

Energy



Mrs. King
Integrated Science

Work & Energy

- **Work**
 - transfer of energy from one object (or system) to another.
- **Energy**
 - ability to do work
- The energy to do work comes from one object and is transferred to the second object
- Measured in joules

Energy

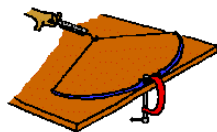
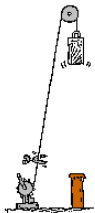
- dissipates from an area of **higher energy** to one of **lower energy** without the input of additional energy

What is Energy?

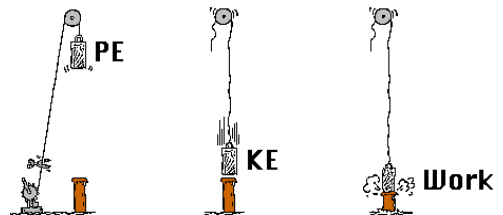
- Key Terms
 - Potential energy
 - Kinetic energy
 - Mechanical energy

POTENTIAL ENERGY

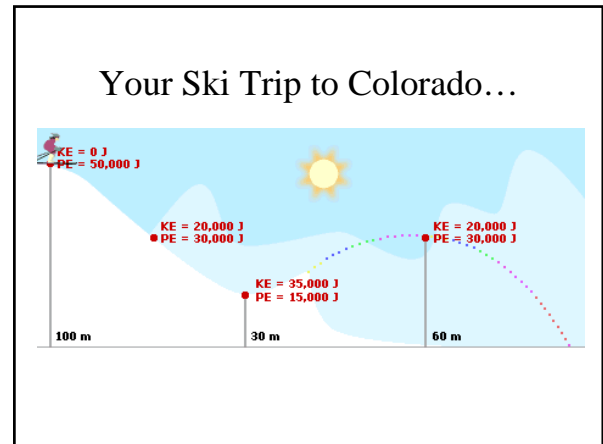
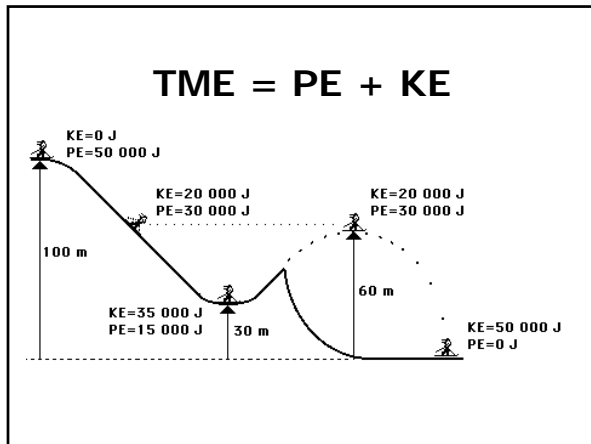
Stored energy



The heavy ram of a pile driver and the stretched bow possess stored energy of position – potential energy.



The ram of a pile-driver possesses mechanical energy – the ability to do work. When held at a height, it possesses mechanical energy in the form of potential energy. As it falls it possesses mechanical energy in the form of kinetic energy. As it strikes the spike, it applies a force to displace the spike – i.e., it does work on the spike.



Gravitational Potential Energy

- Depends on mass and height
- Grav. PE = mass x free fall acceleration x height

$$PE = mgh$$

- mg is weight of object in newtons, which is the same as the force on the object due to gravity
- So, this is really just a calculation of force times distance like the work equation.
- Height measured from ground in most cases.

KINETIC ENERGY

Energy of *MOTION*

- where m = mass of object
- v = speed of object

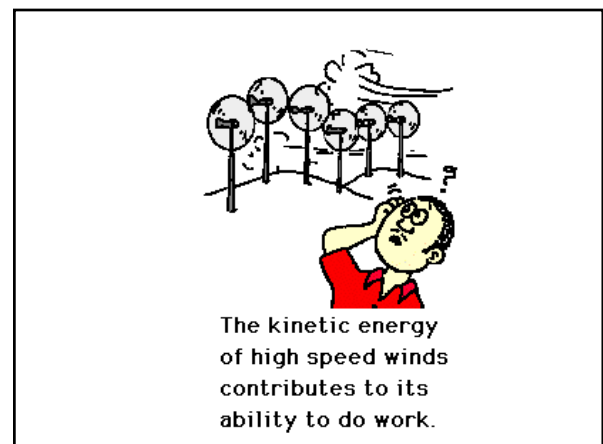
– Formula:

$$KE = \frac{1}{2} * m * v^2$$

To understand the work-energy relation, you must understand the two types of forces.

Kinetic Energy

- An object which has motion, whether it be *vertical or horizontal* motion, has **kinetic energy**.
- Types of KE:
 - vibrational (the energy due to vibrational motion),
 - rotational (the energy due to rotational motion)
 - translational (the energy due to motion from one location to another)



The Law of...

- **Conservation of Mass**

- Mass can not be created or destroyed

- **Conservation of Energy**

- Energy can not be created or destroyed

- This law governs all energy flow, especially observable in the cases of thermal and electrical energy flow

- Heat moves from the hot lava lamp to the relatively cold glass and surrounding air

- Electrons tend to spread until an even charge is obtained throughout the entire system



- This can also be directly observed with a drop of dye added to a glass of water.

- The color will dissipate until the entire solution is a uniform color.

MECHANICAL ENERGY

Work

Mechanical Energy...

- energy which is possessed by an object due to its motion or its stored energy of position.
- Mechanical energy can be either kinetic energy (energy of motion) or potential energy (stored energy of position).

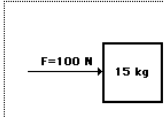
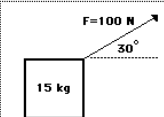
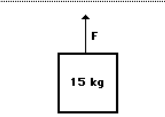
Mechanical Advantage

- The mechanical advantage of a machine describes how much the machine multiplies force or increases distance.
- $\text{Mechanical advantage} = \frac{\text{output force}}{\text{input force}} = \frac{\text{input distance}}{\text{output distance}}$
- > 1 multiplies the input force
- < 1 does not multiply force, but increased distance and speed.

Mechanical Advantage

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

mechanical advantage = $\frac{\text{output force}}{\text{input force}}$

| Diagram A | Diagram B | Diagram C |
|--|--|--|
|  |  |  |
| A 100 N force is applied to move a 15 kg object a horizontal distance of 5 meters at constant speed. | A 100 N force is applied at an angle of 30° to the horizontal to move a 15 kg object at a constant speed for a horizontal distance of 5 m. | An upward force is applied to lift a 15 kg object to a height of 5 meters at constant speed. |



A weightlifter applies a force to cause a barbell to be displaced. The barbell then possesses mechanical energy – all in the form of potential energy.

$$\text{Power} = \frac{\text{Work}}{\text{time}} = \frac{\text{Force} \times \text{displacement}}{\text{time}}$$

$$\text{Power} = \text{Force} * \frac{\text{displacement}}{\text{time}}$$

$$\text{Power} = \text{Force} * \text{Velocity}$$

Calculate Power Rating

$$\text{Power} = \frac{\text{Work}}{\text{time}} = \frac{800 \text{ N} * 2.0 \text{ m}}{1.8 \text{ seconds}}$$

$$\text{Power} = 889 \text{ Watts}$$

- <http://www.physicsclassroom.com/Class/energy/U5L1e.html>



Rock climbers do a lot of work at a slow rate; their power is small.



A powerful lineman is both strong
(applies a big force) and fast
(displaces objects in small times)