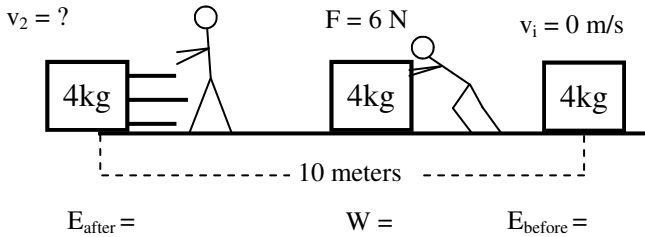


## 2012 PreAP Energy 4

Let's learn the difference between positive and negative work.

1. Slim Jim pushes on an object for 10 m with a 6 N force.

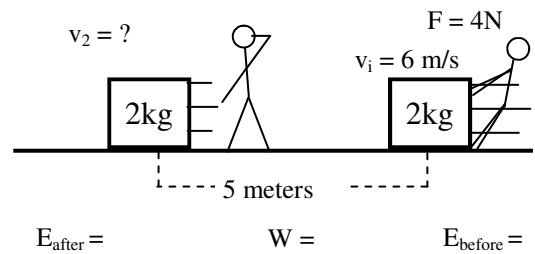


- Since the object is on the ground and at rest to begin with, how much energy does it start with?
- Is the object gaining or losing energy?
- Calculate the work Jim gives the object realizing that in this example  $F$  and  $d$  are both  $-$ .

*This is positive work:  $F$  and  $d$  are in the same direction and the object gains energy.*

- \* How much energy does Jim give the object?
- \* Calculate the final velocity of the object.

2. Slim Jim pulls on an object with 4 N for 5 m. The object slows down but is still moving afterwards.



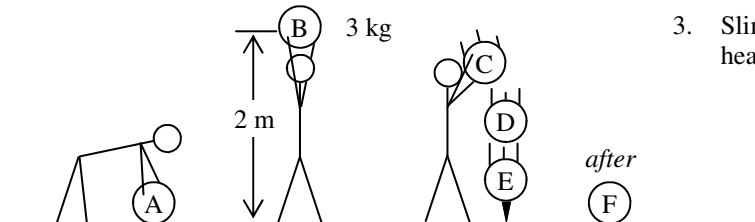
- Calculate its initial energy.
- Is the object gaining or losing energy?
- Calculate the work Jim does on the object realizing that in this example  $F$  is  $+$ .

*This is negative work:  $F$  and  $d$  are in opposite directions and the object loses energy.*

- \* How much energy is left afterwards?
- Calculate the final velocity of the object.

*Work and energy are scalars, which have no direction. It really doesn't matter if  $F$  is  $+$  or  $-$ , only if  $F$  and  $d$  are in the same direction. If the energy of the object increases (in ANY direction), it is  $+W$ . If the object loses energy (in ANY direction) it is  $-W$ .*

3. Slim Jim lifts a 3kg ball from the ground. He lifts it above his head and drops it onto a spike.



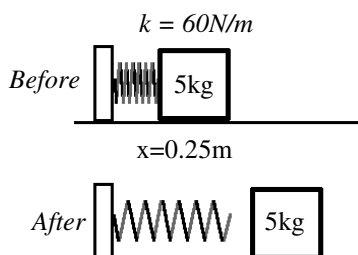
- What kind of energy or energies does the ball have:
 

At A:	At B:
*At C:	At D:
*At E:	At F:

- Calculate the energy the object has at position B.

- How much work did Jim have to do on the object between A and B?
- How much energy must the object have at E just before it hits the spike?
- \*Where does all the energy go?
- \*If the spike is 0.15 m long, how much force was exerted by the ball on the spike as it stops?

4. A 5kg object compresses a spring 0.25m.



- Calculate the energy it has when the spring is compressed.
- What kind of energy does the object have when released?
- If there was no friction on the surface, how much energy does the mass have after released?
- \* Calculate the velocity of the object afterwards. **More on Back**

5. Match the Conservation of energy equations at the right with the following situations.

- |                                                                   |                        |
|-------------------------------------------------------------------|------------------------|
| A. ___ * An object is thrown into the air. Find how high it goes. | 1. $KE - W = KE$       |
| B. ___ An object at rest is moved.                                | 2. $PE = PE + KE$      |
| C. ___ A moving object slows down due to friction.                | 3. $KE = PE$           |
| D. ___ An object is dropped. How fast is it going part way down?  | 4. $KE - W = 0$        |
| E. ___ A spring is compressed.                                    | 5. $PE_{el} = KE + PE$ |
| F. ___ A compressed spring shoots an object into the air.         | 6. $0 + W = KE$        |
| G. ___ A moving object is stopped.                                | 7. $0 + W = PE_{el}$   |

1D: Energy it gains = work done = 60 Joules

1E:  $v = 5.48 \text{ m/s}$

2D:  $36 - 20 = 16$  joules, so now you can calculate the velocity of the object.

3A: at C: it has both KE and PE since it is above the ground and starting to move (fall). It does have more PE at this point. At E: all KE.

3E: negative work done by the spike.

3F:  $W = Fd$   $F = W/d = -400 \text{ N}$

4D:  $0.866 \text{ m/s}$

5A:  $KE = PE$