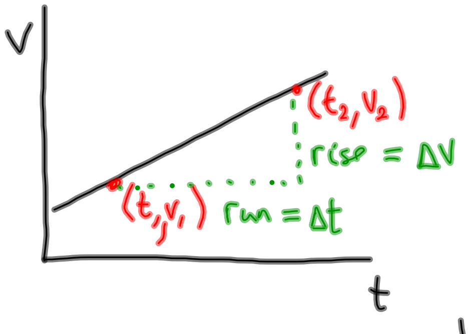
Acceleration

Constant Acceleration



$$\text{slope} = \frac{\text{rise}}{\text{run}}$$

$$\text{slope} = \frac{\Delta v}{\Delta t}$$

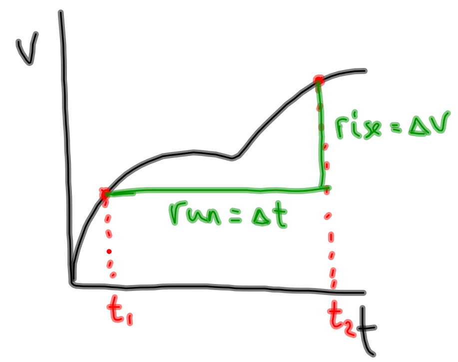
From yesterday's demo, we found that the slope on a v-t graph is equal to the acceleration.

$$\therefore \quad a = \frac{\Delta v}{\Delta t}$$

We can also write in vector notation

$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$$

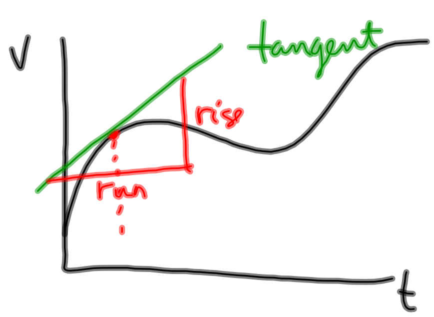
Non-Constant Acceleration



$$\text{slope} = \frac{\Delta v}{\Delta t}$$

$$a_{ave} = \frac{\Delta v}{\Delta t}$$

Find average acceleration by finding the slope of the line between t_1 and t_2



$$\text{slope} = \frac{\Delta v}{\Delta t}$$

$$a_{inst} = \frac{\Delta v}{\Delta t}$$

Instantaneous acceleration is the slope of the tangent at time t.

Calculations involving Acceleration

$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$$

* Acceleration is a vector... there is no scalar term.

$$\vec{a} = \frac{\vec{v}_2 - \vec{v}_1}{\Delta t}$$

you always need to sub $\Delta v = v_2 - v_1$

rearranging for v_2:

$$a\Delta t = v_2 - v_1$$

$$a\Delta t + v_1 = v_2$$

$$v_2 = v_1 + \underbrace{a\Delta t}_{\Delta v}$$

rearranging for v_1

$$a = \frac{v_2 - v_1}{\Delta t}$$

$$a\Delta t = v_2 - v_1$$

$$a\Delta t - v_2 = -v_1$$

$$v_1 = v_2 - \underbrace{a\Delta t}_{\Delta v}$$

rearranging for Δt:

$$a = \frac{v_2 - v_1}{\Delta t}$$

$$a\Delta t = v_2 - v_1$$

$$\Delta t = \frac{v_2 - v_1}{a}$$

Units: $a = \frac{\Delta v}{\Delta t}$ $\qquad \frac{m/s}{s} = m/s/s = m/s^2$

If $a = 5\frac{m}{s^2} = 5\,m/s/s$

In one second, the velocity changes by $5\frac{m}{s}$.