# Chapter 9: Gaseous State

Nov 16, 2022

Chemistry Department, Cypress College

## Class Announcements

**Lab**

- Experiment 18 Boyle's Law
- Submit the lab reports and homework assignments
- Reminder - Need 70% of laborator points to pass the course

**Lecture**

- Finish up Ch 8 and begin Ch 9
- Go over homework 11 (EC for students who present)
- Quiz and Homework assignment released Fri, Nov 18th at 3pm

## Outline

Defining Gas Pressure

Gas Laws: Relationship P, V, and T
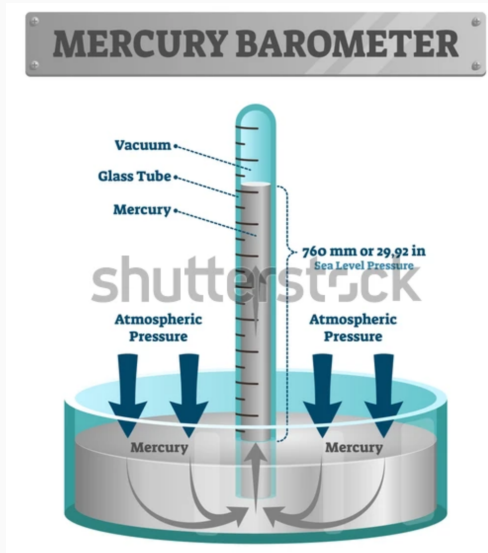
**Q:** How do air balloons float in the air?

## Defining Pressure

$$P = \frac{F}{A} \tag{1}$$

where $P$ is the pressure ($N/m^2$), $F$ is the force (Newton or N) acting on the area, and $A$ is the surface area ($m^2$)

*Common Units:* Psi, Torr, Pa, atm, mm Hg, and $lb/in^2$

## Common Pressure Units Conversion

*Common Units:* Psi, Torr, atm, mm Hg, and $lb/in^2$

$$1atm = 760mm\ Hg$$
$$1atm = 101,325Pa$$
$$1atm = 14.7lb/in^2$$

## Practice: Unit Conversion

Convert the following units:

a) 845 Torr to atm

b) 1.73 atm to Pa

c) 32.1 $lb/in^2$ to atm

# Outline

## Defn: Standard Temperature and Pressure

**Standard Temperature and Pressure (STP)**: the gas is at a given $0^\circ C$, 1 atm, and 22.414 L/mol
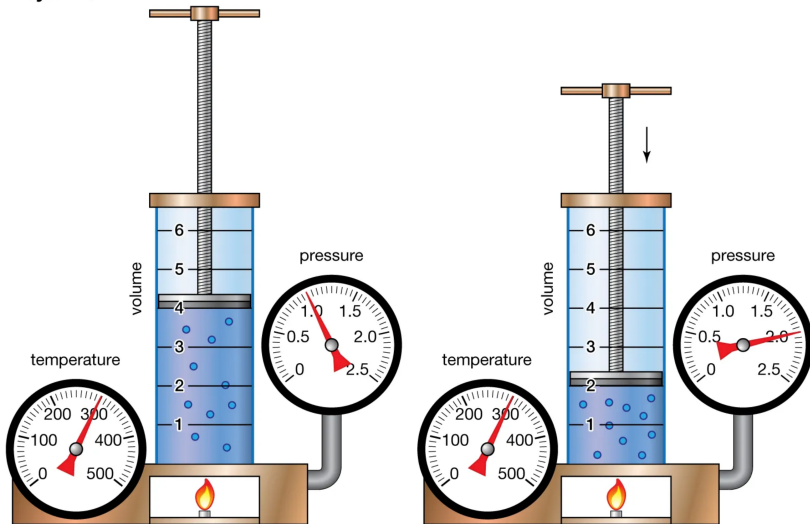
## Boyle's Law

For a given mole of gas, the pressure and volume are inversely proportional.

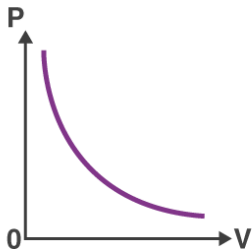$$PV = \text{constant} \tag{2}$$
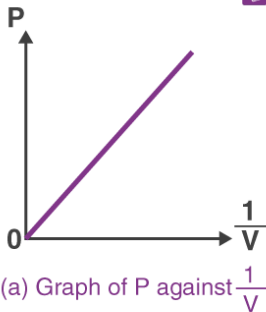
$$P_1 V_1 = P_2 V_2 \tag{3}$$

Boyle's law

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(a) Graph of P against V    (a) Graph of P against $\frac{1}{V}$

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## Practice: Boyle's Law

A balloon contains 510mL of helium when filled at 1.00atm. What would be the volume of the balloon if it were subjected to 2.50 atm of pressure?
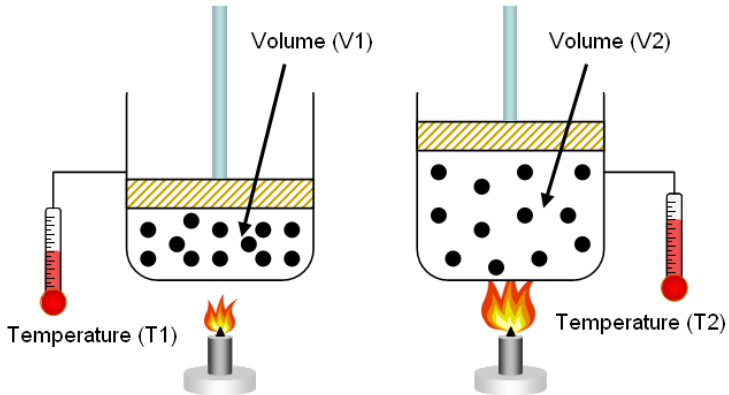
## Charles' Law

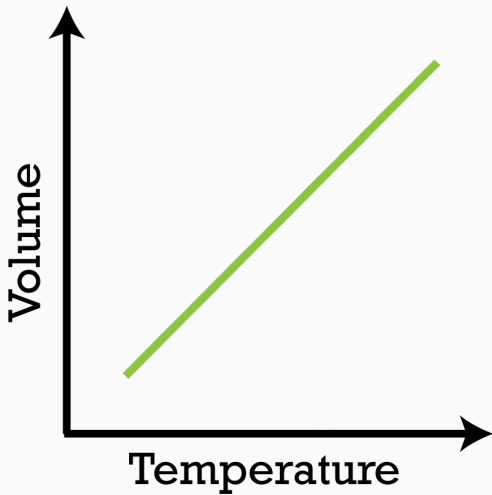For a given mole of gas, the volume and temperature are directly proportional

$$\frac{V}{T} = \text{constant} \tag{4}$$
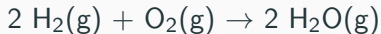
$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \tag{5}$$

## Practice: Charles' Law

If a sample of chlorine gas occupies 50.0mL at 100.0°C, what is its volume at 25.0°C at constant pressure?

## Gay-Lussac's Law of Combining Volumes

In a reaction, the volume ratio of gas matches the mole ratio of the chemical equation

$2 H_2(g) + O_2(g) \rightarrow 2 H_2O(g)$

## Avogadro's Hypothesis

At constant temperature and pressure, the volume and moles of gas are directly proportional

$$\frac{V}{n} = \text{constant} \tag{6}$$

$$\frac{V_1}{n_1} = \frac{V_2}{n_2} \tag{7}$$

## Practice: Volume and Moles of Gas

If a 10.0L balloon contains 0.80 mol of a gas, what wil be the volume of a balloon that contains 0.20 mol of the gas if temperature and pressure remain constant?