Energy

The concept of energy is a human invention. One can't see it or touch it, but we often claim to measure it, use it, even buy it.

In beginning physics we define energy as the ability to do work.

Physics work does not always match the social idea of work.

In physics, work = force x distance W=Fd

Energy

Even the simple formula of W=Fd has a special condition – force and distance must be in the same direction.

Energy has many different forms. We will consider some of the less complicated ones, even so, problems will be difficult. You will need to practice.

Work

Metric units of work include:

Nm ➔ Newton meters

J ➔Joules

kg m^2/s^2 ➔ kilogram meters squared per second squared

Ws ➔ watt seconds

kWhr ➔ kilowatt hours

The Law of Conservation of Energy

Energy is conserved. This means that energy is not created or destroyed.

The Law of Conservation of Energy fits in with other great conservation laws in science.

The Law of Conservation of Matter

The Law of Conservation of Momentum

The Law of Conservation of Charge

"Kinds" of Energy

Work W=Fd
kinetic energy energy of motion $KE=\frac{1}{2}mv^2$
potential energy energy of position PE=mgh
thermal energy heat (molecular kinetic energy)
chemical potential energy
spring potential energy
magnetic potential energy
electric potential energy
electric circuit energy

Energy

The Law of Conservation of Energy says that all the energy at the beginning must equal all the energy at the end.

In your mouse trap devices the more energy changes you have the more points you earn.

What kind of energy changes are these?

1. A ball falling
2. Throwing a rock up
3. Burning some wood
4. Turning on a light
5. Eating some food and then running
6. Driving a car or truck
7. Using your cell phone

Machines

Simple machines are devices that allow us to change how the work is done.

Simple machines include:

inclined planes
pulleys
levers
wheel and axle
wedge
screw

Machines

Machines do not change the amount of energy required to do work.

Reminder of the Law of Conservation of Energy.

Energy is neither created or destroyed.

Machines change the amount of force required to do some particular work.

The trade off for reducing the force is increasing the distance (the amount of work is the same if there is no friction).

Machines

Mechanical Advantage is a description of the force advantage for a particular machine.

Mechanical Advantage (MA) is defined as distance_{in} divided by distance_{out}.

$$MA = \frac{\text{distance}_{in}}{\text{distance}_{out}}$$

Machines

If there is no friction, Mechanical Advantage (MA) is also Force_{out} divided by Force_{in}.

$$MA = \frac{F_{out}}{F_{in}}$$

Efficiency

Because real machines "waste" some of the input work caused by friction it is useful to describe how much work is put out from a machine compared to how much work is put into the machine. This quantity is called efficiency.

$$\text{efficiency} = \frac{\text{Work}_{out}}{\text{Work}_{in}} \times 100$$

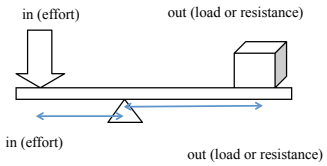
Efficiency is expressed as percents

Percent Review

Percent
literally per (over) cent (100)
number out of 100
50% = 50/100

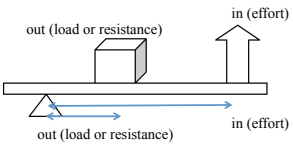
Levers

First Class Lever



Levers

Second Class Lever



Levers

Third Class Lever