# Work, Energy and Power : Notes-5

## Energy

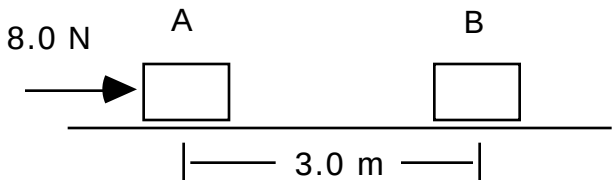
It is the ability to do work.

## Work

The work done on an object equals the force acting on it multiplied by the distance it is moved. The force **must be parallel** to the direction of movement.

## Work = Force x Distance

example:




The work done on the box equals 8.0x3.0 = 24 N m or 24 joules. If there is no friction, the box will accelerate. If the friction is -8.0 N, the box will move at a constant speed. In both cases, the work done by the 8.0 N force is 24 J.

## Kinetic Energy

In the example above, if the friction is zero, the speed of the box will increase. From kinematics, we have; $V_f^2 - V_i^2 = 2ad$. For this example, $V_i = 0$. Multiply both sides of the equation by 1/2 x m. We have, $mad = 1/2mV_f^2$, or $F\,d = 1/2mV^2$. This quantity is called the kinetic energy. The units are joules.

$$\text{Kinetic Energy} = \frac{1}{2} m V^2$$

If the friction is zero, the work done on the mass m equals the change in kinetic energy of the mass.

$$\text{Work} = \Delta E_K$$

If there is a friction force, some or all of the work is done against friction. All or part of the work done will become heat energy.

## Gravitational Potential Energy

If a mass m is lifted vertically through a height h, the work done equals F d = mgh. This quantity is called the gravitational potential energy of the mass m. The units are joules.

## Potential Energy = m g h

The work done in lifting the mass m, equals the change in the potential energy of the mass.

$$\text{Work} = \Delta E_P$$

## The Law of Conservation of Energy

An important law of physics is the Law of Conservation of Energy.

This law states that; energy may be transferred or it may change form, but the total energy of a system remains constant.

The total energy is equal to the sum of the kinetic energy and the potential energy.

$$E_{K1} + E_{P1} = E_{K2} + E_{P2}$$

## Power

The power is equal to the energy expended divided by the time.

$$\text{Power} = \frac{\text{Energy}}{\text{time}} = \frac{\text{Work}}{\text{time}}$$

The units are watts (W) or joules/second.