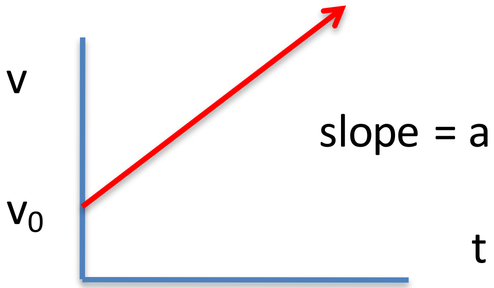
Kinematics

Formulas for Constant Acceleration

Deriving the Kinematics Formulas

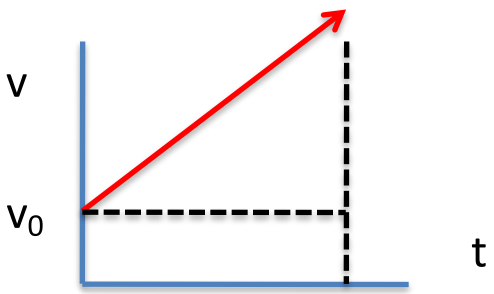
- For constant acceleration, the slope on a v vs. t graph is constant.



y = mx + b
y = at + v_0

Rearranging: $$v = at + v_0$$

- Area under curve = displacement



x = area of rectangle + area of triangle
x = v_0t + ½(t)(v-v_0)
multiply last term by t/t & plug in for a:

$$x = \frac{1}{2}at^2 + v_0 t + x_0$$

- Solve for t in the first equation, and plug into the second equation to get an equation with no time in it.

$$v^2 - v_0^2 = 2a(x - x_0)$$

Formulas for Constant Acceleration

1. $v = at + v_0$
2. $s - s_0 = \bar{v}t = (\frac{v + v_0}{2})t$
3. $s = \frac{1}{2}at^2 + v_0 t + s_0$
4. $v^2 - v_0{}^2 = 2a(s - s_0)$

Notes:

1. If time is not involved in the problem, use equation 4.
2. If time is involved in the problem as a given value or as the unknown, use equation 1 or 3.

Ex1: A truck comes to rest over a distance of 120 m. If it slowed down at a rate of 2.4 m/s^2, how fast was it going initially?

Ex2: A car accelerates from 10 m/s to 25 m/s in 6 s. How far does it travel?

Ex3: A boat is initially 81 m from a dock. Starting from rest, it accelerates towards the doc for 12 s. If its final position is 25 m from the dock, solve for its acceleration.