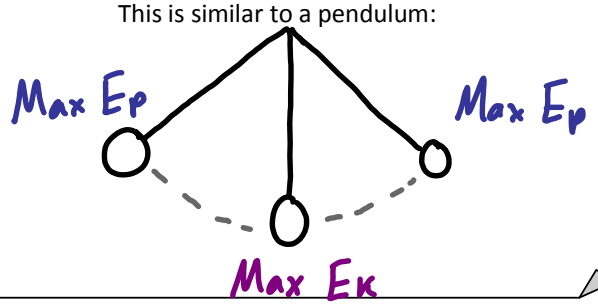
Unit 7: Work, Energy and Power

4 – The Law of Conservation of Energy

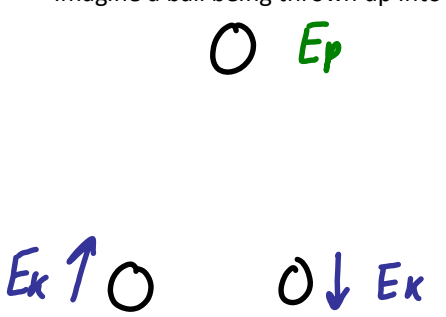
The Law of Conservation of Energy:

Energy cannot be created or destroyed, only changed from one form into another

This is similar to a pendulum:



Imagine a ball being thrown up into the air:



As the ball travels upwards Ek is converted into Ep
As the fall falls down Ep is converted into Ek

- When only conservative forces (like gravity) work on an object... $E_k \rightarrow E_p$ and $E_p \rightarrow E_k$

- When forces like friction are at work then energy is not conserved.

- Friction converts some energy into HEAT

The Law of Conservation of Energy:

$$E_i = E_f$$

$$E_{ki} + E_{pi} = E_{kf} + E_{pf}$$

$$\frac{1}{2}mv_i^2 + mgh_i = \frac{1}{2}mv_f^2 + mgh_f$$

Ex: While jumping over The Great Wall of China an 82 kg skateboarder is needs to leave the ramp traveling at 78 km/h. $\div 3.6 = 21.67$ m/s

a) How much potential energy does he need to start with?

$E_{ki} + E_{pi} = E_{kf} + E_{pf}$

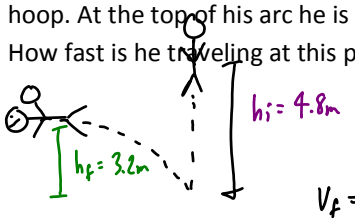
$E_{pi} = E_{kf} = \frac{1}{2}mv^2 = \frac{1}{2}(82)(21.67)^2 = 19247$

$= \boxed{19000\text{ J}}$

b) What minimum height of ramp should he use?

$E_{pi} = mgh_i$ $\quad h_i = \frac{E_p}{mg} = \frac{19247}{(82)(9.8)} = \boxed{24\text{ m}}$

Ex: A trampoline dunk artist is bounces to a maximum vertical height of 4.8 m before launching himself towards the hoop. At the top of his arc he is 3.2 m above the ground. How fast is he traveling at this point?



$E_{ki} + E_{pi} = E_{kf} + E_{pf}$

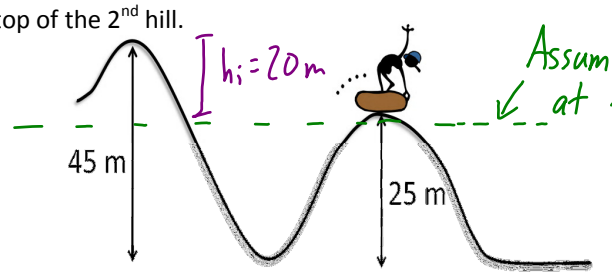
$mgh_i = \frac{1}{2}mv_f^2 + mgh_f$

$v_f = \sqrt{2(gh_i - gh_f)}$

$= \sqrt{2[(9.8)(4.8) - (9.8)(3.2)}$

$= \boxed{5.6\text{ m/s}}$

Ex: A 65 kg snowboarder starts at rest, travels down a hill into a gulley and back up the other side as shown. Find his speed at top of the 2nd hill.



Assume $E_p = 0$ at this height

$E_{pi} + E_{ki} = E_{pf} + E_{kf}$

$E_{pi} = E_{kf}$

$mgh_i = \frac{1}{2}mv_f^2$

$v = \sqrt{2gh_i}$

$= \sqrt{2(9.8)(20)}$

$= \boxed{20.\text{ m/s}}$