Internal Energy

When mechanical energy is “lost” (due to friction or air drag), it does not disappear. It changes into “Internal Energy”: kinetic and potential energies of molecules that make up stuff round us. We can “feel” the increase of internal energy of an object since its temperature is rising. The internal energy can be changed either by doing mechanical work, or by adding Heat:

$$\Delta E_{\text{int}} = Q + W$$

E_{int} – Internal (Thermal) Energy of an object.

Q – Heat adsorbed by the object

W=Fd – Work done by external forces (Force * Displacement)

Calories and Specific Heat

Traditionally, Heat was measured in calories (cal):

- **1 calorie** is an amount of heat needed to increase the temperature of 1g of water by 1^oC.
- Since Heat is a form or energy, calories can be converted to Joules:

1 cal = 4.184 J

Specific heat capacity (ors simply specific heat) of a material is an amount of heat (in Joules) needed to change temperature of a unit mass (1 kg) of the material by 1^oC. In order to heat an object of mass **m** by temperature **ΔT** you need to add thermal energy :

$$Q = Cm\,\Delta T$$

By this definition, specific heat of water is C=1000 cal/kg ^oC= 4184 J/kg ^oC

Homework 16

Problem 1

An Aluminum ball of certain mass m falls from the height h=100m, hits the ground several times and comes to rest. Imagine that all the heat generated due to air resistance and collisions is adsorbed by the ball itself. How much its temperature have changed? Specific Heat Capacity of Aluminum is *C=910 J/kg ^{o}C.*

Problem 2

A cyclist is moving at speed v=5m/s. He applies breaks and comes to a complete stop. Assuming that all the heat generated during the breaking is concentrated in rubber blocks that "squeeze" the wheel, find the change in temperature of the rubber after the breaking, ΔT. Mass of the cyclist with the bicycle is M=100kg, total mass of all rubber blocks is m=50g. Specific heat capacity of rubber is C=2000 J/kg ^{o}C