EXPERIMENT 8

GAS LAWS

DR. MIOY T. HUYNH // YALE UNIVERSITY

CHEMISTRY 134L // SPRING 2019

www.mioy.org/chem134

The Gas State

The gaseous state of matter is unique.

The particles (atoms or molecules) in the gaseous state are in constant random motion

As a result, the particles of a gas take up the entire volume of their container.

In contrast, liquids and solids have fixed volumes; they do not take up the entire volume of their container.

Another consequence is that the particles of a gas constantly collide with one another, and also collide against the walls of their container.

As a result, a gas will always exert a pressure (P).

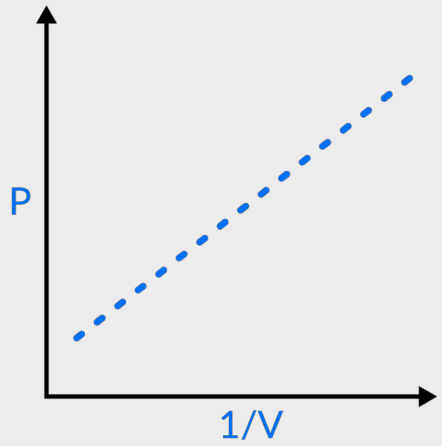
Part 1

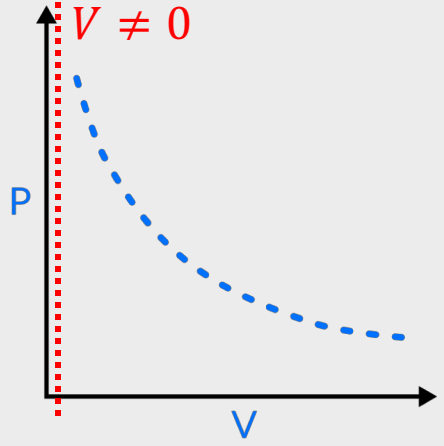
BOYLE'S LAW

For a fixed amount of gas (number of moles, n, is constant) and at a fixed temperature (T):

The pressure (P) exerted by a gas is inversely proportional to the volume (V) of its container.

$$P \propto \frac{1}{V}$$





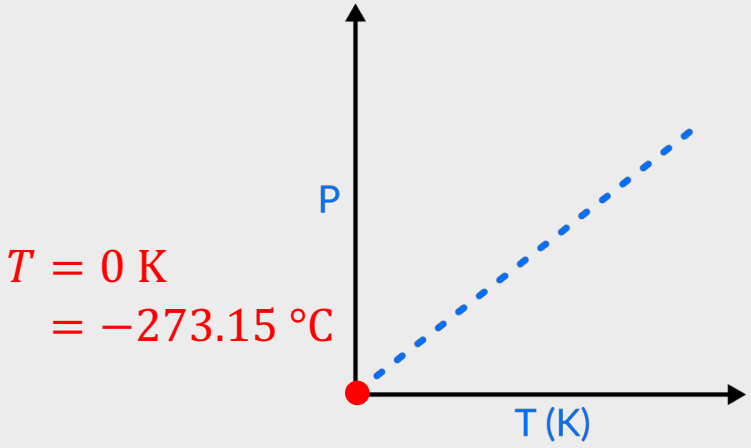
Part 2

AMONTON'S LAW

For a fixed amount of gas (number of moles, n, is constant) and at a fixed volume (V):

The pressure (P) exerted by a gas is directly proportional to its temperature (T).

$$P \propto T$$



Part 3

GAY-LUSSAC'S LAW

When gaseous reactants react to form gaseous products, the volumes of reactants and products (measured at the same temperature and pressure) will be simple integer ratios.

Examples)

- 1 L H_2 (g) + 1 L Cl_2 (g) → 2 L HCl (g)
- 2 L H_2 (g) + 1 L O_2 (g) → 2 L H_2O (g)

AVOGADRO'S HYPOTHESIS

Equal volumes of all gases, at the same temperature and pressure, contain the same number of particles (or moles).

Overview

Part 3: Gay-Lussac's Law & Avogadro's Hypothesis

↓

Part 0: Temperature Calibration

room temperature water
melting point of ice
freezing point of water

↓

Part 1: Boyle's Law

↓

Part 2: Amonton's Law

Notes

1. Calibrate the temperature probe using freezing point of water.
2. Do NOT connect/disconnect the pressure sensor yourself. Let me know when you are ready.
3. Need ~12 datasets for Boyle's and Amonton's Laws.
4. Amonton's Law: try to get one dataset below 0 °C.