Day 2--Momentum, Work, Power and Energy

I. Momentum—Product of an objects mass and velocity.

--Will not change unless mass or velocity changes.

a. Law of Conservation of Momentum—Total amount of momentum in a system of objects will not change unless acted on by some unbalanced force.

b. Discuss Examples—car wrecks, sports(tackling, etc)

I. Work and Power

a. Discuss vocabulary:

i. Work—transfer of energy through motion.

ii. Power—Time rate of work

iii. Joule(J)—unit of energy(including work)

iv. Watt(W)—unit of power

Discuss when work is done and when work is not done!!

i. Done when force is in direction of motion.

   Ex.) You push a box across the floor!!

ii. NOT done when force is not in the direction of motion, or when the object does not move!!

   Ex.) No work done carrying something.(force is directed upward and displacement is forward)

Work?????

A teacher applies a force to a wall and becomes exhausted.

This is not an example of work. The wall is not displaced. A force must cause a displacement in order for work to be done.

Move the box above to reveal the answer!!

Work?????

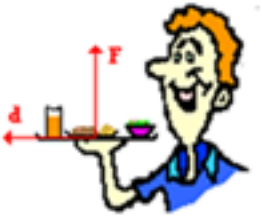
A book falls off a table and free falls to the ground.

Yes.

This is an example of work. There is a force (gravity) which acts on the book which causes it to be displaced in a downward direction (i.e., "fall").

Move the box above to reveal the answer!!

Work?????



A waiter carries a tray full of meals above his head by one arm straight across the room at constant speed.

No.

This is not an example of work. There is a force (the waiter pushes up on the tray) and there is a displacement (the tray is moved horizontally across the room). The applied force and the displacement are not in the same direction!!

Move the box above to reveal the answer!!

Work and Power Examples:

1. A force of 250 N is applied to a box to move it a distance of 6 m. How much work is done?

a) 0 J b) 41.7 J c) 1500 J d) 2000 J

$F = 250\,N$

$d = 6\,m$

$W = ?$

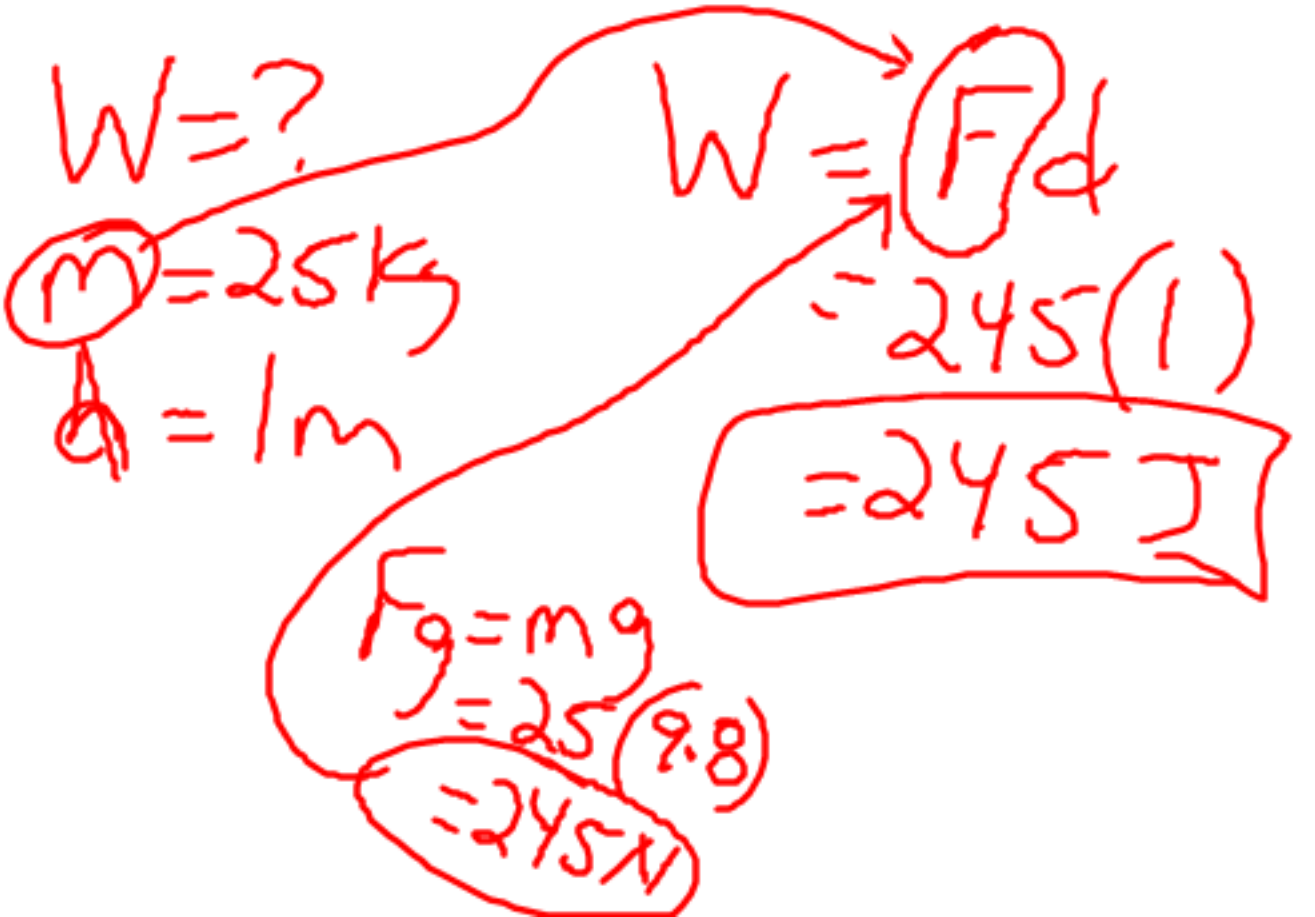
$W = Fd$

$= 250(6)$

$W = 1500\,J$

2. How much work is required to lift a 25 kg object to a height of 1.0 m?

a) 0 J b) 25 J c) 245 J d) 2450 J



3. A truck does 2500 J of work in pulling a stalled car a distance of 4 m. What force was applied on the stalled car?

a) 0 N b) 625 N c) 7500 N d) 10,000 N

$W = 2500\,J$

$d = 4\,m$

$F = ?$

$W = Fd$

$F = \frac{W}{d} = \frac{2500}{4}$

$F = 625\,N$

4. How much work is done carrying a 30 kg box a distance of 10 m?

a) 0 J b) 3 J c) 300 J d) 2940 J

W = ?

* No work is done carrying

Energy

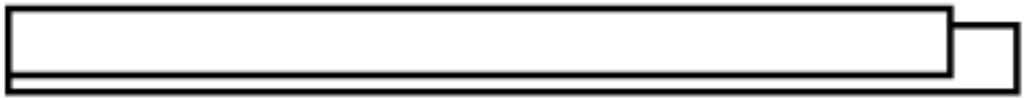
i. Potential Energy—stored energy
    1. Gravitational potential energy
    2. Elastic potential energy
    3. Chemical potential energy(gasoline, food)

ii. Kinetic Energy—energy of motion

iii. Mechanical Energy—Total potential and kinetic energy in a system of objects.

Conservation of Mechanical Energy—Total energy remains constant.

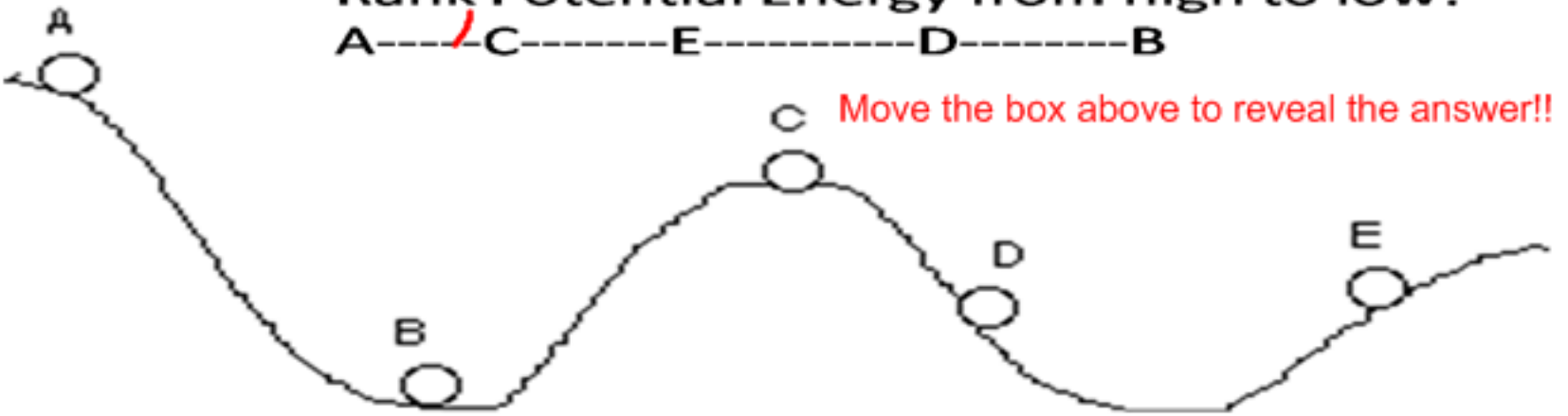
i. Energy may change form, but is never lost or created during any change.



Rank Potential Energy from high to low!

A----C-------E----------D--------B

Move the box above to reveal the answer!!



Rank Kinetic Energy from high to low!

B------D------E----------C--------A

Move the box above to reveal the answer!!

Potential and Kinetic Energy Examples:

1. A 150 kg boulder is resting at the top of a 20 m high cliff. How much potential energy does the boulder have at the top of the cliff?

a) 7.5 J b) 3000 J c) 19,480 J d) 29,400 J

use this equation b/c you have MASS

$m = 150\text{kg}$

$h = 20\text{m}$

$PE = ?$

$PE = mgh$

$= 150(9.8)(20)$

$PE = 29{,}400\text{J}$

2. A 1.0 kg ball is rolling down a hill at a velocity of 3.0 m/s. How much kinetic energy does the ball have as it rolls down the hill?

a) 0 J b) 4.5 J c) 9.0 J d) 88.0 J

$m = 1.0\,kg$

$v = 3\,m/s$

$KE = ?$

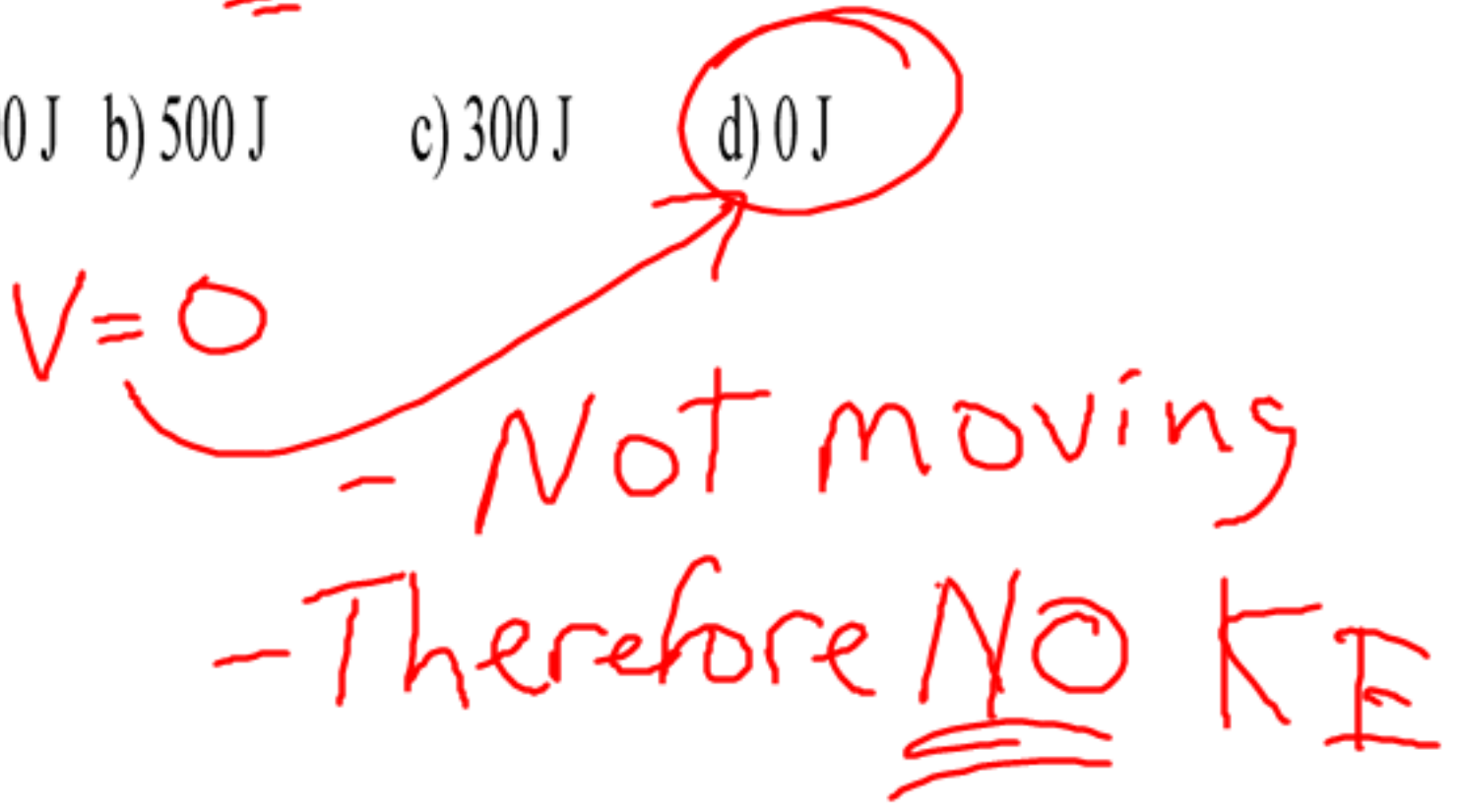
$KE = \frac{1}{2}mv^2$

$= \frac{1}{2}(1)(3)^2$

$KE = 4.5\,J$

3. A 1500 kg car sits at a stoplight. How much kinetic energy does the car have?

a) 1500 J b) 500 J c) 300 J d) 0 J



4. A boulder has 25,000 J of energy as it sits at the top of a cliff. If the boulder fell to the ground, how much kinetic energy would the boulder have just as it hits the ground?

a) 0 J b) 12,500 J c) 18,000 J d) 25,000 J

* Conservation of ENERGY