Basic Kinematics Equations

$s = \frac{d}{t}$	$\bar{\mathbf{v}} = \frac{\Delta x}{\Delta t}$	$\bar{\mathbf{v}} = \frac{V_o + V}{2}$
$a = \frac{v - v_o}{t - t_o}$	$v \equiv \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t}$	$a \equiv \lim_{\Delta t \to 0} \frac{\Delta v}{\Delta t}$
$V_f = Vo + a\Delta t$	$V_f^{\,2} = V_o^{\,2} + 2ax$	$\Delta x = V_o \Delta t + \frac{1}{2} a t^2$

Equations will be used when dealing with Problems with Constant Acceleration

Derivations of the Equations of Motion

•**The definition of acceleration is**

$$a = \frac{v - v_o}{\Delta t}$$

•**Multiply both sides by Delta t.**

$$a\Delta t = V - Vo$$

•**Add Vo to both sides.**

$$Vo + a\Delta t = V$$

•**This is our answer:**

$$V_f = Vo + a\Delta t$$

$$V_f = Vo + a\Delta t$$

Velocity as a function of time.

$$V_f{}^2 = V_o{}^2 + 2ax$$

Velocity as a function of displacement.

$$\Delta x = V_o\Delta t + \tfrac{1}{2}at^2$$

Displacement as a function of time.

•**Solve <u>*V=Vo + at*</u> for t.**

$$t = \frac{V_f - Vo}{a}$$

•**V_{bar} = x/t thus x = V_{bar} times T. Substitute the above equation in for t in the equation X=V_{bar} times t.**

$$x = \bar{\mathbf{V}}\left(\frac{V_f - Vo}{a}\right)$$

•**Substitute in the other equation for V_{bar}.**

$$x = \left(\frac{V_f + Vo}{2}\right)\left(\frac{V_f - Vo}{a}\right)$$

•**Multiply both sides by 2a.**

$$2ax = (V_f + Vo)(V_f - Vo)$$

•**Foil the right side.**

$$2ax = V_f{}^2 - V_o{}^2$$

•**Subtract Vo^2 from both sides and we have our answer:**

$$V_f{}^2 = V_o{}^2 + 2ax$$

•**Set the Equations for V (bar) equal to another.**

$$\frac{\Delta x}{\Delta t} = \frac{V_o + V}{2}$$

•**Since <u>V = Vo + at</u> we can substitute the right term in place of V which removes a variable.**

$$\frac{\Delta x}{\Delta t} = \frac{V_o + V_o + at}{2}$$

•**We can combine like terms and break the right term into two separate terms each over 2.**

$$\frac{\Delta x}{\Delta t} = \frac{2V_o}{2} + \frac{at}{2}$$

•**The twos cancel and we can distribute the delta (t) by multiplying both sides by delta (t)**

$$\Delta x = V_o\Delta t + \tfrac{1}{2}at^2$$