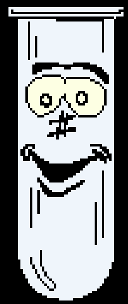


Unit 08 Outcomes

LPT

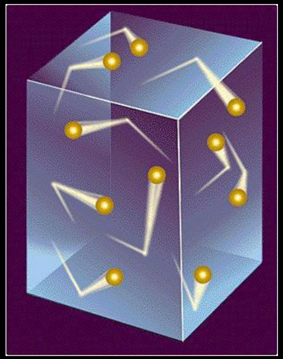
Identify characteristic properties of gases.

- may be compressed
- expand to fill their containers uniformly
- have low densities
- may be mixed
- exert constant uniform pressure on the walls of their containers

Identify 5 main features of the Ideal Gas Model

Gases are composed of molecules in constant motion
(why gases mix to uniformity & fill all portions of the containment vessel)
Gas molecules move in random directions
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)
Molecules of a gas collide frequently with each other & with vessel walls
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)

LPT



Explain physical phenomena in terms of the Ideal Gas Model.

Property	Explanation Gas Molecules:
Compressibility	widely spaced
expands to fill container	in constant, random motion
low density	widely spaced
may be mixed	widely spaced
constant uniform pressure	in constant, random motion collide with no energy loss

Define the term "pressure."

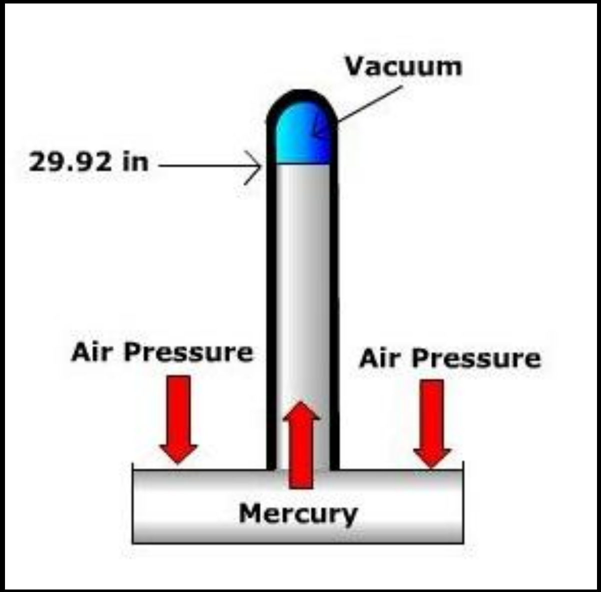
Pressure is result of molecular impact on container walls

Pressure = force per unit area

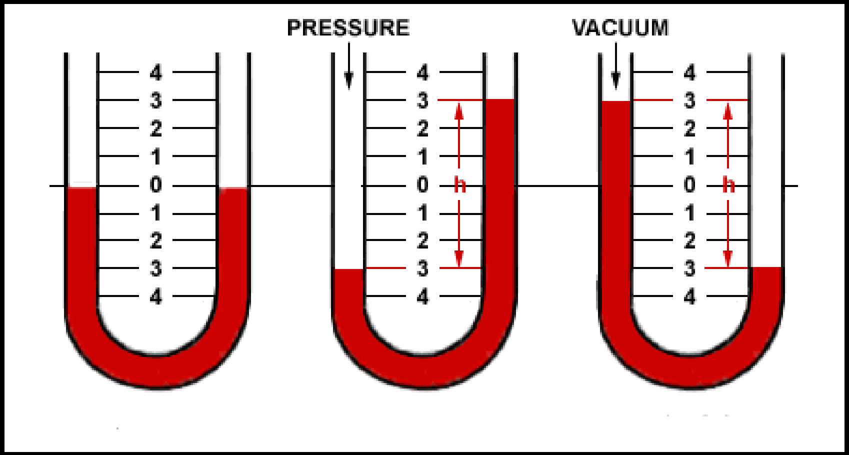
LPT

Describe the devices used to measure gas pressure.

Barometer



Manometer



Recognize units of pressure measurement:

mm Hg
atm
torr

LPT

Given a gas pressure in atmospheres, torr, mm of Hg, express that pressure in each of the other units

"Per" Expressions

1mm Hg = 1 torr

1 atm = 760 mmHg

1 atm = 14.7 psi

$$465 \text{ torr} \times \frac{1 \text{ atm}}{760 \text{ torr}} = 0.6118 \rightarrow 0.612 \text{ atm}$$

$$2.41 \text{ atm} \times \frac{760 \text{ torr}}{1 \text{ atm}} = 1831.0 \rightarrow 1830 \text{ torr}$$

Define the term "temperature."

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

K.E. = energy of motion

= 1/2 mass(velocity)^2

Define "Absolute Zero"

the point where no motion occurs

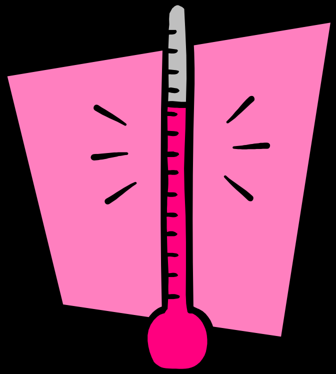
0 on the absolute (Kelvin) temperature scale

Convert between degrees Kelvin & in degrees Celsius

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

$52\ {}^{o}C + 273 = 325\ K$

$589\ K - 273 = 316\ {}^{o}C$



Identify the symbol STP

Standard Temperature & Pressure

List the values of STP

Standard Temperature : 273 K   (0° C)

Standard Pressure : 760 torr = 760 mm Hg = 1 atm

Describe the relationship between the volume of a gas and temperature

Charles's Law: at constant *pressure,* the volume is directly proportional to the absolute temperature

$$\frac{v_1}{t_1} = \frac{v_2}{t_2}$$

Describe the relationship between the pressure of a gas and temperature

Guy-Lussac's Law:At constant *volume,* the pressure is directly proportional to the absolute temperature

$$\frac{p_1}{t_1} = \frac{p_2}{t_2}$$

Describe the relationship between the volume of a gas and pressure

Boyle's Law: At constant *temperature,* the volume is indirectly proportional to the absolute pressure

$$p_1 v_1 = p_2 v_2$$

LPT

Charles Law Problem:

A sample of gas has a volume of 585.0 mL at 25.0 °C. What is the volume of the gas if the temperature is increased to 45.0 °C?

	P	V (mL)	Tc	Tk
Initial	-	585.0	25.0	298
Final	-	?	45.0	318

$$\frac{585\ \text{mL}}{298} = \frac{V}{318\ \text{K}} \rightarrow V = 624\ \text{mL}$$

LPT

Guy-Lussac Law Problem:

A sample of gas has a pressure of 585.0 mm Hg at 25.0 °C. What is the pressure of the gas if the temperature is increased to 145.0 °C?

	P	V	Tc	Tk
Initial	585.0	-	25.0	298
Final	?	-	145.0	418

$$\frac{585\ \text{mL}}{298} = \frac{P}{418\ \text{K}} \rightarrow P = 821\ \text{mm Hg}$$

LPT

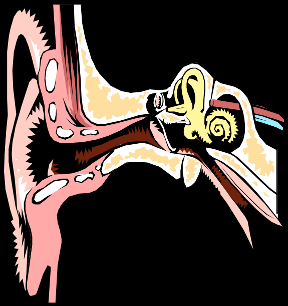
Boyles Law Problem:

A gas has a volume of 3.75 L at a pressure of 759.0 mm Hg. What is the volume of the gas if the pressure is decreased to 625.0 mm Hg?

	P(mm Hg)	V (mL)	Tc	Tk
Initial	759.0	585.0	-	-
Final	625.0	?	-	-

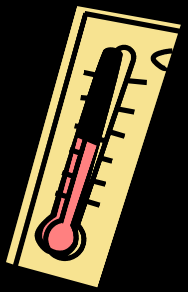
(759.0 mmHg) (3.75 L) = (625.0 mm Hg) V

V = 4.55 L



LPT

Given initial pressure (or temperature) & initial and final temperatures (or pressures) of a fixed quantity of gas at constant volume, calculate the final pressure (or temperature)



Convert ºC to K

Then, use Guy-Lussac's Law

$$\frac{p_1}{t_1} = \frac{p_2}{t_2}$$

Given the initial volume (or temperature) & initial and final temperatures (or volumes) of a fixed quantity of gas at constant pressure, calculate the final volume (or temperature)

Convert ºC to K

Then, use Charles's Law

$$\frac{v_1}{t_1} = \frac{v_2}{t_2}$$

Given initial volume (or pressure) & initial and final pressures (or volumes) of a fixed quantity of gas at constant temperature, calculate the final volume (or pressure)

Use Boyle's Law

$$p_1 v_1 = p_2 v_2$$

For a fixed quantity of a confined gas, given the initial volume, pressure, and temperature and the final values of any two conditions, calculate the final value of the third condition.

(Initial or final conditions may be standard temperature and pressure, STP).

Convert °C to K

Then, use general gas law:

$$\frac{p_1 v_1}{t_1} = \frac{p_2 v_2}{t_2}$$

LPT

General Law Problem:

A 3.65 L sample of a gas is at STP. The temperature of the gas increases to 55.0 °C and the volume changes to 5.26 L, what is the new pressure in torr?

	P (torr)	V (L)	Tc	Tk
Initial	760	3.65	0.0	273
Final	-	5.26	55.0	328

$$\frac{(760\ \text{torr})\ (3.65\ \text{L})}{273\ \text{K}} = \frac{P\ (5.26\ \text{L})}{328\ \text{K}}$$

P = 634 torr

LPT