Physics 20 Unit 3 - Work and Energy

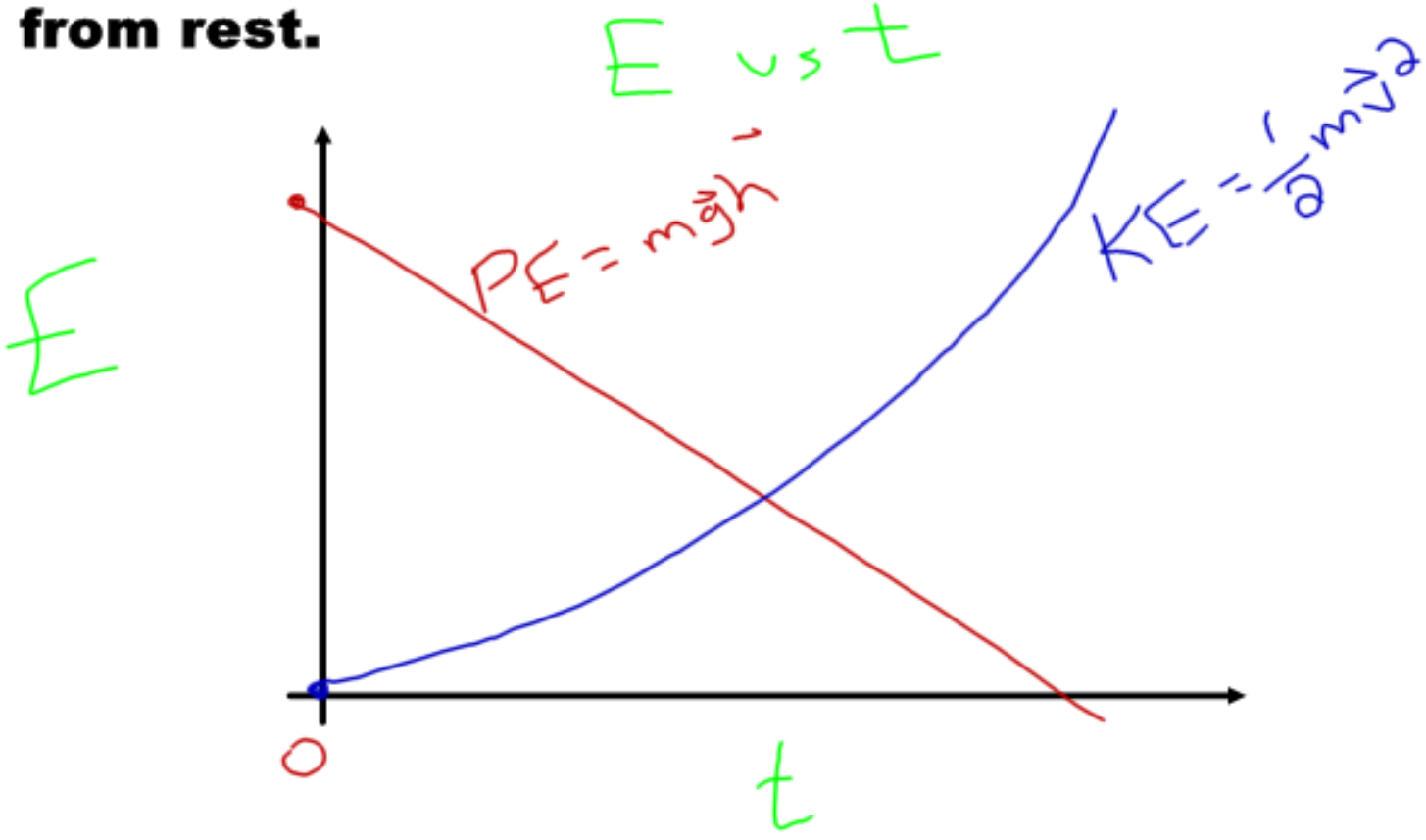
Mechanical Energy

and the

Work Energy Theorem

Conceptual Review

Draw (on the same set of axis) a E_p vs. time graph and an E_k vs. time graph for a skier going down a steep slope, starting from rest.



Mechanical Energy

We have dealt with 3 kinds of energy so far:

- **Kinetic Energy - Energy of Motion**
- **Gravitational Potential Energy**
- **Elastic Potential Energy**

These energies are rarely found on their own. In a given situation, there is often more than one type of energy present. Therefore, it is helpful to consider the total of the energies present: this is the mechanical energy.

Mechanical Energy: the sum of energies acting in a given system.

We can take this one step further and combine our concept of work with the concept of mechanical energy.

Since mechanical energy is a sum of all energies, and work is a change in energy, we could write:

The Work-Energy Theorem

$$W = \Delta E_k + \Delta E_p$$

All work done on a system is the sum of the changes in potential and kinetic energies.

ex) A farmer is hauling feed to his chickens. He lifts a 9.00 kg bucket of feed up 5.00 m by rope to his coop roof. This takes a force of 150 N upwards.

a) What work does he do on the feed?

Ans: 750 J

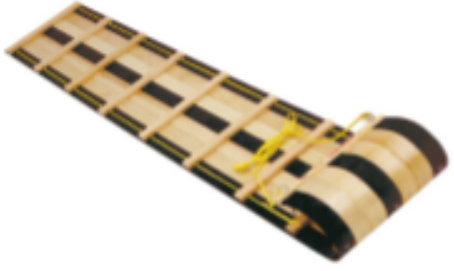
b) What is the change in PE of the feed?

Ans: 441 J

c) What is the change in KE of the feed?

Ans: 309 J

ex) At Real's Toboggan Party, a 150 kg sled and rider are pushed up a hill. The initial velocity of the rider is 2.50 m/s and the final velocity is 5.80 m/s. The hill has a vertical height of 6.53 m. What amount of work is needed to push the sled up the hill?



Secret Sled Thing

Because we want the change in KE, use (KE_f - KE_i).

We can also use the definition of mechanical energy to help solve problems:

ex) A Christmas care package of mass 450 kg is dropped to soldiers in Afghanistan. During the fall, the package reaches a velocity of 35 m/s at a height of 350 m. What is the mechanical energy of the package? (pick appropriate units of energy)

But why is Mechanical Energy really important?

Because I'm about to say to you...

THE LAW OF CONSERVATION OF ENERGY!!!

this is a big idea...

In an isolated system, mechanical energy is conserved. Energy is not created or destroyed, only changed in form.

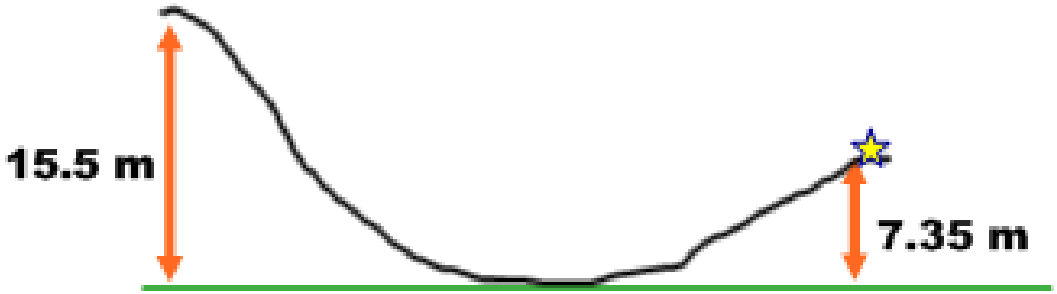
Let's unpack this statement:

Isolated System - a system when energy or matter can not enter or leave.

The universe is an example of an isolated system. We can also construct imperfect isolated systems to study (on paper) such as simple (ideal) pendulums.

Energy is Conserved - this means the total amount of energy present in the system is always the same. It may, however, be in constant flux in energy types.

ex) A frictionless rollercoaster car has a mass of 200 kg and travels along a path as shown below:



Calculate the:

a) PE at the first hill.

b) The KE and speed at the bottom dip.

c) The speed at the top of the second hill.