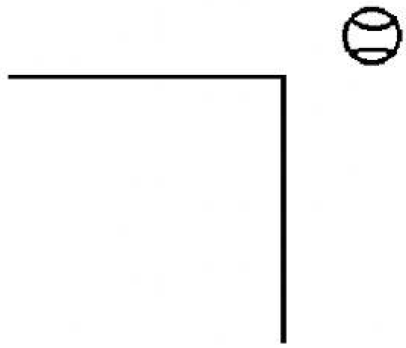
Energy – Part 2

In the last worksheet we did calculations where a ball is dropped from a height and there is NO air friction so it is an isolated (closed) system. However, in reality there is air friction which would mean that some energy would be converted to heat – so Emech (bottom) would be LESS THAN Emech (top) because some of the energy is "lost" to heat along the way.

Example 4

A 0,5 kg ball is dropped from a 200 m sheer cliff. The ball reaches the bottom at a velocity of 40 $m.s^{-1}$.
Calculate:



4.1 **the E_{mech} of the ball at the top of the cliff**

Emech (top) = Ep + Ek (top)

= mgh + ½ mv^2

= (x x) + (½ x x ^{2})

= J

Hint: ball is DROPPED from rest

4.2 **the E_{mech} of the ball at the bottom of the cliff**

Don't forget to square the velocity!

Emech (bottom) = Ep + Ek (bottom)

= mgh + ½ mv^2

= (x x) + (½ x x ^{2})

= J

4.3 **the energy converted into heat due to air friction**

E due to friction = -

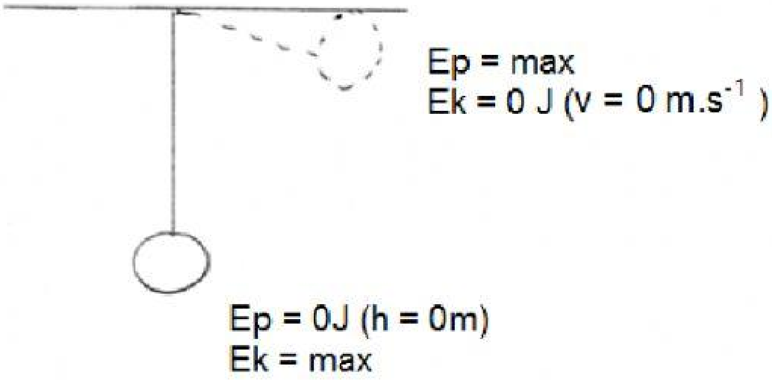
= J

Hint: There IS air friction in this case so Emech (top) does NOT = Emech (bottom)

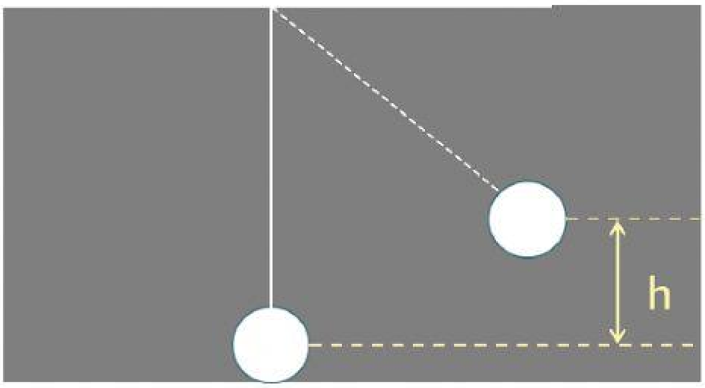
This completes the examples on the first type of energy problems (a free falling object). Now let us look at two other possibilities:

2. Swinging Pendulum

At the lowest point during the motion the Ep of the pendulum bob will = 0J. At the highest point, the pendulum bob will stop and get ready to fall back down, so at this point Ek = 0J. If the system is isolated, E_{mech}(top) = E_{mech}(bottom).



Note: if there is no air friction, the pendulum will reach the same height on the other side before falling back down again.



$E_{mech} = E_k + E_p$

Top: $= 0 + mgh$

Bottom: $= \frac{1}{2}mv^2 + 0$

Example 1:

A pendulum with a 5kg bob at one end is released from a vertical height of 3m. Calculate the Ek of the bob at its lowest point.

Step 1: Emech(top) = Ep + Ek (top)

= mgh + 0

= x 9,8 x

= J

Step 2: Emech (bottom) = Emech (top) = J

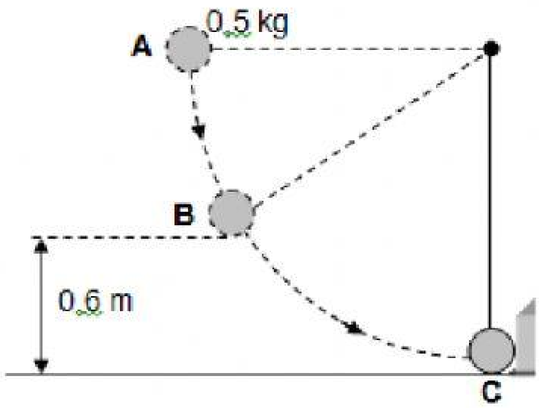
Step 3: Emech (bottom) = Ep + Ek (bottom)

BUT Ep (bottom) = 0J

So Ek (bottom) = Emech (bottom) = J

Example 2:

A steel ball of mass 0,5 kg is suspended from a string of negligible mass. It is released from rest at point **A**, as shown in the sketch below. As it passes through point **B**, which is 0,6 m above the ground, the magnitude of its velocity is 3 $m \cdot s^{-1}$. (Ignore the effects of friction.)



Calculate the mechanical energy of the steel ball at point **B**.

Emech (at B) = Ep + Ek (at B)

= mgh + ½ mv^2

= (x x) + (½ x x ^{2})

= J