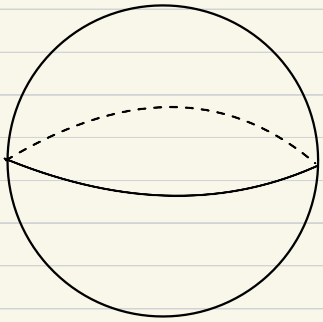
LEC14 - Related Rates



Experiment 1:

Suppose we can slowly heat the air inside this sphere without letting air in and out, while keeping the size of the sphere fixed

What will happen to the pressure of the air inside the sphere?

→ It will increase since the faster movement of air molecules leads to more collisions which leads to higher pressure

What will happen to the pressure of the air if the sphere size is increased?

→ It will decrease since there is more space, so fewer collisions, leading to less pressure

Ideal Gas Law:

- $PV = nRT$

Pressure

Volume

Amount of Substance

Ideal gas constant

Absolute temperature (never −)

- $P = \frac{kT}{V}$

Constant $(n \cdot R)$

Temperature

Volume

Pressure

- $P = \frac{kT}{V}$ is more general since n, R are constant for our purpose (R is always constant & we arent changing amount of gas)

*Leibniz notation is more suitable when it is unclear what is a variable in the equation

- $\frac{dP}{dt} = \frac{k}{V}$ Take the derivative with P as y and K as x, everything else is constant
  → If volume is held constant

- $\frac{dP}{dV} = -\frac{kT}{V^2}$ Take the derivative with P as y and V as x, everything else is constant
  → If temperature is held constant

- The ideal gas law relates the temperature, volume, pressure, and amount of gas in a single equation (we assume amount is constant)
- We can derivate the ideal gas law with respect to any variables, and express it using Leibniz notation