Chem 111

Lecture 13

Announcements

- Exams

- Spark discussion board is up and running again

- Oct 11: Holiday no class
- Oct 12: Monday Schedule

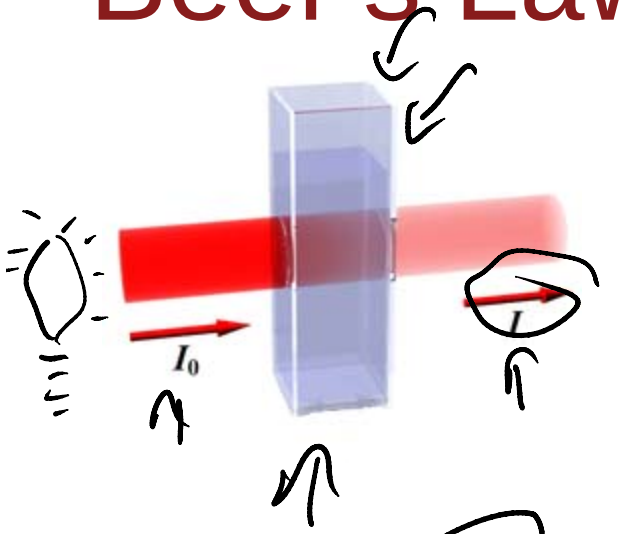
Homework

- Continue Reading Chapter 5
- OWL online homework

Recap

- Limiting Reactants
- Concentration
- pH

Beer's Law



Transmittance: is the fraction of incident light that passes through a sample.

$$T = \frac{I}{I_0}$$

Absorbance: is the negative log of the transmittance

$$A = -\log T = -\log\frac{I}{I_0} = \epsilon bc$$

A = absorbance

ϵ = molar absorptivity

b = length

c = concentration

Thermodynamics

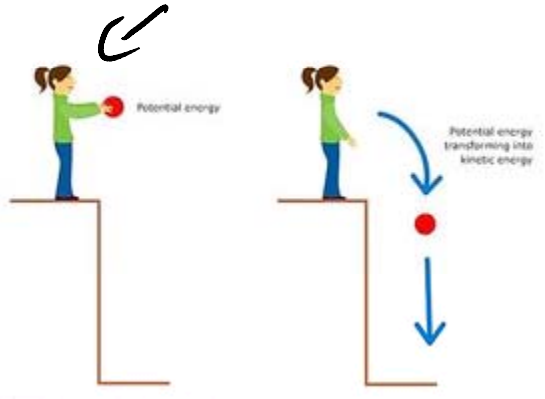
work = force x distance

The study of energy and its transformations.

heat + work

Energy is the capacity to do work or to transfer heat.

Kinetic Energy - is the energy of motion
Potential Energy – stored energy



Energy is conserved: Can neither be created nor destroyed

Units

SI unit of energy is the **joule (J)**

$$J = \frac{kg \ \ m^2}{s^2}$$

kJ

The **calorie** the amount of energy required to raise the temperature of 1 g of water by 1 ^{o}C.

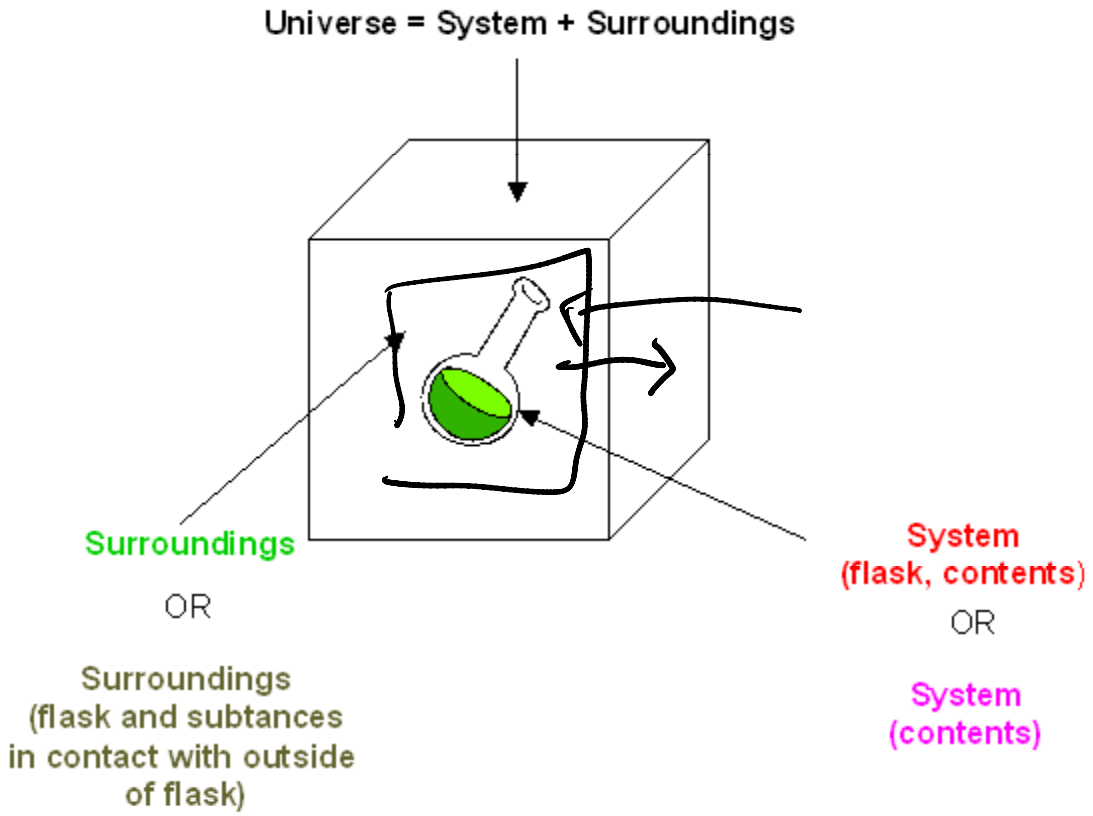
1 cal = 4.184 J (exactly) ← 4.184000000

Nutritional **Calorie** is different

1 Cal = 1000 cal or 1 kcal

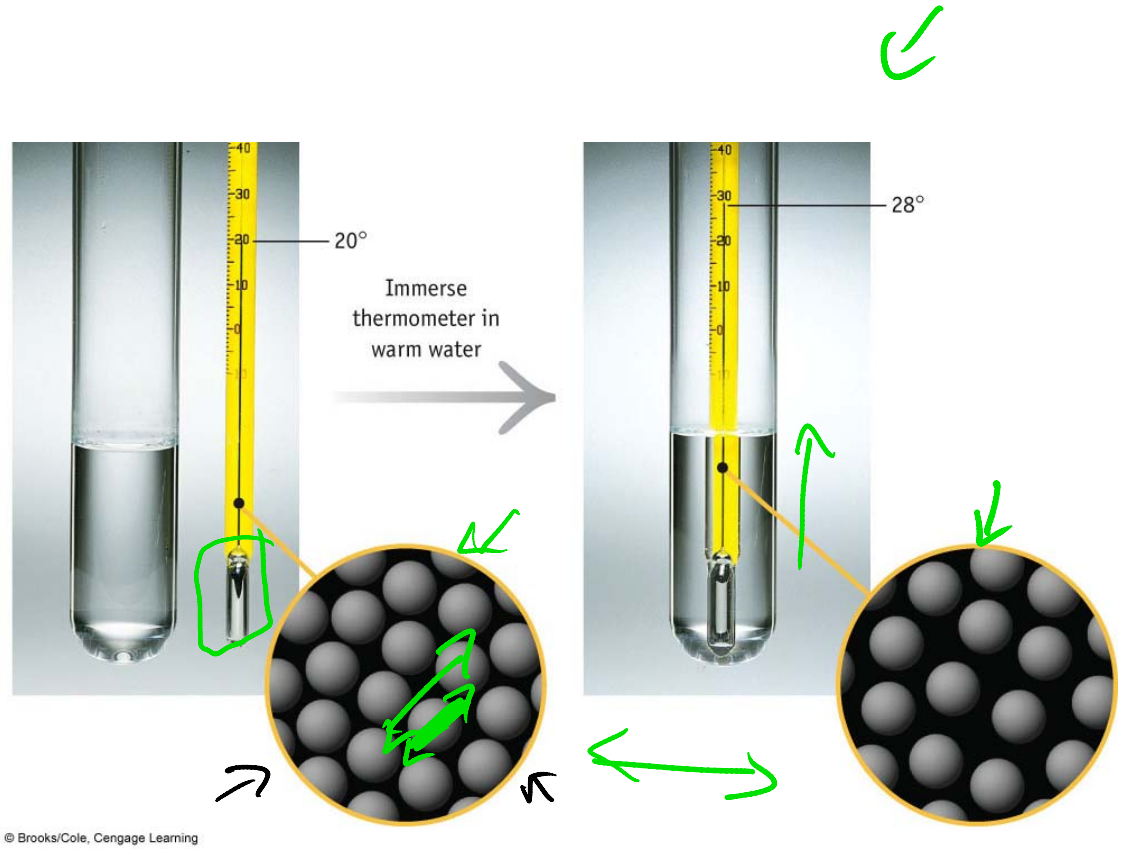
System and Surroundings

System: the portion that we are interested in
Surroundings: everything else



Temperature

Temperature is a measure of an objects ability to transfer energy as heat.



Thermal Equilibrium

Happens when the objects have reached the same temperature.

1. Energy transfer is spontaneous from the object that has higher temperature to an object with lower temperature.
2. Energy transfer continues to happen till thermal equilibrium is reached.
3. Object whose temp. increase gained thermal energy and the object whose temp. decreased lost thermal energy.

Endothermic v Exothermic

Endothermic Process – is a process where the system absorbs heat. Heat flows *into* the system from the surroundings.

Exothermic Process – is a process where the system evolves heat. Heat flows *out of* the system into the surroundings.

Heat Capacity

Specific Heat Capacity (C) – amount of heat that is required to raise the temperature of 1 gram of a substance by 1 K.

$$Specific\ Heat = \frac{quantity\ of\ heat\ transferred}{(grams\ of\ substance)\ x\ (temperature\ change)}$$

$$C = \frac{q = heat}{(m)\ x\ (\Delta T)}$$

mass

$\Delta T = T_{final} - T_{int.}$

75 - 50 = 25

It takes 209 J to increase the temperature of 50.0g of water by 1.00 K

$$C = \frac{209\ J}{(50.0\ g)\ x\ (1.00\ K)} = 4.18\ \frac{J}{gK}$$

liquid

metal .8 $\frac{J}{gK}$

Let’s Practice

How much heat is needed to warm 250 g of water (about a cup of water) from 22 ^{o}C (about room temperature) to near its boiling point, 98 ^{o}C?

Specific Heat H_2O = 4.18 J/gK

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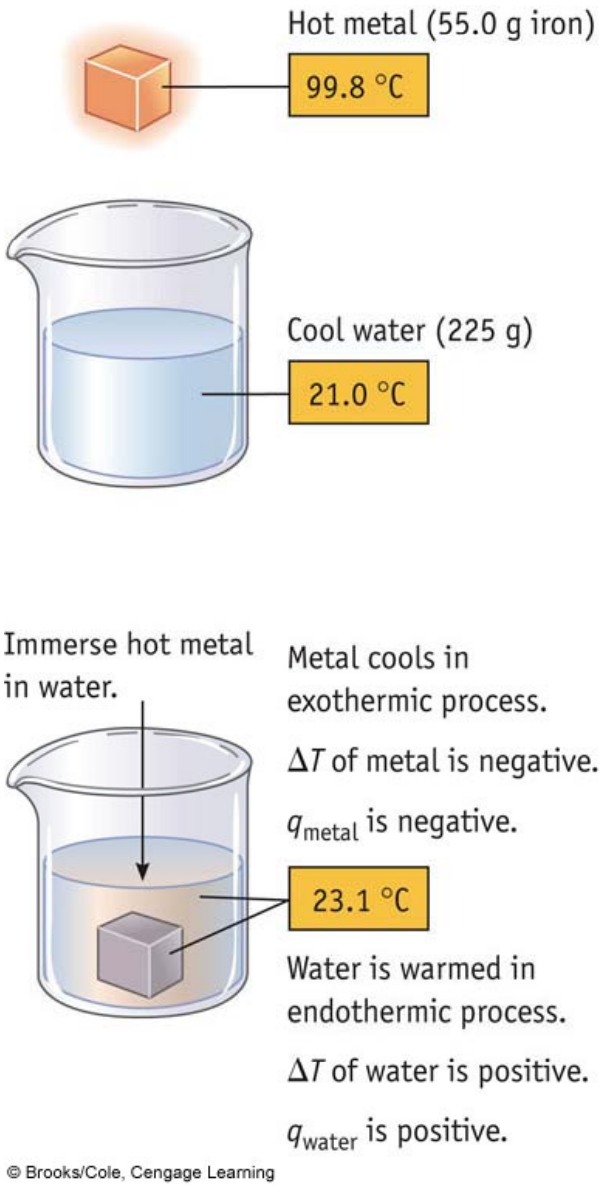
- Assume energy is transferred as only heat
- Energy is only transferred within the system
- q_{water} is positive value
- q_{metal} is negative value
- $q_{water} = -q_{metal}$

$q_{water} + q_{metal} = 0$

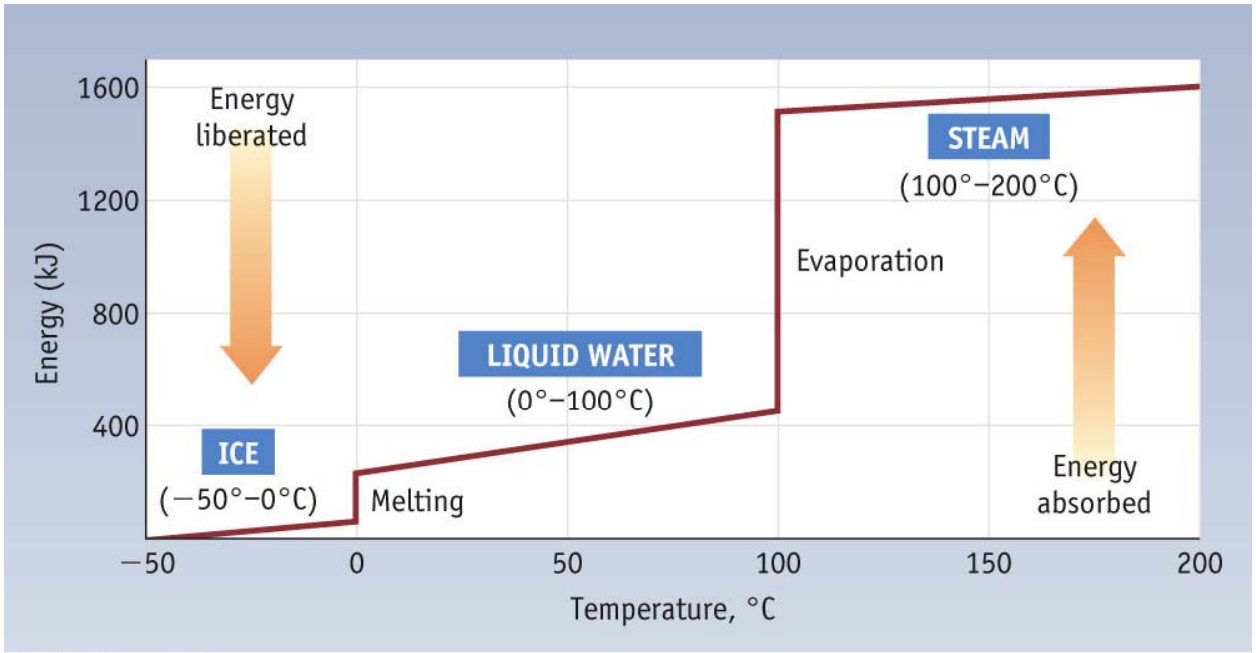
- Water and metal end up at the same temperature



Phase Change

Heat of Fusion: Heat required to convert a pure substance from a solid to a liquid.

Heat of Vaporization: Heat required to convert pure substance from a liquid to a gas.



Temperature is constant throughout a change of state