• Transition
• Kinetic Theory / Statistical Mechanics
  o History
    ▪ Experiment
    ▪ Theory
      • Brownian Motion
  o Diffusion
    ▪ Tasteless Example
    ▪ Demo
  o Statistical Distribution
    ▪ A cube of gas of identical particles (like Ar atoms)
    ▪ Statistical Mechanics
      • Shape of the speed distribution
        ▪ Temperature relates to a distribution
          ▪ Increased Temperature
  • Average Energy
    o Pause here & Use
      ▪ Conceptual Question 1. If the speed of each molecule in an ideal gas tripled, would the Kelvin temperature triple? By what factor would it increase?
      ▪ Conceptual Question 2: Say you have two containers, one of He and one of Ar, if their particles had the same speed, what would be the relationship between their temperatures?
    o Derivation of Pressure as a function of Particle Energy
      ▪ Ex 1: Say you have $3.01 \times 10^{24}$ molecules of H$_2$ at $4 \times 10^5$ Pa in a $10^{-3}$ m$^3$ container. What is the average kinetic energy?
      ▪ Units Refresher (Why SI is good): Note how the units work out – that’s because each of these compound units, Pa, N, and J, are defined as simple products of the base units. If you always use the fundamental SI units, always convert distance to m, pressure to Pa, mass to kg, etc. your units will always work out.
      ▪ Ex 2: Speed of ‘air molecules’, N$_2$. Given that air is at atmospheric pressure, 1 atm = $10^5$ Pa. And that it has a density of 1.29 kg/m$^3$, what is the average (rms) speed of an ‘air molecule’?
      ▪ Ex like 34: In lab, you heated up a flask, the number of molecules in it remained constant (they had nowhere to go & we weren’t breaking them), the volume remained constant, but the pressure rose. For some it rose from 1 atm to 1.20 atm. How fast were the air molecules going then?
    o On with the program: Average Kinetic Energy - Temperature Relation
      ▪ Ideal Gas Law
        ▪ Conditions of Validity
30. Near the surface of Venus, the rms speed of carbon dioxide molecules (CO$_2$) is 650 M/S. What is the temperature (in kelvins) of the atmosphere at that point?

34. Initially, the translational rms speed of a molecule of an ideal gas is 463 m/s. The pressure and volume of this gas are kept constant, while the number of molecules is doubled. What is the final translational rms speed of the molecules?

50. Two moles of nitrogen (N$_2$) gas are placed in a container whose volume is $8.5 \times 10^{-3}$ m$^3$. The pressure of the gas is $4.5 \times 10^5$ Pa. What is the average translational kinetic energy of a nitrogen molecule?