Phy100: More on Energy conservation

1) General conservation law for isolated systems;

2) Thermal energy.

Introduction to heat or thermal energy

Mechanical energy (E=K+U) is conserved when there are

No dissipations say due to frictions or the system is frictionless (see simulations), or due to inelastic collisions. Practically, there are always dissipations.

Energy in a particular form (mechanical) is conserved only conditionally.

Energy conversion from mechanical to heat is usually due to : a) inelastic collisions (See Paul's demo);
b) frictions (surface frictions, air frictions or air drag).

Q1

Before coming to this course, I have known/ heard of

1) friction forces exerted on a moving object by rough surfaces;
2) frictions are sources of heat generation on surfaces such as in car brakes;
3) Both 1) and 2);
4) Non of above.

Q1

Two marbles, one twice as heavy as the other, are dropped from the roof of a building. The friction force on the heavier one is also TWICE as much as the force acted on the light one. When hitting the ground, the heavier marble has

1) as much kinetic energy as the light one;
2) Twice as much as the light one;
3) half as much as the light one;
4) Impossible to determined.

Frictions lead to heat generation.

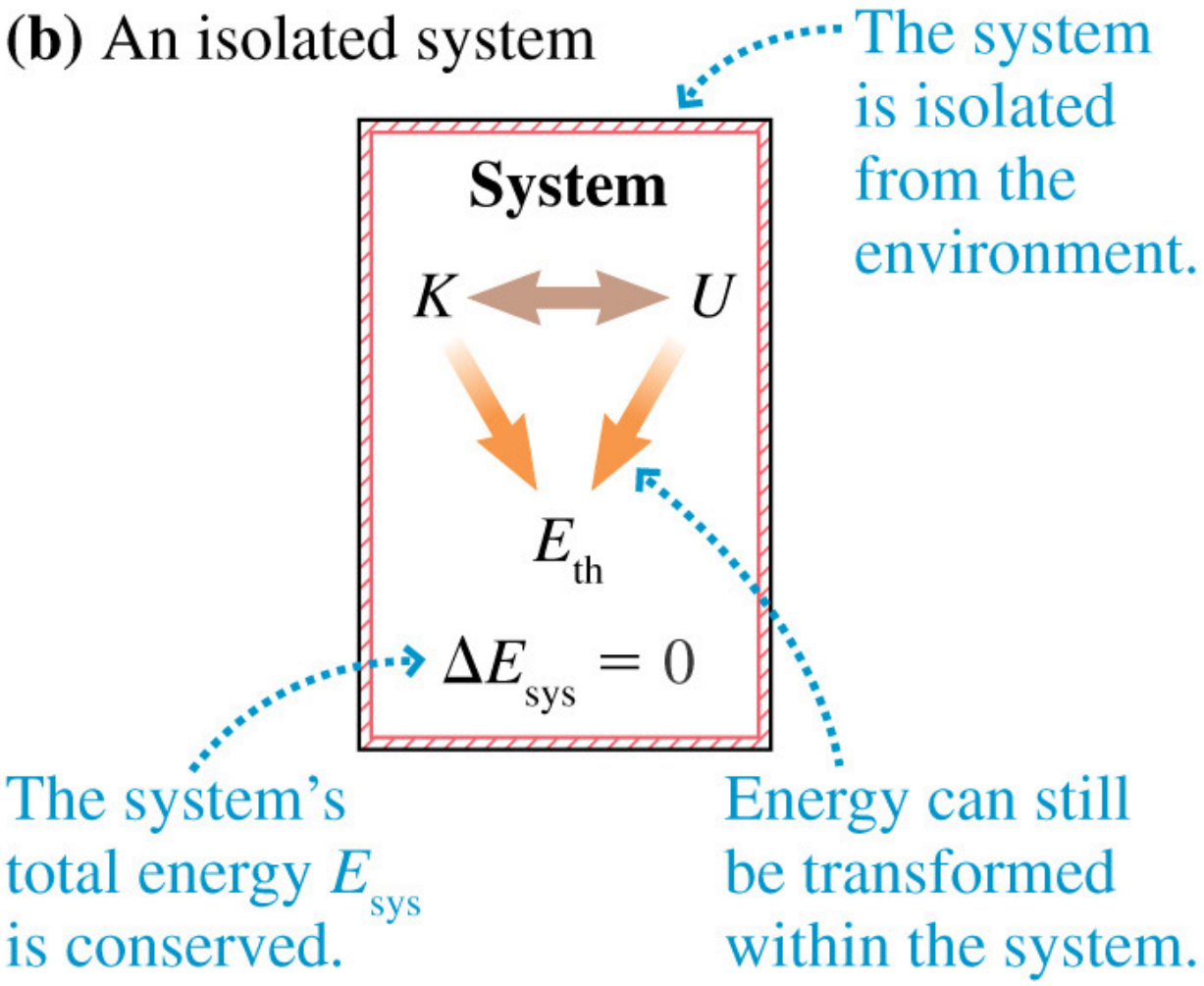
K (heavy)= 2U -2H; K(light)=U – H; K(heavy)=2 K(light)

Q2

Two marbles, one twice as heavy as the other, are dropped from the roof of a building. The friction force on the heavier one is the SAME as the force acted on the light one. When hitting the ground, the heavier marble has

1) as much kinetic energy as the light one;
2) Twice as much as the light one;
3) half as much as the light one;
4) Impossible to determine

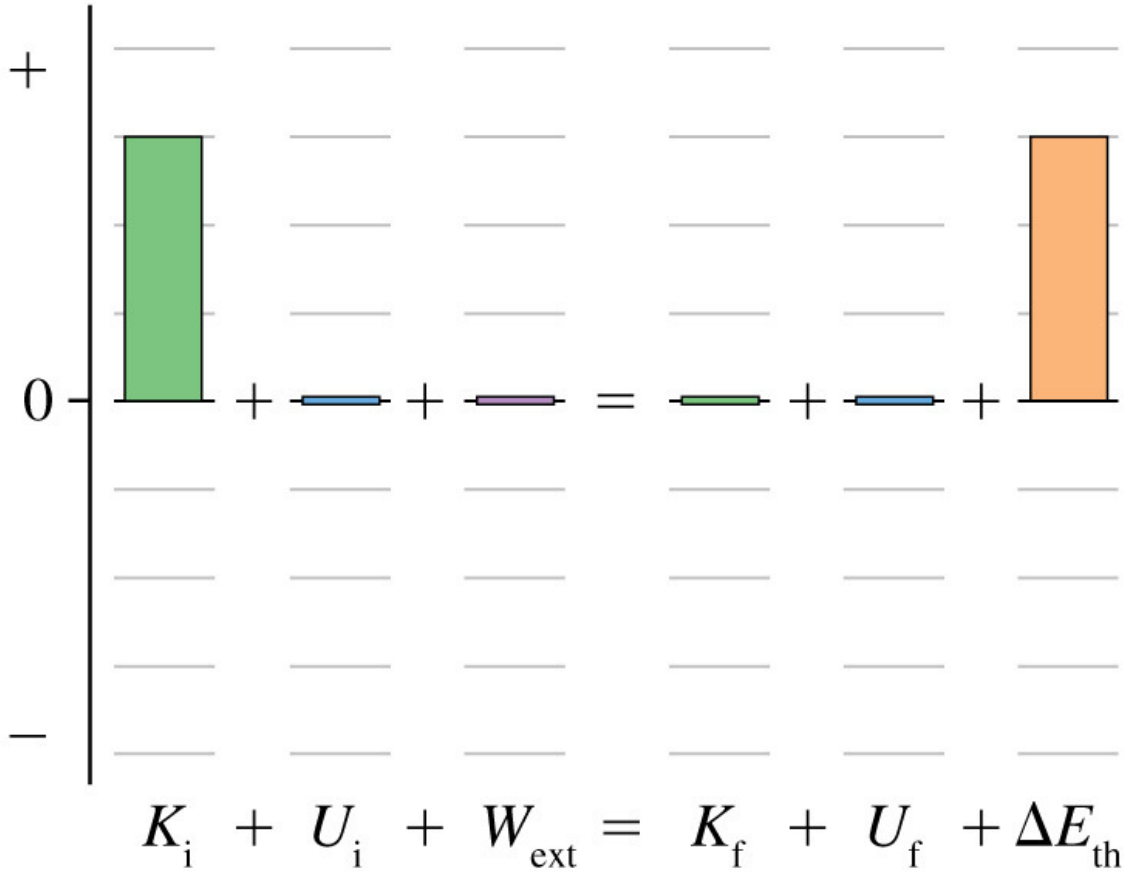
K (heavy)= 2U -H; K(light)=U – H.



Energy conservation including thermal energy
Esys is conserved for an isolated system

Energy bar chart for a block

sliding across a rough floor until it stops



Q 2

Simulations of energy conservation---

Energy skate park

Assume that the weight of skater is 60kg and initially he stands 5m above the lowest point of the track. Approximately how much heat is generated when he comes to a stop:

1) 30J; 2) 300J; 3) 3000J; 4) 30,000 J.

What is thermal energy?

Thermal energy is a measure of how hot an object is.
Human bodies are very good themometers:
most of us can sense the difference between below and above 30C!! We also know that one should not touch surfaces of a heated oven because it is HOT.

More precisely, thermal energy is the total energy of microscopic motions of atoms or molecules (either vibrational or rotational but at nanometer scales).
It can be associated with temperatures.

HOT <-----> physically, motions of atoms speed up!!
(More atoms occupying excited energy states.)

Simulations on heat and thermal energy

Friction forces

Microwaves heat up coffee