# Physics 12 Motion at Constant Acceleration

1. There are four kinematic equations that allow analysis of object motion when that motion has a constant acceleration. The equations are:

$$v = v_o + at$$

$$v_{av} = \frac{v + v_o}{2}$$

$$d = v_o t + 1/2 a t^2$$

$$v^2 = v_o^2 + 2ad$$

Derivation of the last two equations:

average velocity can be calculated two ways:

$$v_{av} = \frac{d_f - di}{t}$$

$$v_{av} = \frac{v + v_o}{2}$$

combining these

$$\frac{v + v_o}{2} = \frac{d_f - d_i}{t}$$

if the initial position is 0

rearrange and get

$$d_f = \frac{(v + v_o)}{2} \times t$$

substitute equation 1 in for v and get

$$d = \frac{(v_o + v_o + at)}{2} \times t$$

$$d = v_o t + 1/2 a t^2$$

The last equation derivation:

$$d_f = d_i + v_{av} t$$

$$d_f = d_i + \frac{(v + v_o)}{2} t$$

$$d_f = d_i + \frac{(v + v_o)(v - v_o)}{2 \quad a}$$

$$d_f = d_i + \frac{v^2 - v_o^2}{2a}$$

if di = 0

$$2ad_f = v^2 - v_o^2$$

$$v^2 = v_o^2 + 2ad$$