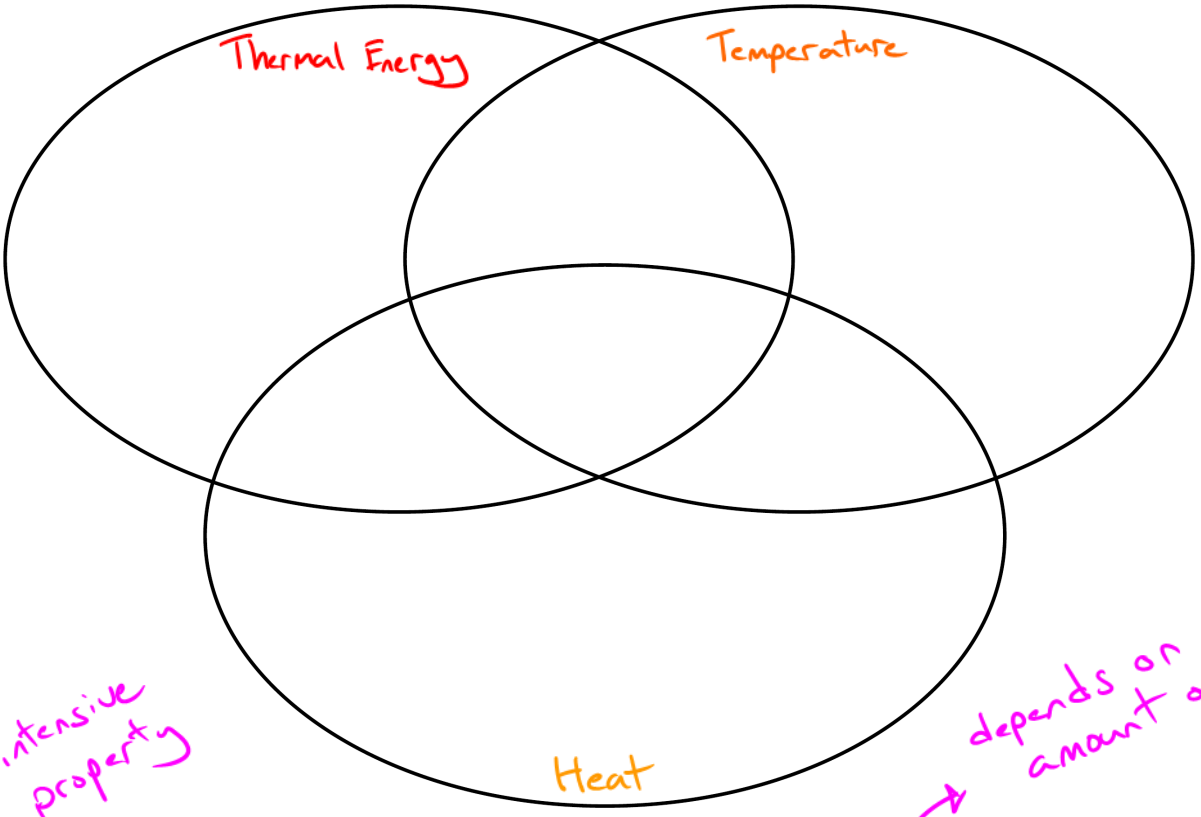
Thermodynamics Notes

2 – Thermal Energy, Temperature and Heat OH MY!

In the space below, create a **Venn Diagram** for the terms Thermal Energy, Temperature and Heat.

Include all the ways the terms are Similar and different. ***Start in pencil!***



intensive property

depends on the amount of matter

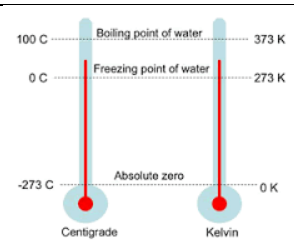
Thermal Energy (E_H): the sum total kinetic energy of all the moving atoms in a gas

Temperature (T): the average kinetic energy of the atoms in a gas.

°C vs. K

- Spacing between divisions is the same.
- Abs Zero (-273.15 °C and 0 K) is the temp at which all particles stop moving.
- In labs, particles have been slowed to speeds corresponding to 5×10^{-10} K.

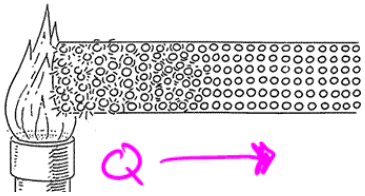
$°C = K - 273.15$ OR $K = °C + 273.15$



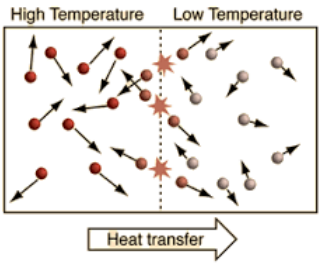
Heat (Q): the transfers of thermal energy (caused by a difference in temp)

Thermal E is transferred from the faster moving atoms to the slower moving atoms.

The process is known as Heat.



Due to the **Law of Conservation of Energy**, Heat lost by one object must equal Heat gained by the second object.



Example:
Three samples of gases made of the same element, sample 1, sample 2 and sample 3, have the same thermal energy. Sample 1 has twice as many atoms are sample 2. Sample 3 has twice as many atoms are sample 1. What can you say about the temperatures of the three samples?

a. $T_1>T_2>T_3$
b. $T_3>T_2>T_1$
c. $T_3> T_1>T_2$
d. $T_2>T_1>T_3$
e. $T_1=T_2=T_3$

Thermal E is the sum total!

Example:
The temperature of the gas (air) inside a basketball is increased when pumped up. This means that…

a. Total E_K of the gas decreases and Avg. E_K of the molecules decreases
b. Total E_K of the gas decreases and Avg. E_K of the molecules decreases
c. Total E_K of the gas increases and Avg. E_K of the molecules increases
d. Total E_K of the gas increases and Avg. E_K of the molecules decreases

Example:
Hydrogen has a boiling point of 20.28 K. Find its temperature in Celsius.

$°C = K - 273.15$
$°C = 20.28K - 273.15K$
$°C = -252.87°C$

Example:
A piece of metal at exactly 80 °C has its Celsius temperature tripled. By what does its Kelvin temperature increase?

240°C

$K = °C + 273.15$
$K = 240°C + 273.15$
$K = 513.15°C$
∴ increase by $513.15°C - 80°$
$= 433.15°C$

Before we go any further we must ask ourselves… what the heck is Thermodynamics?

Up Next: Laws of Thermodynamics