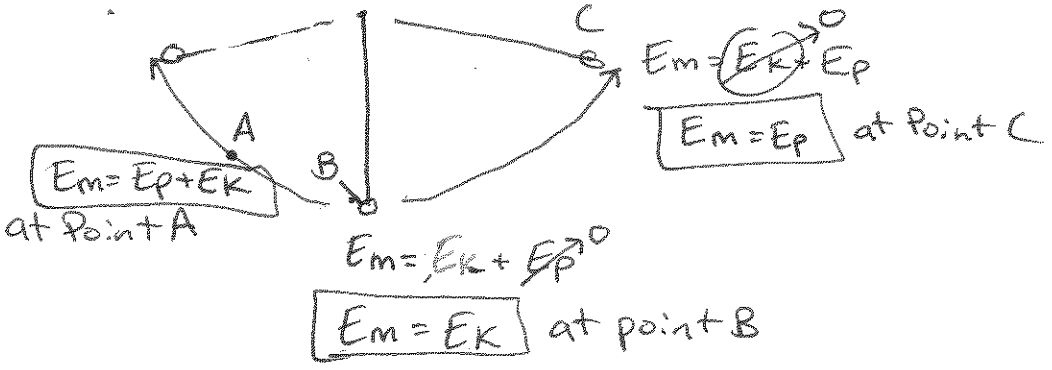
Mechanical Energy NOTES

- Mechanical Energy is defined as energy due to the motion or position of an object.
- Since an object can have both Kinetic and potential energy at the same time it can also be defined as the Sum of the Kinetic and potential energy an object possesses.

A great example of this is the action of a pendulum:



- Mechanical Energy can be calculated using the following formula:

$$E_m = E_p + E_K$$

$$E_m = mgh + \frac{1}{2}mv^2$$

E_m : mechanical energy

E_p : potential energy $E_p = mgh$

E_K : Kinetic energy $E_K = \frac{1}{2}mv^2$

What if I have to rearrange and solve for E_k or E_p?

$E_m = E_p + E_k - E_p$ (−E_p)

$E_m - E_p = E_k$

$E_m = E_p + E_k - E_k$ (−E_k)

$E_m - E_k = E_p$

Example:

1. A 0.300 kg baseball is thrown in a straight line through the air. At a height of 2.50 m above the surface of the Earth, it has a speed of 20.0 m/s. What is the total mechanical energy of the baseball?

$m = 0.3\,kg$
$h = 2.50\,m$
$v = 20\,m/s$
$E_m = ?$

$$E_m = E_K + E_P$$
$$E_m = \frac{1}{2}mv^2 + mgh$$
$$E_m = \frac{1}{2}(0.3kg)(20m/s)^2 + (0.3kg \times 9.81m/s^2 \times 25m)$$
$$E_m = 67.3575\,J$$

$$\boxed{E_m = 67.4\,J}$$

2. A 55.00 kg high jump athlete leaps into the air in an attempt to clear the bar. At the top of the leap, the athlete has a total mechanical energy of 3.00×10^3 J and is moving at 8.330 m/s. Calculate the gravitational potential energy of the athlete.

$m = 55\,kg$
$E_m = 3.0 \times 10^3\,J$
$v = 8.330\,m/s$
$E_p = ?$

$$E_m = E_p + E_K - E_K$$
$$-E_K$$
$$E_m - E_K = E_P$$
$$3.0 \times 10^3\,J - \left(\frac{1}{2} 55kg \times 8.33m/s^2\right) = E_p$$
$$E_p = 1091.805\,J$$

$$\boxed{E_p = 1.09 \times 10^3\,J}$$