

Physics Formulas

This is a short sheet of the different physics formulas that are relevant for this class. Unfortunately, not all of them appear in the text. For each one the different variables are defined and their units are given in mks.

Newton's 2nd Law: $\vec{f} = m\vec{a}$ or $\vec{f} = \frac{d\vec{p}}{dt}$

The first version is all you need for this class. It only applies when the mass is constant.

f : a vector of the net force [N or kg*m/s²]

m : a scalar of the mass [kg]

a : a vector for the net acceleration [m/s²]

Linear Momentum: $\vec{p} = m\vec{v}$

p : a vector of the momentum [kg*m/s]

m : a scalar of the mass [kg]

v : a vector of the velocity [m/s]

Angular Momentum: $L = mvr$ or $\vec{L} = \vec{r} \times m\vec{v}$

The first version is all you need for this class. It only works for circular motion.

L : the angular momentum [kg*m²/s]

m : a scalar of the mass [kg]

v : the velocity [m/s]

r : the distance from the center of rotation to the mass [m]

Speed under constant acceleration: $\vec{v}(t) = \vec{v}_0 + \vec{a}t$

v : the velocity [m/s]

v_0 : the initial velocity or the velocity at time zero [m/s]

a : acceleration [m/s²]

t : time [s]

Distance moved under constant acceleration: $\vec{d}(t) = \vec{d}_0 + \vec{v}_0t + \frac{1}{2}\vec{a}t^2$

d : the distance moved [m]

d_0 : the initial position, this is very often zero [m]

v_0 : the initial velocity or the velocity at time zero [m/s]

a : acceleration [m/s²]

t : time [s]

Kinetic Energy: $e = \frac{1}{2}mv^2$

e : energy [J or kg*m²/s²]

m : a scalar of the mass [kg]

v : the velocity [m/s]

Limited Gravitational Potential Energy: $e = mgh$

This formula only applies near the surface of a planet. If you are dealing with longer distances you need to use the full Newton's form below.

e : energy [J or kg*m²/s²]

m : a scalar of the mass [kg]

g : local acceleration of gravity (9.8 m/s² on the Earth) [m/s²]

h : high above the surface of the moon/planet [m]

Mass Energy Equivalence: $e = mc^2$

e : energy [J or kg*m²/s²]

m : a scalar of the mass [kg]

c : the speed of light in a vacuum (roughly 3*10⁸ m/s) [m/s]

Centrifugal Force: $f = mv^2/r$

Newton's Law of Gravity: $f = \frac{Gm_1m_2}{d^2}$

General Gravitational Potential Energy: $e = -\frac{Gm_1m_2}{d}$

Circular Orbit Velocity:

Escape Velocity: