Physics
Chapter 5: Work and Energy

Section 5.4

Work, Energy, and Power

Work and Energy: The Work-Kinetic Energy Theorem

--When work is done on an object, the net work done equals the change in kinetic energy of the object.

$$W_{net} = \Delta KE$$

(The Work-Kinetic Energy Theorem)

--This equation can be used to calculate the change in KE of an object when friction is small, or gives the initial KE when friction acts on the object.

--Work done on a moving object by friction is given by:

$$W_{friction} = \Delta ME$$

--If friction is zero, then ΔME is zero, and:

$$ME_i = ME_f$$

--The above equation says that, in the absence of friction, ME is conserved--conservation of mechanical energy.

--The work=kinetic energy theorem states that work is a method of transferring energy; a force that acts perpendicular to the direction of motion of an object does no work on the object because no energy is transferred to the object.

--The work done by one object on another object is given by:

$$W = Fd(\cos\theta)$$

--The change in kinetic energy in terms of the net work done is given by:

$$W_{net} = \Delta KE$$

Power

--<u>Power</u> is the rate at which work is done or the rate at which energy is transferred.

$$Power = \frac{work}{time}$$

$$P = \frac{W}{\Delta t}$$

$$P = \frac{Fd}{\Delta t}$$

$$P = \frac{mgd}{\Delta t}$$

--Power can also be expressed in terms of the force and speed of the object, since the distance moved per unit time is the speed of the object:

$$P = \frac{Fd}{\Delta t} = F\frac{d}{\Delta t} = F * V$$

(Power = force x speed)

--The SI unit of power is 1.0 J/s, which is called a <u>watt</u> (W).

$$\frac{\text{Joule}}{\text{second}} = \text{watt}$$

$$\frac{\text{J}}{\text{s}} = \text{W}$$

(746 watts = 1 horsepower)

--I can do just as much work as your big John Deere tractor...

--Two machines, or two people, or a person and a machine, can do the same amount of work.

--The one that does the work in less time has more power.

--I can do just as much work as your big John Deere tractor, but it has more power and thus can do the work in much less time!

--The watt is also used to express electrical power.

--Electrical power is commonly expressed in kilowatts (kW)

(1 kW = 1000 W)

--The kilowatt-hour (kWh) is the unit of <u>electric energy</u>. 1kWh = 1 kW x 1 h