Kinematics Review

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

Constant acceleration $a = \frac{\Delta v}{\Delta t}$ $(\Delta v = v_2 - v_1)$

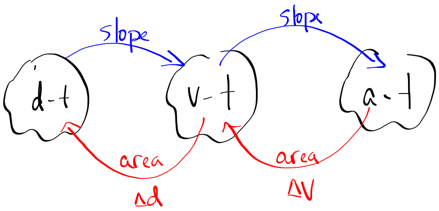
$v_{ave} = \frac{\Delta d}{\Delta t}$ $\left(v_{ave} = \frac{v_1 + v_2}{2}\right)$

Maybe useful:

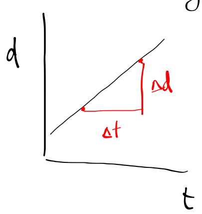
① $\Delta d = v_1 \Delta t + \frac{1}{2} a (\Delta t)^2$

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

③ $v_2^2 = v_1^2 + 2a\Delta d$



constant velocity

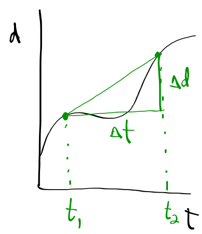


← slope = $\frac{\Delta d}{\Delta t}$

slope = velocity

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

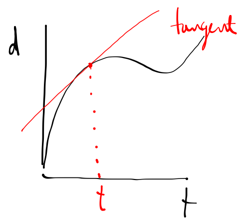
non constant velocity



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

slope = average velocity

$v_{ave} = \frac{\Delta d}{\Delta t}$ ← line connecting two points. (slope of secant)



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

slope = instantaneous velocity

$v_{inst} = \frac{\Delta d}{\Delta t}$ ← slope of tangent.

11. a) constant velocity:

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

$$\Delta d = v\Delta t$$

$$\Delta d = (25\,m/s)(0.80\,s)$$

$$\Delta d = 20\,m \quad (2.0\times10^{1}\,m)$$

b) $a = -9.3\,m/s^2$
$v_1 = 25\,m/s$
$v_2 = 0$
$\Delta d = ?$

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

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

$$\Delta d = \frac{(v_2^2 - v_1^2)}{(2a)}$$

$$\Delta d = \frac{0^2 - (25\,m/s)^2}{2(-9.3\,m/s^2)}$$

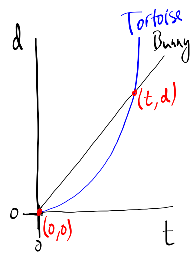
$$\Delta d \doteq 34\,m$$

braking distance

+ thinking distance = 20 m

total stopping distance = 54 m

9. Bunny - constant velocity of 25 m/s



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

$$\Delta d = v\Delta t$$

$$d - 0 = (25\,m/s)(t - 0)$$

$$d = 25t$$

Tortoise

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

$$d = \frac{1}{2}(3.0\times10^{-3})t^2$$

$$25t = (1.5\times10^{-3})t^2$$

12. $v_1 = ?$
$v_2 = 0$
$\Delta d = 5.85\,m$
$a = -9.81\,m/s^2$

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

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

$$v_1^2 = 0^2 - 2(-9.81\,m/s^2)(5.85\,m)$$

$$v_1 = 10.7\,m/s$$

Compare to 50 km/h

$$\frac{50\,km}{h}\left(\frac{1000\,m}{1\,km}\right)\left(\frac{1\,h}{3600\,s}\right)$$

13.9 m/s speed limit

Dynamics

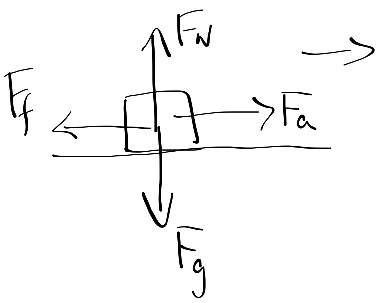
Newton's Second Law: $\vec{F}_{net} = m\vec{a}$

↑ DRAW A FBD!!!

Weight: $F_g = mg$

Friction: $F_f = \mu F_N$ ← the normal force ($\perp$ surface)

↑ μ is coefficient of friction



$\vec{F}_{net} = m\vec{a}$

$F_a - F_f = ma$

Static friction → $F_f \leq \mu F_N$ (max)

Kinematics ←acc→ dynamics

TO DO

13 → 22