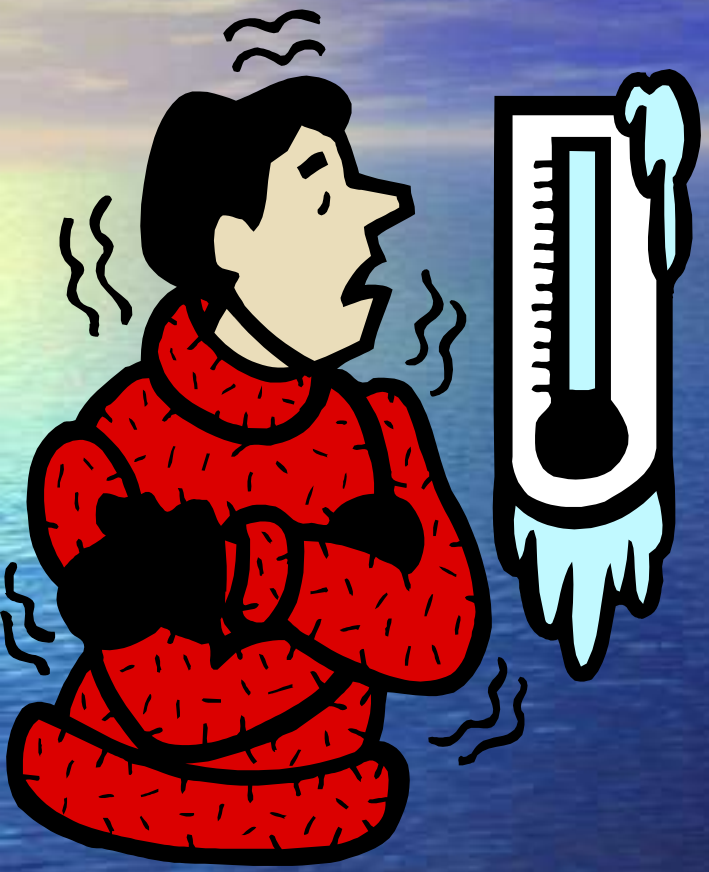
P. Sci.

Unit 4 cont.

Heat and Temperature

Chapter 16

What is Temperature?



- Particles (atoms and molecules) within a substance are constantly moving (kinetic energy)
- Temperature is the measure of the average kinetic energy in an object

What is Temperature cont.

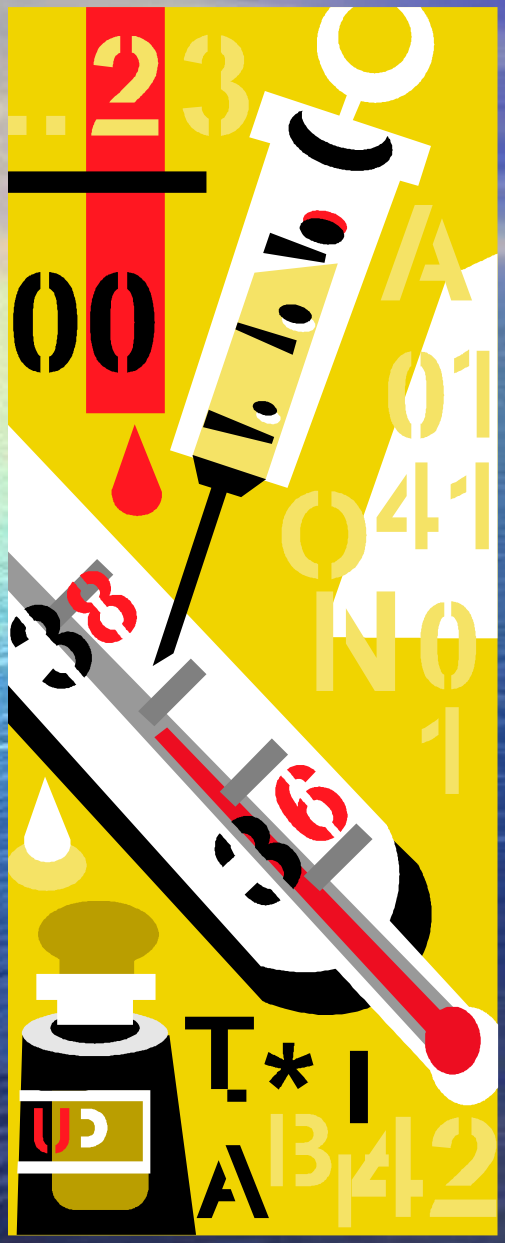
- As kinetic energy increases, temperature increases.
- Thermometers- expand as temperature increases and contracts as temperature decreases.

Measuring Temperature

Units for temperature can be

- Celsius (centigrade)
- Fahrenheit
- Kelvin

Fahrenheit



- American scale – not used in science
- For Water
  - Freezing point: 32°F
  - Boiling point: 212°F

Celsius

- Also known as Centigrade
- For water
  - Freezing point: 0°C
  - Boiling point: 100°C
- 1°C= about 2°F

Kelvin

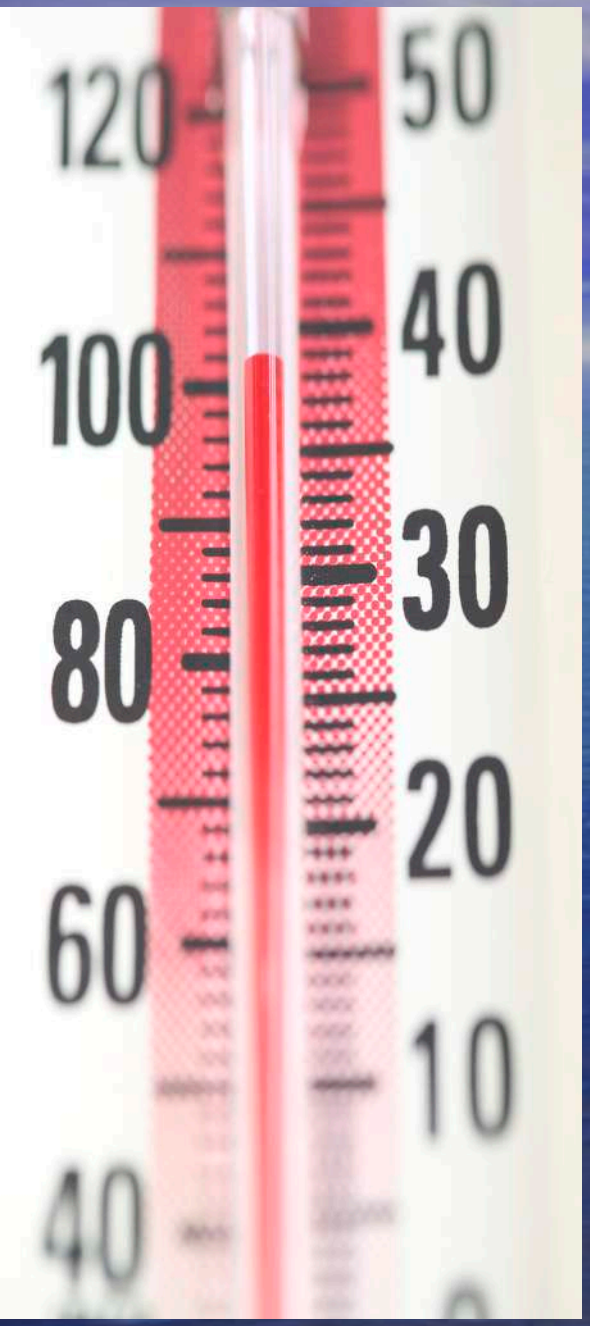
- SI unit to measure temperature
- 0 K is absolute zero= -273.13 °C
- Energy is minimal and cannot go any lower

Temperature Conversation

$K = °C + 273$

$°F = (9/5x\ °C) + 32$ $°C = 5/9(°F-32)$

- Convert 58 °C to K
- Convert 58 °C to °F
- Convert 358 K to °C



Energy Transfer

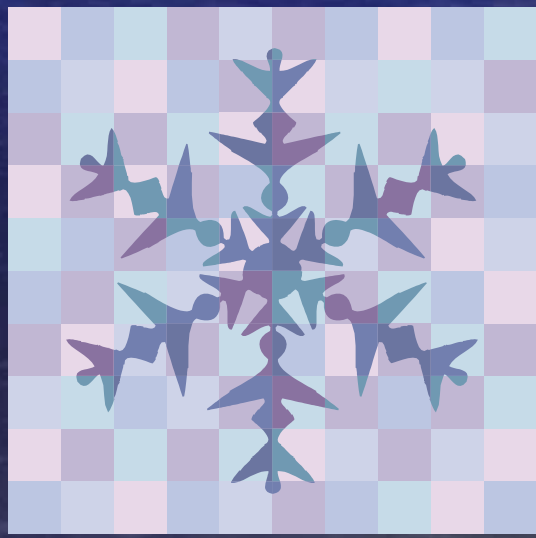
- Temperature is energy transferred as heat
- Energy must move for heat to occur.

Energy Transfer cont.

- Heat: transfer of energy between the particles of 2 objects due to temperature difference.
- Heat flows from high temperature (energy) to low temperature (energy)

Examples of energy transfer

- Freezing water for ice
- Dew evaporating in morning sunlight
- Heating water for a shower



Types of Energy Transfer

1. Conduction:

direct contact; 2 objects in contact are at unequal temperatures

2. Convection:

movement of warm fluids.

- Movement of the heated substance (liquid or gas)
- Convection Current: cycle of a heated fluid that rises, cools, and falls

3. Radiation: no physical contact needed.

- Transfer of energy through electromagnetic waves (infrared, visible light, ultraviolet)
- No movement of matter

–Example: standing in sunlight

Which type of heat transfer is illustrated below?

c

Conductors

- Any material through which energy is easily Transferred.

- Usually solid metals because their molecules are tightly packed.
- Gases and liquids are poor conductors because the molecules are not as tightly packed together.

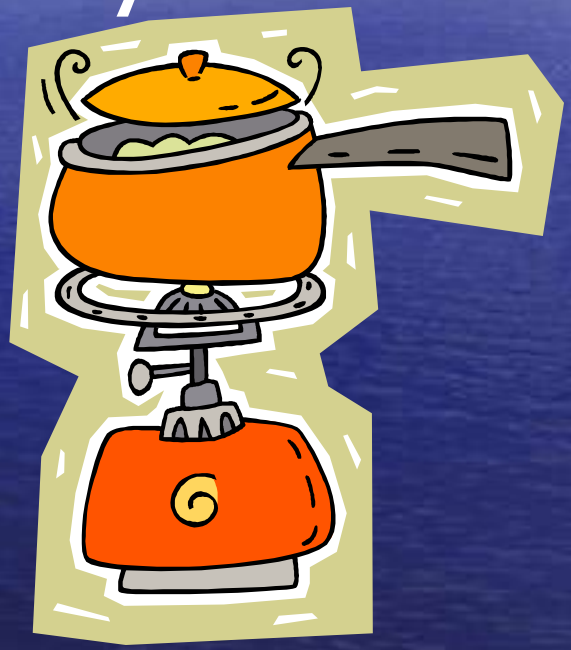
Insulators

- Slow down heat transfer
- Poor conductors
- Examples: rubber or wood

Specific Heat

- The amount of energy needed to raise 1kg of a substance by 1 K

$Q = cm\Delta t$



  - Q = heat
  - c = specific heat
  - m= mass
  - Δt= change in temperature
    - Δt = final Temp – initial temp
  - SI unit is Joules (J)

Specific Heat Calculations

- Aluminum has a specific heat of 0.902 J/kg x °C. How much heat is lost when a piece of aluminum with a mass of 23.984 kg cools from a temperature of 415.0 °C to a temperature of 22.0 °C?

Specific Heat Calculations

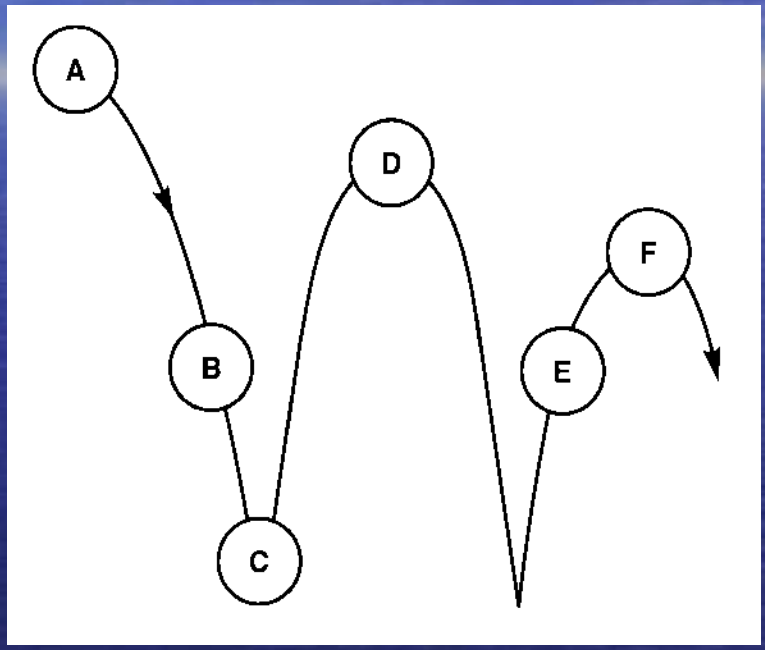
1. How much heat is required to warm 275 kg of water from 76 °C to 87 °C? (specific heat of water is 4.179 J/g °C)

- Remember…
  - energy is always conserved.
  - Energy is transferred from higher temperatures to lower temperatures.
  - Insulation minimizes unwanted energy transfers in walls, attics, etc.

Energy Transformations in Illustrations

Bouncing Ball

- When dropping a ball it travels the following path where is the



Kinetic energy is decreasing

Kinetic energy is increasing

Kinetic energy is the HIGHEST

Kinetic energy is the LOWEST

Potential energy is decreasing

Potential energy is increasing

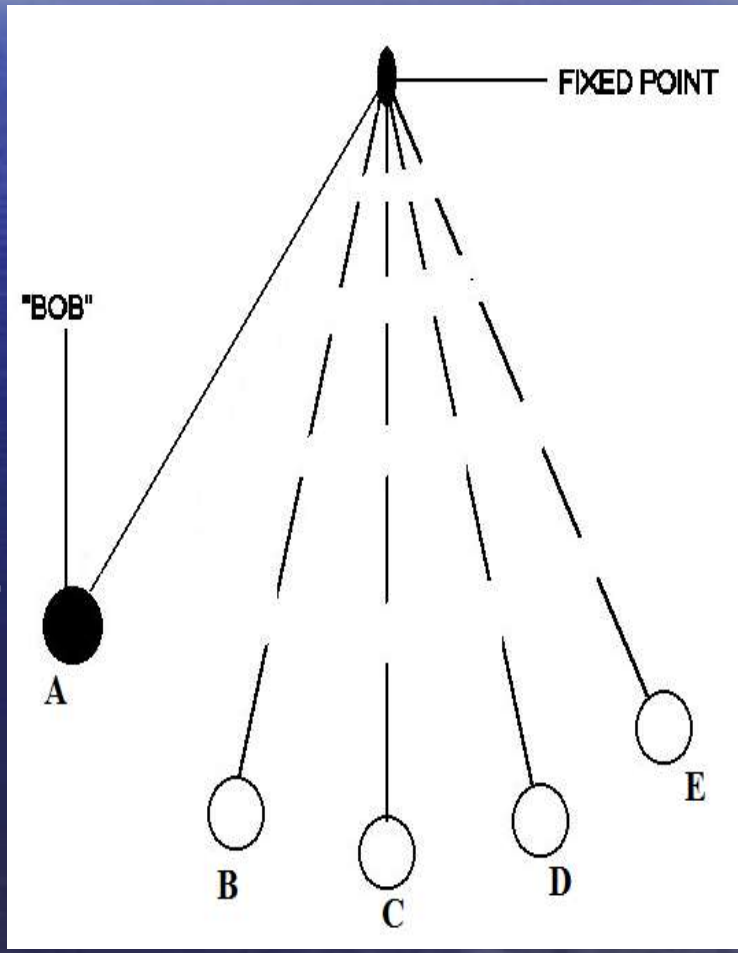
Potential energy is the HIGHEST

Potential energy is the LOWEST

Both KE and PE present

Pendulum

- A pendulum travels the following path where is the
  - Kinetic energy is decreasing
  - Kinetic energy is increasing
  - Kinetic energy is the HIGHEST
  - Kinetic energy is the LOWEST
  - Potential energy is decreasing
  - Potential energy is increasing
  - Potential energy is the HIGHEST
  - Potential energy is the LOWEST
  - Both KE and PE present



Reading Specific Heat Tables

- Recall specific heat tells you how much energy is needed to increase the temperature of 1 gram by 1 degree.
  - What substance takes the most energy to heat?
  - What substance take the least energy to heat?
  - What two substances listed make good conductors?
  - What two substances make good insulators?

Substance	c/J kg^{-1} K^{-1}	Substance	c/J kg^{-1} K^{-1}
Aluminium	900	Ice	2100
Iron/steel	450	Wood	1700
Copper	390	Nylon	1700
Platinum	130	Glass	670
Lead	130	Carbon	500
Hydrogen	14000	Ethanol	2400
Air	718	Paraffin	2100
Nitrogen	1040	Water	4186
Steam	2000	Sea water	3900

$K = °C + 273$

$°F = (9/5x\ °C) + 32$ $°C = 5/9(°F-32)$

Kinetic Energy $= 1/2\ (\text{mass} \times \text{velocity}^2)$

$KE = ½\ m\ v^2$

Potential Energy = mass x gravity x height

$PE = m\ g\ h$

$g = 9.8\ m/s^2$

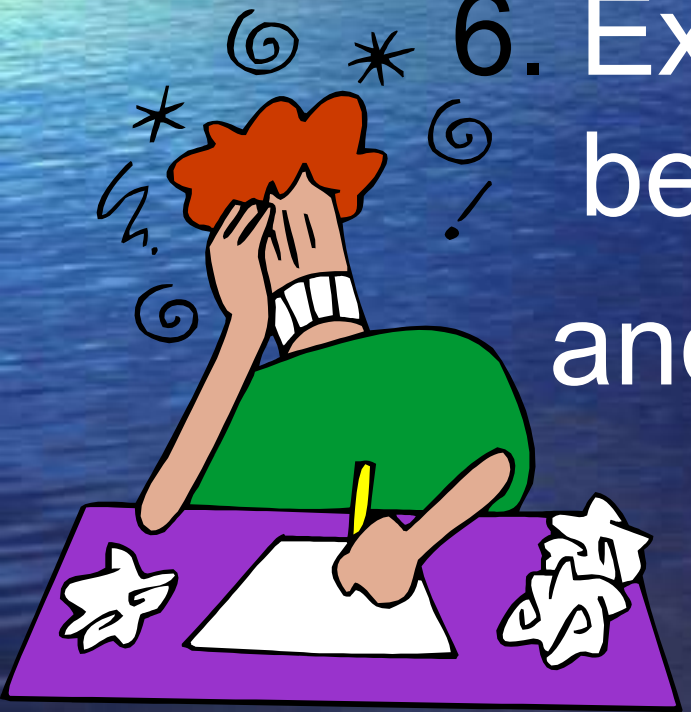
Heat = mass x specific heat x change in temp

$Q = m\ c\ \Delta t$

Review

1. What is temperature?
2. Name the 3 different scales with which temperature is measured.
3. Convert 51°C to Kelvin.

4. Convert 324K to Celsius.
5. Name 3 methods of energy transfer and explain how they work.
6. Explain the difference between conductors and insulators



Unit 4 Equations

$K = °C + 273$

$°F = (9/5x\ °C) + 32$

$°C = 5/9(°F-32)$

Kinetic Energy $= 1/2$ (mass x velocity^2)

$KE = ½\ m\ v^2$

Potential Energy = mass x gravity x height

$PE = m\ g\ h$

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Heat = mass x specific heat x change in temp

$Q = m\ c\ \Delta t$

Δt = final temp – initial temp