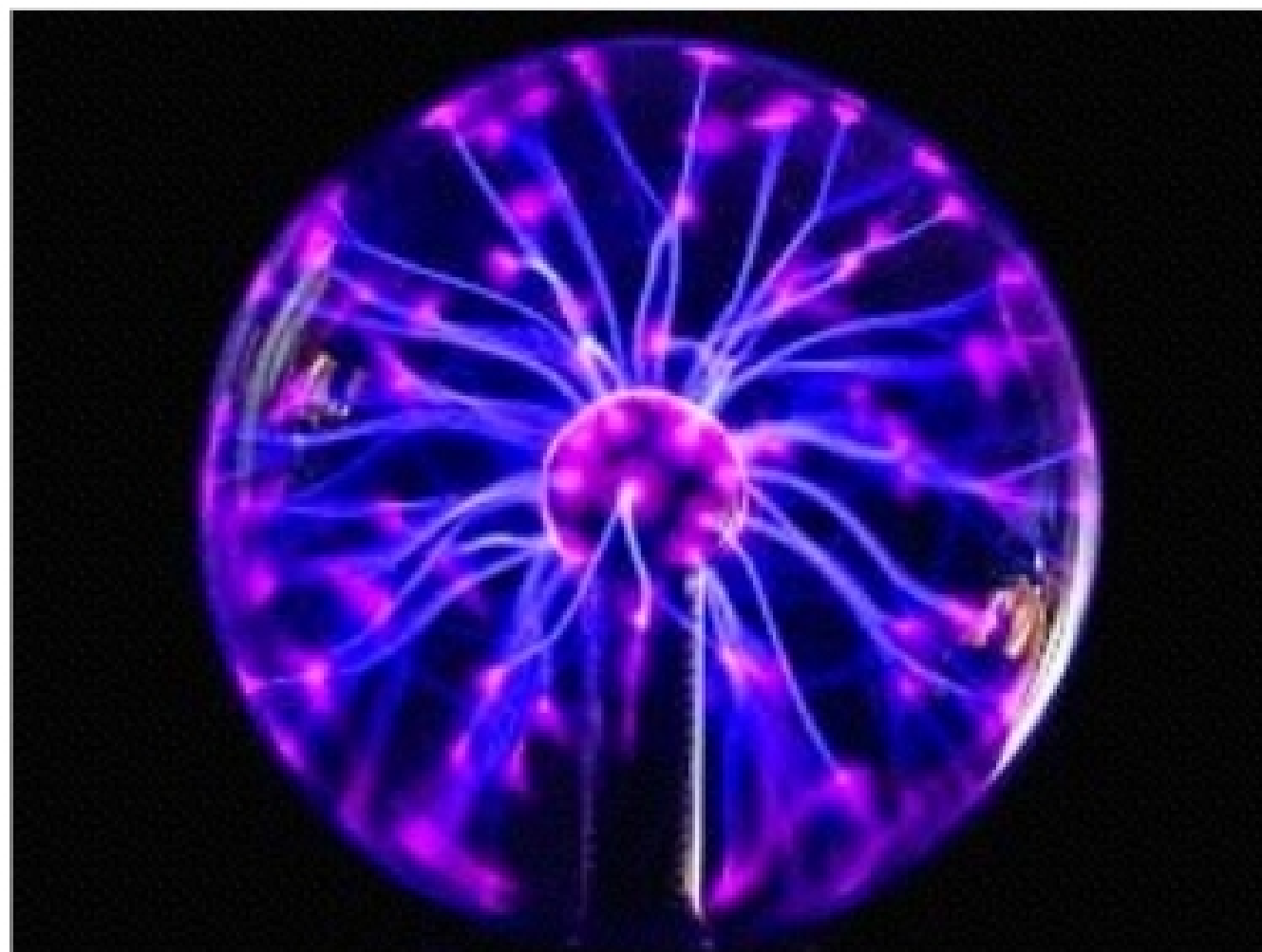


CHEM 101

Gases



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Characteristics of Gases

- Physical properties of gases are all similar
- Composed mainly of nonmetallic elements with simple formulas and low Molar mass (Mm)
- Gases:
 - expand to fill their containers
 - are highly compressible
 - have extremely low densities
 - Two or more gases form a homogeneous mixture.

Properties Which Define the State of a Gas Sample

- Temperature Scales:

$$^{\circ}\text{C} = 5/9(^{\circ}\text{F} - 32^{\circ})$$

$$\text{K} = ^{\circ}\text{C} + 273.15$$

absolute zero is 0K or -273.15

- Volume: (Space Occupied)

$$1\text{L} = 1\text{dm}^3$$

$$1\text{cc} = \text{mL}$$

$$1\text{L} = 1000\text{mL} = 1000\text{cc}$$

- The amount of gas usually expressed as the number of moles
- Pressure

Pressure: the amount of force applied to an area.

- Pressure:

$$P = \frac{F}{A}$$

P = pressure

F = force

A = area

$$P = gdh$$

g = gravity

d = density

h = height

- Atmospheric pressure is the weight of air per unit of area.

Units of Pressure

- Pascals: $1\text{Pa} = 1\text{N/m}^2$ (SI unit of pressure)

$$1\text{Pa} = 1\text{N/m}^2 = \frac{\text{kg} \cdot \text{meter/s}^2}{\text{m}^2}$$

- Bar: $1\text{bar} = 10^5\text{Pa} = 100\text{kPa}$
- mmHg or torr: These units are the difference in heights measured in mm of two connected columns of mercury.
- Atmosphere: $1.00\text{atm} = 760\text{torr} = 760\text{mmHg} = 101.325\text{kPa}$
- Standard Pressure: Normal atmospheric pressure at sea level.

$$\text{Standard Pressure} = 1.00\text{atm} = 760\text{torr} = 760\text{mmHg} = 101.325\text{kPa}$$

Ex:

Convert 0.0605 atm into pressure in Torr.

$$P_{\text{gas}} = (0.0605\cancel{\text{atm}})(760\cancel{\text{mmHg}} / 1\cancel{\text{atm}})(1\cancel{\text{Torr}} / 1\cancel{\text{mmHg}}) = 460\text{ Torr}$$

Boyle's Law - Pressure and Volume Relations

At constant temperature with a given amount of air **increasing** pressure **decreasing** the volume.

$$P = 1/V \text{ at constant } T \text{ and } n \text{ (moles)}$$

$$PV = \text{constant}$$

Charles's Law - Volume and Temperature Relations

The **volume** of a fixed amount of gas at **constant pressure** is **directly proportional** to its **absolute temperature (Kelvin)**

$$V = T \text{ at constant } n \text{ and } P$$

Avogadro's Law - Quantity and Volume Relations

The **volume** of a gas at **constant temperature** and **pressure** is **directly proportional** to the **number of moles** of the gas.

$$V = n \text{ at constant } T \text{ and } P$$