Measuring \_\_\_\_\_\_\_ Pressure

Torricelli developed the “\_\_\_\_\_\_\_” from *baro*, meaning *weight* and *meter* meaning *measure*.

He also coined the unit “Torr” which is equal to \_\_\_\_\_\_\_ .

What is pressure & its units?

What is STP and its units?

The Nature of Gases

\_\_\_\_\_\_\_ 🡪 the gradual mixing of molecules of different gases from \_\_\_\_\_\_\_ to \_\_\_\_\_\_\_ concentration.

\_\_\_\_\_\_\_ 🡪 the movement of molecules through a small \_\_\_\_\_\_\_ into an empty container.

\_\_\_\_\_\_\_ Gas Law: \_\_\_\_\_\_\_

*P* = \_\_\_\_\_\_\_ in atm, mm Hg, or kPa *V* = \_\_\_\_\_\_\_ in liters

*n* = \_\_\_\_\_\_\_ *R* = ideal gas \_\_\_\_\_\_\_ based on units

*T* = \_\_\_\_\_\_\_ in Kelvins

Boyle’s Law

Boyle’s Law describes the relationship between the \_\_\_\_\_\_\_ of a gas and its \_\_\_\_\_\_\_ at a \_\_\_\_\_\_\_ temperature and number of moles.

A gas can be compressed to take up less space: the \_\_\_\_\_\_\_ the pressure applied to the gas, the \_\_\_\_\_\_\_ the volume it will occupy. (e.g. piston chamber in engines)

Bubbles in a fish tank \_\_\_\_\_\_\_ in size as they move toward the surface of the water experiencing \_\_\_\_\_\_\_ pressure. Bubbles at the bottom of the tank are \_\_\_\_\_\_\_, experiencing \_\_\_\_\_\_\_ pressure than bubbles up higher in the water.

Robert Boyle (1627-1691) decided to experiment with only \_\_\_\_\_\_\_ and \_\_\_\_\_\_\_ of a gas, so he held the \_\_\_\_\_\_\_ and number of \_\_\_\_\_\_\_ of the gas constant.

PV = nRT 🡪 \_\_\_ = k

Mathematically: P ∞ 1/V (*take away the constants*)

At the same conditions of temperature and moles: P1V1 = k, P2V2 = k

Thus: \_\_1\_\_1 = \_\_2\_\_2



What relationship is shown by the graph?

Give some examples of Boyle’s Law:

Charles’ Law

Jacques Charles (1746-1823) experimented with only \_\_\_\_\_\_\_ and \_\_\_\_\_\_\_ of a gas, so he held the \_\_\_\_\_\_\_ and number of \_\_\_\_\_\_\_ of the gas constant.

PV = nRT 🡪 \_\_\_\_\_ = k

Mathematically: V ∞ T (*take away the constants*)

At the same conditions of pressure and moles: V1 = kT1, V2 = kT2

Thus: \_\_1/\_\_1 = \_\_2/\_\_2



In the plot of V-vs-T, the \_\_\_\_\_\_\_ relationship is \_\_\_\_\_\_\_, with an intercept of \_\_\_\_\_\_\_ zero on the \_\_\_\_\_\_\_ scale.

The slope depends on the pressure and the amount of gas.

The dashed lines on the graph are to represent the fact that you \_\_\_\_\_\_\_ achieve absolute zero.

Kelvin includes avg \_\_\_ & \_\_\_\_\_\_\_.

Give some examples of Charles’ Law:

Gay-Lussac’s Law

Gay-Lussac (1746-1823) experimented with only \_\_\_\_\_\_\_ and \_\_\_\_\_\_\_ of a gas, so he held the \_\_\_\_\_\_\_ and number of \_\_\_\_\_\_\_ of the gas constant.

PV = nRT 🡪 P/T = k

Mathematically: P ∞ T (*take away the constants*)

At the same conditions of volume and moles: P1 = kT1, P2 = kT2

Thus: \_\_1/\_\_1 = \_\_2/\_\_2



In the plot of P-vs-T, the \_\_\_\_\_\_\_ relationship is linear.

The slope depends on the volume and the amount of gas.

The dashed lines on the graph are to represent the fact that you cannot achieve \_\_\_\_\_\_\_ \_\_\_\_\_\_\_.

\_\_\_\_\_\_\_ includes avg KE & volume.

Give some examples of Gay-Lussac’s Law:

Avogadro’s Law

Amedeo Avogadro (1776-1856) experimented with only \_\_\_\_\_\_\_ and \_\_\_\_\_\_\_ of a gas, so he held the \_\_\_\_\_\_\_ and \_\_\_\_\_\_\_ of the gas constant.

PV = nRT 🡪 V = kn 🡪 k = V/n

Mathematically: V ∞ n (*take away the constants*)

At the same conditions of pressure and temperature: V1 = kn1, V2 = kn2

Thus: \_\_1/\_\_1 = \_\_2/\_\_2



In the plot of V-vs-n, the \_\_\_\_\_\_\_ relationship is linear.

For a gas:

1 mol = # molecules / 22.4 L

\_\_\_\_\_\_\_ volume = \_\_\_\_\_\_\_

NA = 6.02 x 1023 particles, etc.

Combined gas law

For a fixed quantity of gas, pressure & volume vary inversely while temperature varies directly with pressure & volume. Fill in the names in the chart:



Real World Application of the Combined Gas Law

Internal combustion \_\_\_\_\_\_\_ operate on the principle of taking a \_\_\_\_\_\_\_ (\_\_\_) of gas in, compressing it (\_\_\_), igniting it (\_\_\_), then pushing the exhaust out.

Spraying a gas from an aerosol can … \_\_\_\_\_\_\_ (\_\_\_) of gas decreases as it goes from being compressed in the container to being released into the atmosphere. \_\_\_\_\_\_\_ (\_\_\_) increases substantially. Kinetic energies of gas molecules decrease. Gas \_\_\_\_\_\_\_ (\_\_\_) therefore decreases as it is sprayed

Ideal Gases

Ideal gases are \_\_\_\_\_\_\_ gases that perfectly fit all of the \_\_\_\_\_\_\_ of the kinetic molecular theory; i.e.,

* Gases consist of \_\_\_\_\_\_\_ particles that are \_\_\_\_\_\_\_ apart relative to their size.
* There are \_\_\_ forces of attraction or repulsion \_\_\_\_\_\_\_ the gas particles.
* Collisions between gas particles and between particles and the walls of the container are \_\_\_\_\_\_\_ collisions, so no \_\_\_\_\_\_\_ energy is lost in those collisions.

There is \_\_\_ gas for which these assumptions are true.

Ideal Gases & Real Gases

A gas will behave in an ideal fashion (PV = nRT) if its temperature is at or greater than \_\_\_\_\_\_\_ K (0⁰ C), and its pressure is near or less than \_\_\_ atm (\_\_\_\_ kPa).

\_\_\_\_\_\_\_ \_\_\_\_\_\_\_ (273 K or higher) and \_\_\_\_\_\_\_ (101.3 kPa or lower)



When pressure is \_\_\_\_\_\_\_ as in image (b), the \_\_\_\_\_\_\_ that the gas molecules occupy is \_\_\_\_\_\_\_ compared to the region in which they are contained.

Particles in such \_\_\_\_\_\_\_ gases have \_\_\_\_\_\_\_ and there are \_\_\_\_\_\_\_ between the particles.

Because of these attractions, a gas can condense, or even solidify, when it is compressed or cooled. Therefore \_\_\_\_\_\_\_ temperatures also cause deviations from the ideal gas law.

Ideal gas behavior exists at \_\_\_\_\_\_\_ . \_\_\_\_\_\_\_ temperatures (molecules move \_\_\_\_\_\_\_ … more attractions) and \_\_\_\_\_\_\_ pressures (more \_\_\_\_\_\_\_ in less volume) show significant deviations from the ideal gas law.

\_\_\_\_\_\_\_ pressure

When two or more ideal gases are \_\_\_\_\_\_\_ together, the \_\_\_\_\_\_\_ pressure of the mixture is equal to the \_\_\_\_\_\_\_ of the pressures of each individual gas.

Partial pressure:

* + refers to pressure of \_\_\_\_ gas in a mixture of gases
	+ the pressure of a single gas as if it occupied the container by \_\_\_\_\_\_\_
	+ the sum of all \_\_\_\_\_\_\_ pressures equals \_\_\_\_\_\_\_ pressure of the mixture

Gases exhibit:

Diffusion 🡪 the gradual mixing of molecules of different gases from \_\_\_\_\_\_\_ to \_\_\_\_\_\_\_ concentration.

Effusion 🡪 the movement of molecules through a small \_\_\_\_\_\_\_ into an empty container.

Effusion 🡪 A gas \_\_\_\_\_\_\_ through a tiny \_\_\_\_\_\_\_ in its container.

Gases of \_\_\_\_\_\_\_ molar mass diffuse and effuse \_\_\_\_\_\_\_ than gases of higher molar mass.

Graham’s law of effusion **🡪** the rate of effusion of a gas is \_\_\_\_\_\_\_ proportional to the square root of the gas’s \_\_\_\_\_\_\_ \_\_\_\_\_\_\_.

Helium gas (\_\_\_\_\_\_\_ massive) effuses much \_\_\_\_\_\_\_ than ethylene oxide gas (\_\_\_\_\_\_\_ massive).

Which of the following gas particles will diffuse fastest if all of these gases are at the same temperature and pressure? (give molecular masses)

SO2 N2O Hg Cl2