Kinematics Review

Constant Velocity (Uniform Motion)

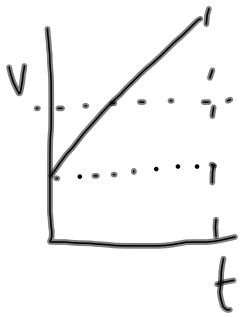
$$v = \frac{\Delta d}{\Delta t}$$

Constant Acceleration

$$v_{ave} = \frac{\Delta d}{\Delta t} \quad \left(\text{where } v_{ave} = \frac{v_1 + v_2}{2}\right)$$

$$a = \frac{\Delta v}{\Delta t} \quad \left(\text{where } \Delta v = v_2 - v_1\right)$$

Maybe Useful equations:



$$\Delta d = v_1 \Delta t + \frac{1}{2} a (\Delta t)^2$$

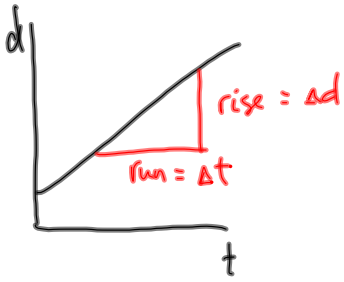
$$\Delta d = v_2 \Delta t - \frac{1}{2} a (\Delta t)^2$$

$$v_2^2 = v_1^2 + 2a\Delta d$$

There are 5 kinematics variables: $\Delta d, \Delta t, v_1, v_2, a$

If you know any 3, you can find the other 2.

Consider an object with constant velocity:

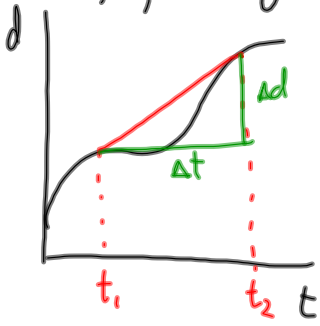


$$\text{slope} = \frac{\Delta d}{\Delta t}$$

but slope = velocity

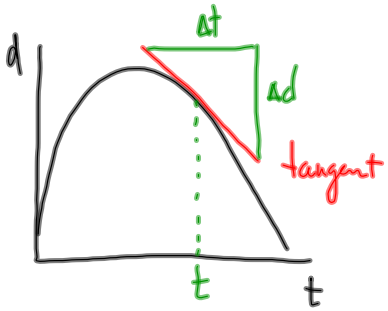
$$\therefore \quad v = \frac{\Delta d}{\Delta t}$$

Changing Velocity



V_{ave} is the slope between t_1 and t_2

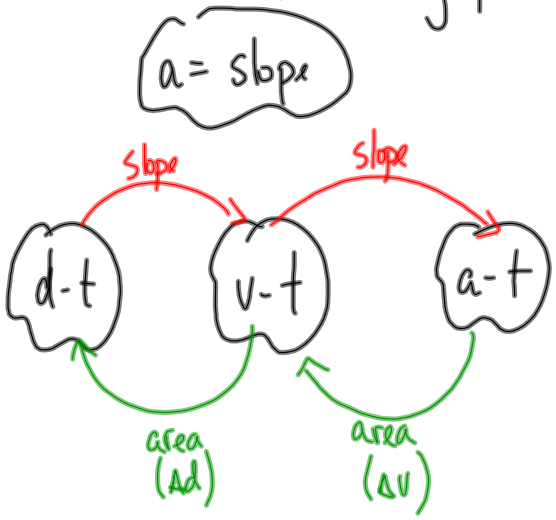
$$V_{ave} = \frac{\Delta d}{\Delta t}$$



Instantaneous velocity is the slope of the tangent at t.

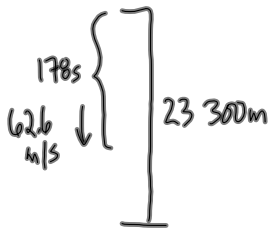
$$V_{inst} = \frac{\Delta d}{\Delta t}$$

Same idea for acceleration from v-t graph



Review

2.



$V_1 = 0$

$\vec{V}_2 = 62.6\,m/s\,[down]$

$\Delta t = 178s$

$a = ?$

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

$\vec{a} = \frac{62.6\,m/s\,[down]}{178s}$

$\vec{a} = 0.352\,\frac{m}{s^2}\,[down]$

5. $\vec{V}_1 = 200\,km/h\,[N]$

$\vec{a} = 5.0\,km/h/s\,[N]$

$\Delta t = 1.0\,min = 60s$

$\vec{V}_2 = ?$

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

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

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

$\vec{V}_2 = \vec{V}_1 + \vec{a}\Delta t$

$\vec{V}_2 = 200\,\frac{km}{h}\,[N] + 5.0\,\frac{km/h}{s}\,[N]\,(60s)$

$\vec{V}_2 = 200\,\frac{km}{h}\,[N] + 300\,\frac{km}{h}\,[N]$

$\vec{V}_2 = 500\,\frac{km}{h}\,[N]$

3. $V_1 = 25\,km/h$

$V_2 = 35\,km/h$

$\Delta V = 10\,km/h = 2.\overline{7}\,m/s$

$\Delta t = 20s$

$a = ?$

$10\,\frac{km}{h}\left(\frac{1000m}{1km}\right)\left(\frac{1\,h}{3600\,s}\right)$

$a = \frac{2.\overline{7}\,m/s}{20s}$

$a = 0.14\,\frac{m}{s^2}$