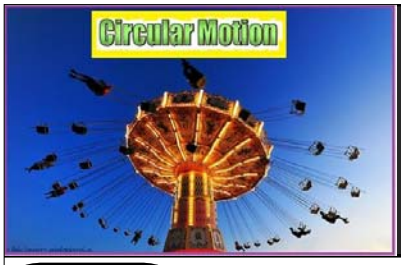


Unit 3: Circular Motion, Work and Energy

3.6 Energy

Energy - the capacity to do work, can be converted from one form to another, change in energy is called work

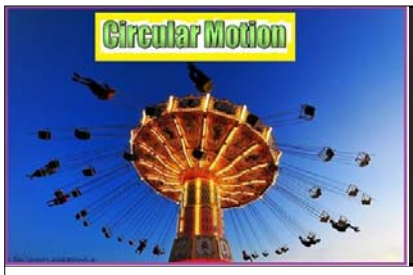
Units: Joules

Gravitational Potential Energy

$$E_p = mgh$$

Kinetic Energy

$$E_k = \frac{1}{2}mv^2$$



Ex.) A 70 kg person climbed a 12 m ladder. Calculate the potential energy with respect to:

a) The ground.

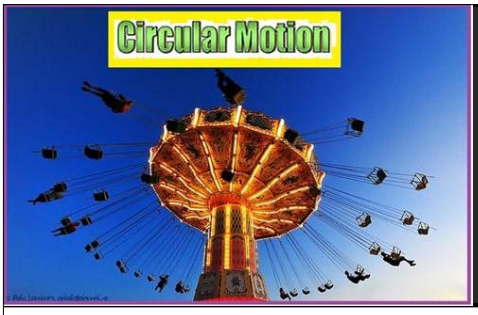
b) The roof (11 m above the ground).

c) A tree, 7.0 m below the top of the ladder.

a) $E_p = mgh = (70)(9.81)(12) = \boxed{8.2\times10^3\ J}$

b) $E_p = mgh = (70)(9.81)(1) = \boxed{6.9\times10^2\ J}$

c) $E_p = mgh = (70)(9.81)(7.0) = \boxed{4.8\times10^3\ J}$

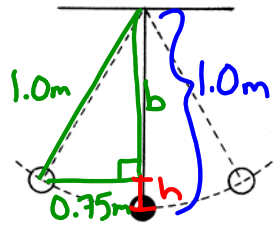


Ex.) A pendulum bob of mass of 2.00 kg is fixed from the ceiling by a string of length 1.00 m. If the bob is pulled 0.750 m to one side, what is its potential energy with respect to its equilibrium position?

$b^2 = c^2 - a^2$

$b = \sqrt{1.0^2 - 0.75^2}$

$b = 0.66\,m$



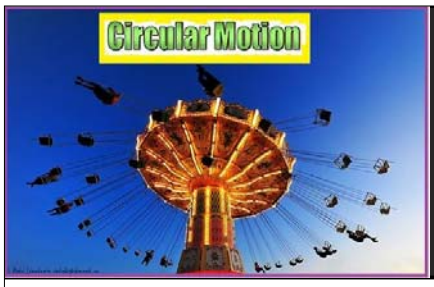
$h = 1.0 - 0.66$

$= 0.34$

$E_p = mgh$

$= (2.00)(9.81)(0.34)$

$= \boxed{6.64\,J}$



Ex.) A 10.0 N ball is accelerated uniformly from rest at a rate of 2.50 m/s². What is the kinetic energy of this object after it has accelerated a distance of 15.0 m?

$F_g = mg$

$10.0 = m(9.81)$

$m = 1.02\,kg$

$V_i = 0\,m/s$

$\vec{a} = 2.50\,m/s^2$

$\vec{d} = 15.0\,m$

$\vec{V_f} = ?$

$\vec{V_f}^2 = \vec{V_i}^2 + 2\vec{a}\vec{d}$

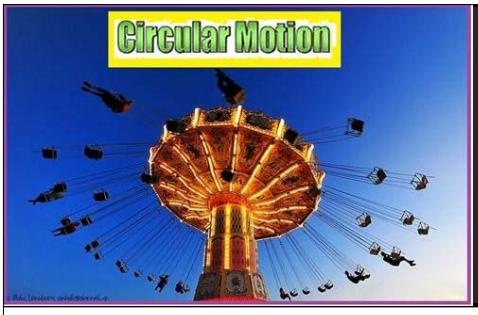
$V_f = \sqrt{0^2 + 2(2.50)(15)}$

$V_f = 8.66\,m/s$

$E_K = \frac{1}{2}mv^2$

$= (1/2)(1.02)(8.66)^2$

$= \boxed{38.2\,J}$



Ex.) An 8.0 kg rock is dropped from a height of 7.0 m. What is the kinetic energy of the rock as it hits the ground?

$V_f^2 = V_i^2 + 2ad$

$V_f = \sqrt{0^2 + 2(9.81)(7.0)}$

$V_f = 11.7\ m/s$

$E_K = \frac{1}{2}mv^2 = (\frac{1}{2})(8.0)(11.7)^2$

$= \boxed{5.5\times10^2\ J}$

Law of Conservation of Energy

$E_p = max$, $E_k = 0$

$E_p = 0$, $E_k = max$

$E_p = mgh$

$= (8.0)(9.81)(7.0)$

$= \boxed{5.5\times10^2\ J}$

Ex.) By what factor must the kinetic energy increase to cause the speed to triple?

$E_K = \frac{1}{2}mv^2$

$\frac{1}{2}m(3v)^2$

$\frac{1}{2}\cdot m\cdot 9v^2$

$9\cdot\underbrace{\frac{1}{2}mv^2}_{E_K}$

E_K is 9x greater

Pg. 305 #2,3,6,7,9.