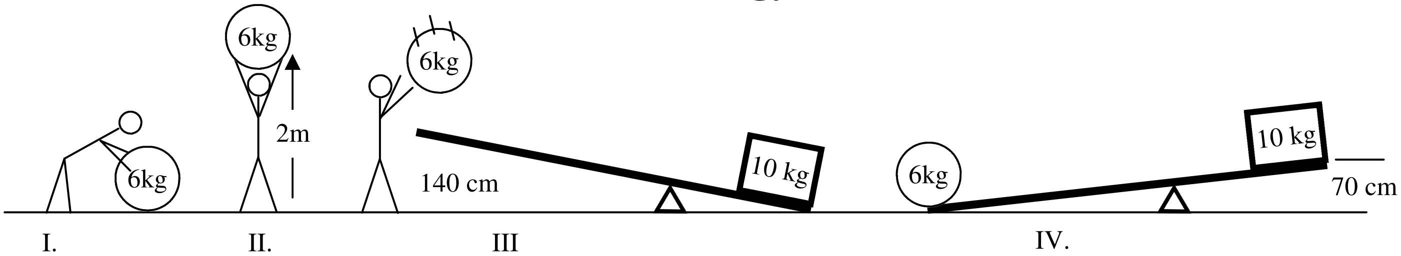
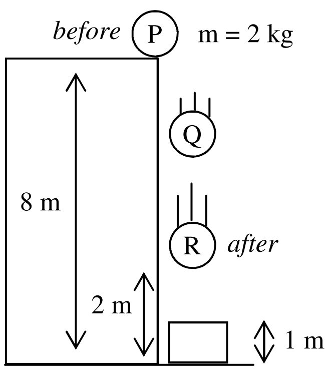
PreAP Energy 9



1. The above sequence shows Slim Jim lifting a medicine ball above his head and then dropping it onto a lever.
   - A. What kind of energy does the ball start with?
   - B. Calculate the ball's energy in part II.
   - C. * How much total energy does the ball have as it falls?
   - D. * In part IV, how much energy does the ball have?
   - E. So, how much energy did the ball lose in part III?
   - F. * If the ball lowers the lever 140 cm, what is the average force applied by the lever?
   - G. How much energy does the 10 kg box have in part IV?
   - H. * Use the equation for efficiency at the right to calculate the efficiency of this energy transfer.

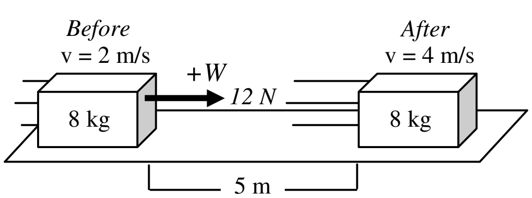
$$Eff = \frac{W_{out}}{W_{in}} x100$$



2. A 2 kg ball is dropped from an 8m tall ledge. There is no air friction.
   - A. * How fast is it going when it is still 2 m above the ground? (Hint: remember that you can set PE = to 0 at any point.)

   The ball then crushes a box as it stops at the bottom.
   - B. * Since there is no air friction, how much total energy does the ball have just before it hits the box?
   - C. * Use Conservation of Energy to solve for the average force applied by the box to stop the ball.

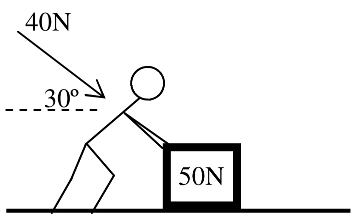
3. An 8 kg object is pushed by a 12 N force for 5 m to accelerate it from 2 m/s to 4 m/s. Do your work under the diagram.



KE_{before} = W = KE_{after} =

   - A. * Before you calculate, since the velocity is doubled, by how much does the kinetic energy change (use the equation)?
   - B. Calculate the energies and work done.
   - C. * How much mechanical energy was gained by the object?
   - D. How much energy did the force try to add to the object?
   - E. * Calculate the efficiency of the energy transfer.
   - F. Where did the lost energy go?
   - G. * How did the total energy of the universe change?

More on back.



4. Slim Jim pushes on a 50N object as shown.
   A. * Calculate the normal force acting on the box.

   Remembering that only the parallel force does work.
   B. * If the box moves 12m, how much work did Slim Jim do on the box?

5. Two objects are dropped from rest from different heights.
   A. * Just before it hits the ground Object I is going 10 m/s, how high was it dropped from?
   B. * Object II was dropped from rest and is going 20 m/s just before it hits the ground, how high was Object II dropped from?
   C. Put this information into the table.
   D. If a third object were dropped from rest, how high would it have to be dropped from to have a velocity of 30 m/s at the ground (without calculating).

	V	h
Object I	10 m/s	
Object II	20 m/s	
Object III	30 m/s	

See the pattern? Why does it work this way, because $(1/2)mv^2 = mgh$. Keeping everything but v and h as constants $v^2 \propto$ (is proportional to) h. So 2v results in 4h.

6. Three 4 kg objects are moving and stop by compressing a spring that has a spring constant of 16 N/m.
   A. * Object I is moving 2 m/s. How far is the spring compressed?
   B. * Object II is moving 4 m/s. How far is the spring compressed?
   C. Object III is moving 6 m/s. Without calculating (using the trend), how far is the spring compressed?

	V	x
Object I	2 m/s	
Object II	4 m/s	
Object III	6 m/s	

Why? Because $(1/2)mv^2 = (1/2)kx^2$. So $v^2 \propto$ (is proportional to) x^2. So $v \propto x$. So doubling v doubles x, etc.

1C: same as the PE in part II: 120 J 1D: 0 J (at rest, on ground) 1F: 85.7 N (W = Fd = 120 J lost; d = 1.4 m)
1H: 58% = mgh gained by box/ energy lost by ball = 70/120
2A: 10.95 m/s; 2B: 160 J, which is mgh for the top. Just before it hits the box it will have mostly KE, but total still = 160 J.
2C: Box does −160J of work. Find d.
3A: since v is squared, doubling v, means KE is x4
3C: 48 J (64−16) 3E: 80% 3G: no change, ever (it just changes type)
4A: 50 + 20 = 70 N. Only sin component changes normal force.
4B: 415.2 Joules
5A: 5 m (use PE = KE) 5B: 20 m
6A: 1 m (use KE = PEel) 6B: 2 m