Work and Kinetic Energy

Starting with the 2^{nd} Newton's Law:

$$F = ma$$

One can derive another important result:

"Change in kinetic energy is equal to the mechanical work done by all forces"

$$\Delta K = W$$

$K = \frac{mv^2}{2}$, is called Kinetic Energy of an object

$W = F\Delta x$, is called Mechanical Work

(Work = Force x Displacement)

Potential Energy

Work by done by gravity depends only on initial and finite height h

$$W_{gravity} = -mg\Delta h$$

therefore,

$$\Delta K = -\Delta mgh + W_{\text{not gravity}}$$

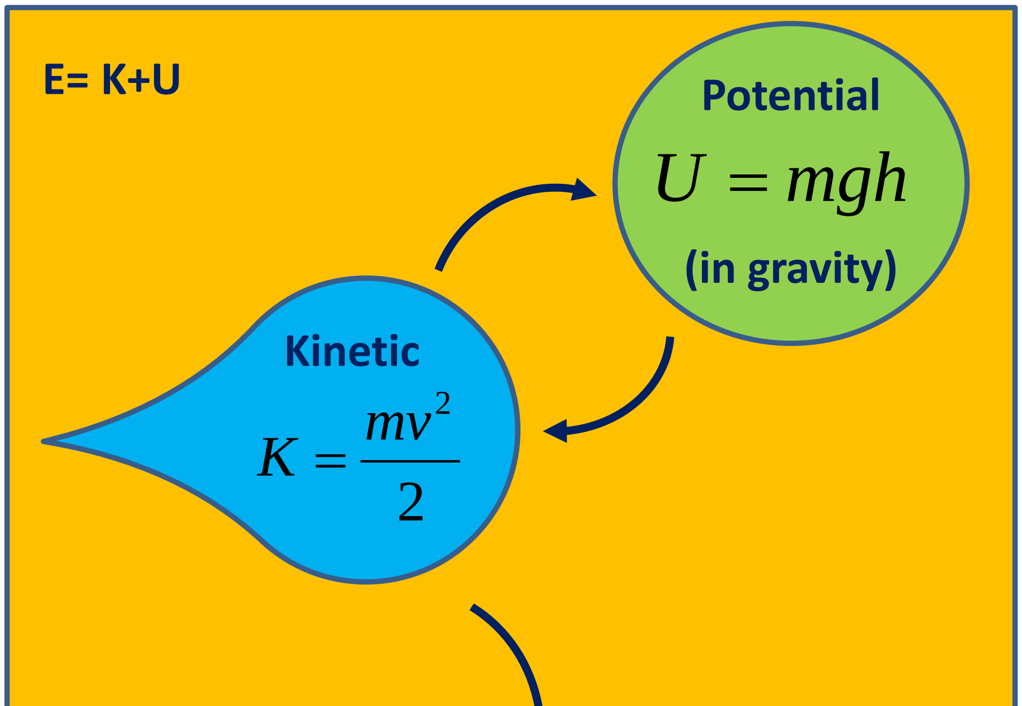
$U = mgh$ is called Potential Energy

$$\Delta(K + U) = W_{\text{not gravity}}$$

Therefore, if there is no forces other than gravity (no friction, engine or other external force), Total Energy (Kinetic + Potential) is conserved:

$$E = K + U = const \qquad \Delta E = W_{\text{not gravity}}$$

Energy Conservation and Change



Change in Energy= Work

$$W = F\Delta x$$

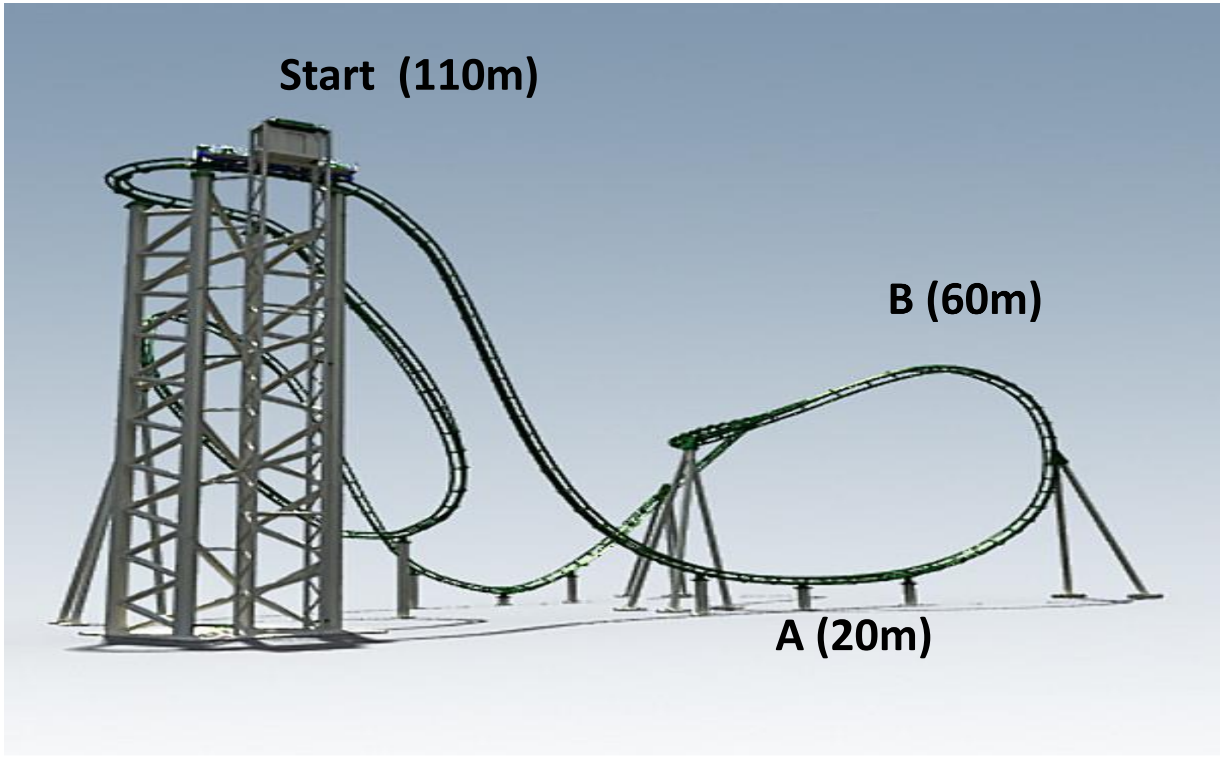
Unit of Energy & Work is called Joule (J)

$$1J = 1N \cdot m = 1\frac{kg \cdot m^2}{s^2}$$

Homework

Problem 1.

A rollercoaster train starts motion with zero initial speed at the height ***H=110m*** above the ground. It travels down to point (A) at height ***h_A=20m***, and then climbs up to the point B at height ***h_B=60m***. Find its speed at the points A and B, neglecting air resistance and any kind of friction. There is no engine, just gravity.



Problem 2 A bobsleigh goes down the track whose initial point is at height ***h=150 m***. If there were no friction and no air resistance during the descend, find the distance ***d*** that bobsleigh had to travel after the finish line to come to the complete stop. Assume that the coefficient of friction on that horizontal part of the trip is ***μ=0.5***.