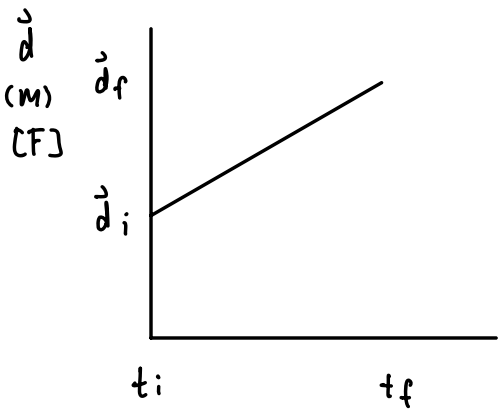


$$\vec{v} = \frac{\vec{d}_f - \vec{d}_i}{t_f - t_i} \quad \text{if} \quad t_i = 0, \; d_i = 0$$

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

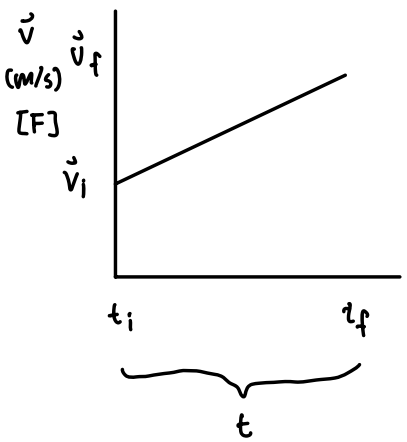
Uniform!

$\vec{a} = 0 \, m/s^2$

uniform

all others

$\vec{a} \neq 0$ non uniform

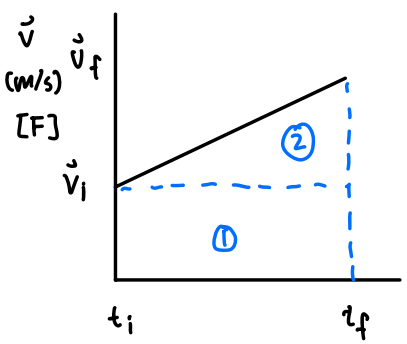


$$\vec{a} = \frac{v_f - v_i}{t_f - t_i}$$

$$\vec{a} = \frac{v_f - v_i}{t}$$

t is total time segment

$$at = \vec{v}_f - \vec{v}_i$$



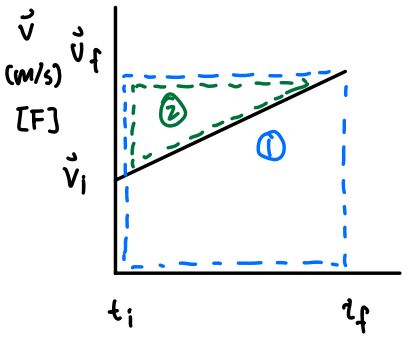
$$\vec{d} = ① + ②$$

$$\vec{d} = \vec{v}_i t + \frac{1}{2}(v_f - v_i)t$$

$$\vec{d} = \vec{v}_i t + \frac{1}{2}(\vec{a}t)t$$

$$\vec{d} = \vec{v}_i t + \frac{1}{2}\vec{a}t^2$$

Sub

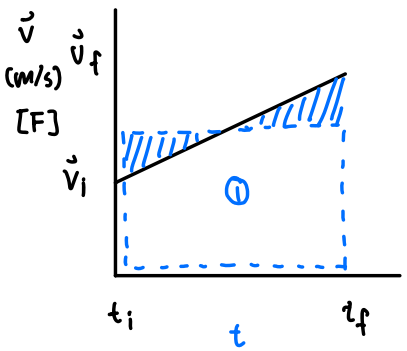


$$\vec{d} = ① - ②$$

$$\vec{d} = \vec{V}_f t - \frac{1}{2}(\vec{V}_f - \vec{V}_i) t$$

$$\vec{d} = \vec{V}_f t - \frac{1}{2}(\vec{a}t) t$$

$$\vec{d} = \vec{V}_f t - \frac{1}{2} a t^2$$



$$\vec{d} = ①$$

$$\vec{d} = \frac{\vec{V}_f + \vec{V}_i}{2} t$$

$$\vec{d} = \vec{V}_{avg} t$$

$$(\vec{V}_f - \vec{V}_i)\ \vec{d} = \frac{\vec{V}_f - \vec{V}_i}{2} t\ (\vec{V}_f - \vec{V}_i)$$

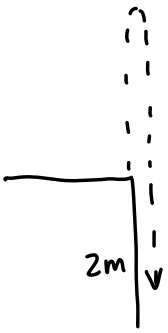
$$(\vec{a}t)\vec{d} = \frac{\vec{V}_f^2 - \vec{V}_i^2}{2} t$$

$$2\vec{a}\vec{d} = \vec{V}_f^2 - \vec{V}_i^2$$

Motion Equation Sample Problems

Variables : $\vec{V}_i$ $\vec{V}_f$ $\vec{d}$ $\vec{a}$ t

Example: Moxie is on the 2m high roof of her dog palace. She throws up a ball at 30km/h. How long does it take to hit the ground below?



$\vec{d} = -2m\,[U]$

$\vec{V}_i = 8.33\,m/s\,[U]$

$\vec{a} = -9.81\,m/s^2[U]$

$t = ?$

30km/h → $8.33\,m/s$

$$\vec{d} = V_i t + \frac{1}{2}at^2$$

$$-2 = 8.33t + \frac{1}{2}(-9.81)t^2$$

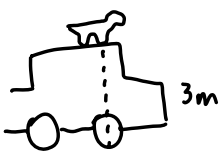
$$-4.905t^2 + 8.33t + 2 = 0$$

$$t = -0.21,\ \boxed{1.91}$$

Example 2:

Moxie throws your keys to you from the roof of your 3m high truck, with a velocity of 5km/h. You trip and catch the keys at ground level. At what velocity were the keys traveling when you caught them

5km/h → $1.389\,m/s$



$\vec{d} = 3m\,[D]$

$\vec{V}_i = 1.389\,m/s\,[D]$

$\vec{a} = 9.81m/s^2\,[D]$

$V_f = ?$

$$2\vec{a}\vec{d} = V_f^2 - V_i^2$$

$$2(9.81)(3) = V_f^2 - (1.39^2)$$

$$\vec{V}_f = \sqrt{2(9.81)(3) + (1.39)^2}$$

$$\vec{V}_f = 7.79\,m/s\,[D]$$