Phys 161: Formulae

1-D kinematics:
\[ \ddot{\varphi} = \frac{x_f - x_i}{t_f - t_i} = \frac{\Delta x}{\Delta t} \]
\[ v = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} = \frac{dx}{dt} \]
\[ \ddot{a} = v_f - v_i \]
\[ a = \lim_{\Delta t \to 0} \frac{\Delta v}{\Delta t} = \frac{dv}{dt} = \frac{d}{dt} \left( \frac{dx}{dt} \right) = \frac{d^2x}{dt^2} \]

1-D, constant acceleration:
\[ v = v_0 + a_0 t \]
\[ x - x_0 = \frac{1}{2} (v + v_0) t \]
\[ x - x_0 = v_0 t + \frac{1}{2} a_0 t^2 \]
\[ v^2 = v_0^2 + 2a_0 (x - x_0) \]

Kinematics in more than one spatial dimension:
\[ \mathbf{v} = \frac{d\mathbf{x}}{dt} \]
\[ \mathbf{a} = \frac{d\mathbf{v}}{dt} \]

Kinematics with constant acceleration:
\[ \mathbf{v} = \mathbf{v}_0 + \mathbf{a}_0 t \]
\[ \mathbf{r} = \mathbf{r}_0 + \mathbf{v}_0 t + \frac{1}{2} \mathbf{a}_0 t^2 \]

Acceleration due to gravity: \( g = 9.8 \text{ m/s}^2 \) downward.
Radial acceleration experienced by an object moving in a circle of radius \( r \) with speed \( v \) is \( v^2/r \) toward the center of the circle.