatures have positive value

$K = {}^oC + 273$ ${}^oC = K - 273$

William Rankine 1859

Proposed a scale based on absolute zero as zero point

Uses the Fahrenheit degree

${}^oR = {}^oF + 459$ ${}^oF = {}^oR - 459$

Gas laws must use absolute temperatures

Temperature Conversions

$$^{o}F = 9/5\,^{o}C + 32$$

$$^{o}C = 5/9(^{o}F - 32)$$

$$K = ^{o}C + 273$$

By convention, there is no ^{o} symbol for degrees Kelvin

Gas Behavior: Equations (Laws)

Must use absolute temperature and pressure
We: Assume given pressure units = absolute
 Convert given Celsius temperature to Kelvin

"Ideal" Gases

Described by Kinetic Theory of Gases
Behavior predictable by "Ideal Gas Laws"
Valid at low pressures & high temperatures
Not valid at compressed gas cylinder pressures
 Need more complex "Real" Gas Equations

STP
Standard Temperature & Pressure

Standard Temperature = 0° C (273 K)
 Standard Pressure = 1 atm (760 torr)

At STP:
22.4 L = 1 mole of any gas
22.4 L weighs Molar Mass
22.4 L contains 6.02×10^{23} fu

Assignment

Start Taking Unit 8 Practice Test
 Blackboard only records highest score
 Take until multiple 100's have been scored (questions are variable)
 (Gives sense of test exam format and content)

The Practice Quiz is very similar to the Unit Exam
 Success on Unit exam is directly related to practice exam experience