

# PHYSICS 151 READING

## ASSIGNMENT FOR NOVEMBER 16

### SECTIONS 11.4-11.7

Please notice that this file is two pages long.

#### 11.1-11.3

- I realize some of you will be disappointed that I'm skipping all this good Bio stuff in these sections. I do apologize, it is good stuff, but I need to make sure we cover certain physics topics. Read these sections for your own enrichment.

#### 11.4 - Thermal Energy and Temperature

- Ideal gas - object made of atoms that do not interact with each other except by colliding.
- Temperature - measure of the average kinetic energy of a molecule in an ideal gas.
- Temperature scales - Celsius, Fahrenheit, and Kelvin.
- The Kelvin scale makes the relation between kinetic energy and temperature exact.  $K_{avg} = \frac{3}{2}k_B T$ .
- Boltzmann constant  $k_B = 1.38 \times 10^{-23} J/K$ .
- Thermal Energy for ideal gas of  $N$  particles:  $E_{th} = \frac{3}{2}Nk_B T$ .

## 11.5 - Heat and the First Law of Thermodynamics

- Heat,  $Q$  - energy transferred between two objects with different temperature that results in a change in the thermal energy.
- Work can also cause a change in an object's thermal energy.
- Thermal equilibrium - two objects at the same temperature have no net energy exchange
- Thermodynamics - Motion of heat.
- First Law of Thermodynamics - for a system in which only the thermal energy changes  $\Delta E_{th} = W + Q$

## 11.6 - Heat Engines

- Heat engine - a device that uses the transfer of heat from a hot object to a cold object in order to do work.
- The equation for the maximum efficiency of a heat engine  $e = 1 - \frac{T_C}{T_H}$ , as well as, the fact that you cannot have a 100% efficient engine comes from the second law of thermodynamics which we'll get to after Thanksgiving.

## 11.7 - Heat Pumps

- Heat pump - a device that does work in order to move heat from a hot object to a colder one.