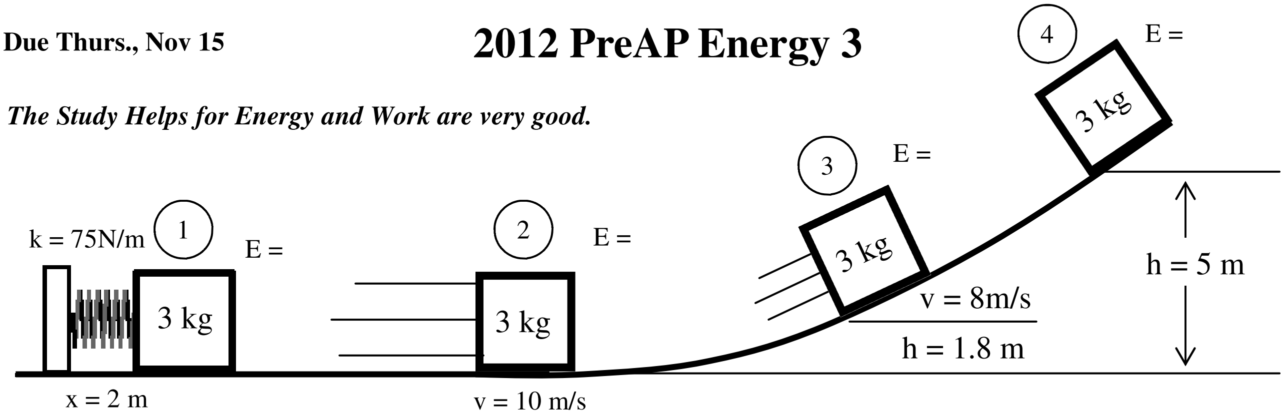
Due Thurs., Nov 15

2012 PreAP Energy 3

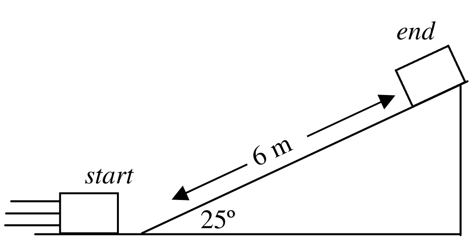
The Study Helps for Energy and Work are very good.



1. A 3 kg object is against a compressed spring. When released the object moves up a ramp until it stops. Assume there is no friction on the surface and use g = 10 m/s^2.
   A. What kind of energy does the object have at
   Position 1: _____________Position 2: ____________Position 3: ____________Position 4: _____________
   B. Label the above diagram with the kind of energy or energies it has at each position.
   C. Calculate the energy at position 1:
   D. Calculate the energy at position2:
   E. * Calculate the total energy at position 3:
   F. Calculate the energy at position 4:
   G. Label the amount of energy at each position on the diagram above.
   H. How does the energy compare at each position?
   I. The energy of the object is not gained or lost, just t_____________.
   J. So does the total energy of the system change?
   K. If there was absolutely no friction on the surface or in the spring, how long would the mass go up and back?
   L. If there was friction, how would the final height of the object change?

   If the energy of an object is just changing kinds, like above, the energy of the system stays the same and no work is done. To change the energy of system requires an outside force like friction, which does work on the object.

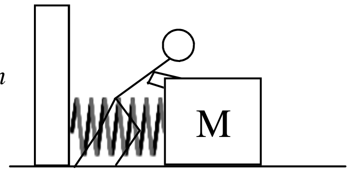
2. +W, –W, or no Work (0)? (*More explanation on the back.*)
   A. _____When the energy is just transferred.
   B. _____When an object loses energy.
   C. _____When an object gains energy.
   D. _____When energy doesn't change.
   E. _____An object slows down.
   F. _____An object is raised up.
   G. _____An object rolls down a hill.
   H. ____ An object at rest on a hill.
   I. ____ Compressing a spring.
   J. ____ Sitting on an object.
   K. ____ Lowering an object down to the ground.
   L. ____ Speeding up an object.
   M. ____ Friction acting on an object.
   N. ____ Holding onto an object.



3. A 2 kg object moves up a 6 m long ramp, which is tilted at an angle of 25º.
   A. What kind of energy did it start with?
   B. What kind of energy did it end up with?
   C. *Calculate its final energy (*remembering that h is vertical*).
   D. If there is no friction on the ramp, how much kinetic energy did it have at the bottom?
   E. *Calculate what velocity it must have had at the bottom of the ramp.

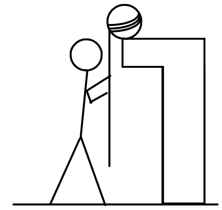
Sometimes students have trouble figuring out is when to include work. Just "energy is added" is not always enough.

Notice that BOTH Slim Jim and the spring are increasing the energy of the mass, so both are doing work. The spring does an amount of work equal to ½kx² ($\frac{1}{2}kx^2$)*. (See below for more info on the spring.) That's what potential energy is: stored work OR the amount of work that will be done on the object when it is released.*



$PEel_{spring} + W_{Jim} = KE_{mass}$.

Here both gravity and Slim Jim will do work on the ball. Gravity will do an amount of work equal to mgh, where mg is the force and h is the distance. Because Slim Jim is also pulling on the object, the object will fall faster than $-9.8\ m/s^2$ *and gain more than mgh of KE.*



$PE_{gravity} + W_{Jim} = KE_{mass}$.

So, if an object's energy is increased due to gravity or a spring, then work IS BEING DONE, but is already included in the potential energy of that object and does not have to be included as work, too.

Q1E: $E_{total} = KE + PE$.
Q3C: PE = mgh = 2(10)(6)sin25º = 50.7 Joules   Q3E: KE = 50.7 Joules, v = 7.1 m/s

How a spring's potential energy = work done by the spring.

Force is in N and the spring constant is in N/m. So, obviously, [N/m]×[m] = [N], so the force of a spring = kx. You may then think that $W_{spring} = F_{spring}(d) = kx(x) = kx^2$. *But where does the ½ come from? When the spring is relaxed, its force = 0 N. When it is fully stretched to a distance of "x" its force is kx. The AVERAGE force is then ½kx and the work done by the spring =* $(\frac{1}{2}kx)(x) = \frac{1}{2}kx^2$. *OR the work done by the spring when released = the work done by the spring or* $W_{by\ spring} = PE_{elastic} = \frac{1}{2}kx^2$.