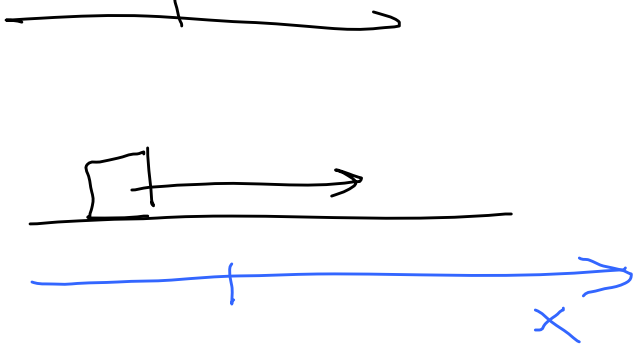
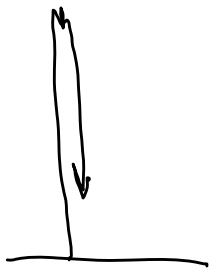
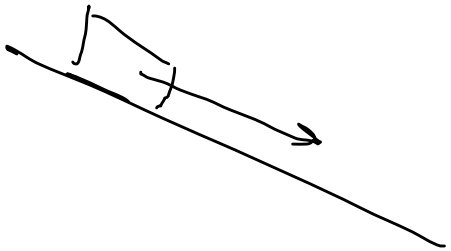
Phys 2110-4 1/18/12

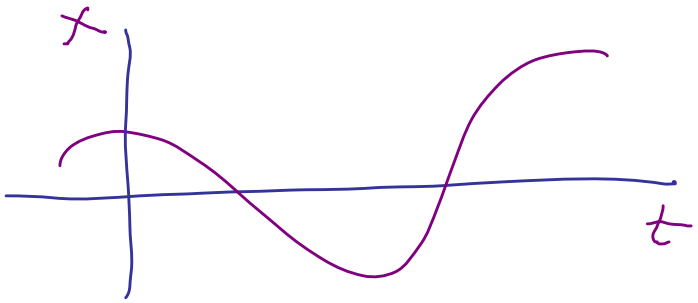
Note Title 1/18/2012

Chap 2 1-Dim Motion

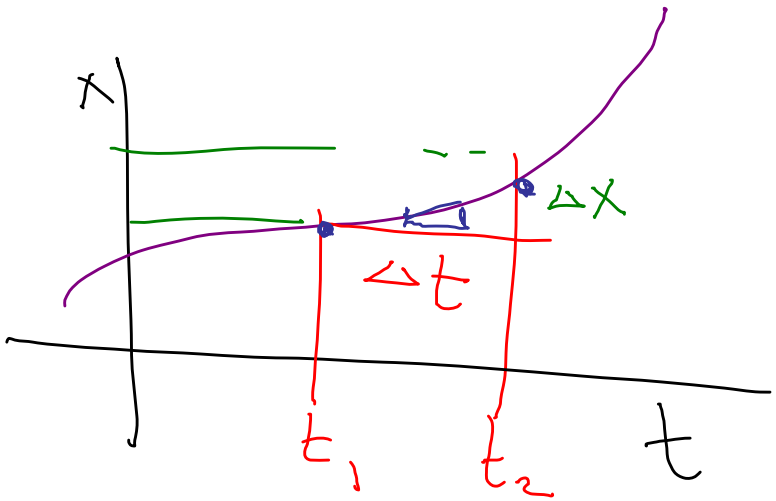








How rapidly is location changing?



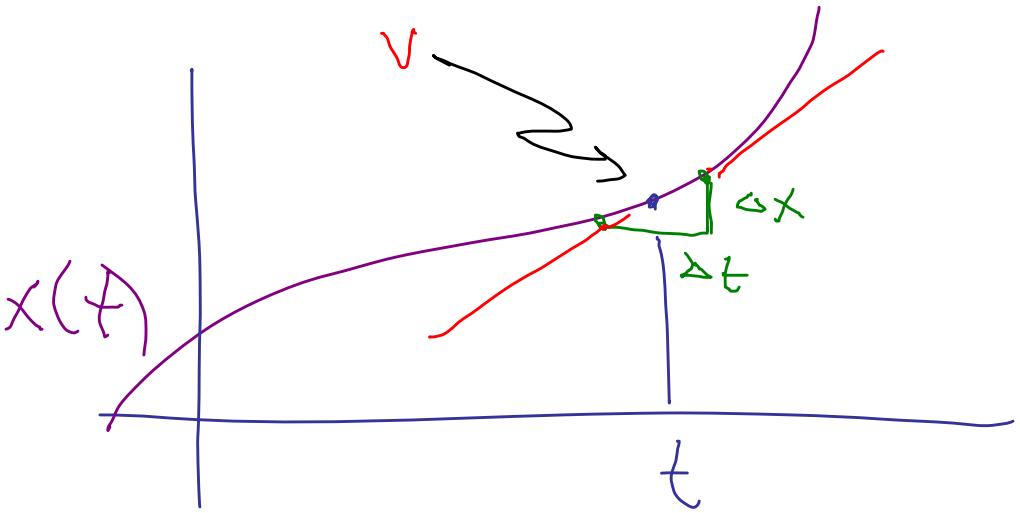
$\Delta t = t_2 - t_1$

$\bar{v} = \frac{\Delta x}{\Delta t}$ = slope of segment

Average velocity, m/s

$\bar{v}$ depends on time interval.

"How rapidly is something moving right now."



At t,

Choose Δt, Δx

make them both small,

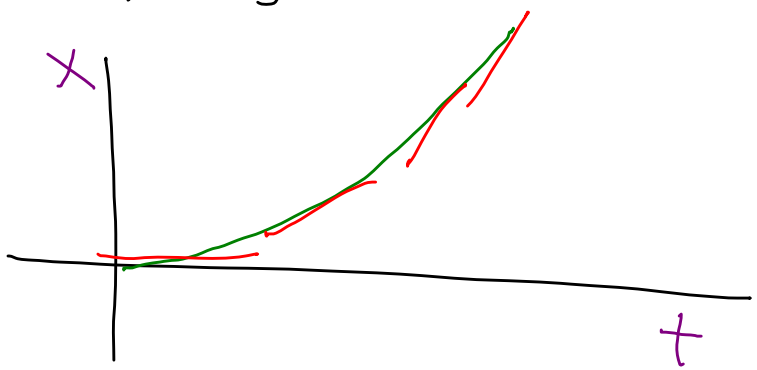
Segment approaches tangent,

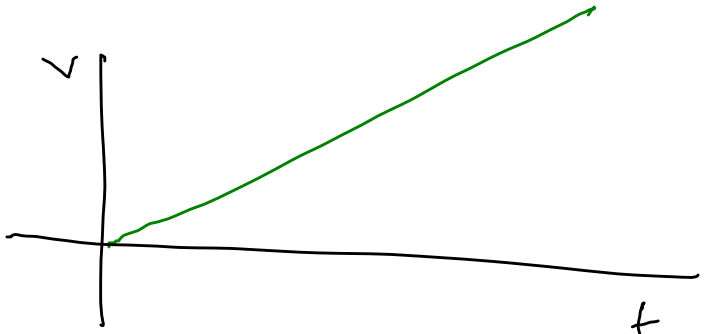
slope $\longrightarrow$ derivative of x with respect to t, dx/dt

$$v = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} = \frac{dx}{dt}$$

$$= x'(t)$$

"v is the derivative of the x(t) curve"





2.21 A model rocket is launched str up. Its altitude y is

$y = bt - ct^2$ where

$b = 82 \frac{m}{s}$ $c = 4.9 \frac{m}{s^2}$

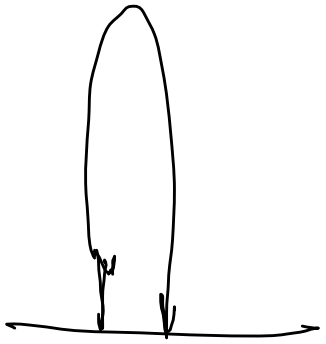
a) Find v(t)

b) When is vel. zero?

$$y = bt - ct^2$$

$$v = \frac{dy}{dt} = b - 2ct$$

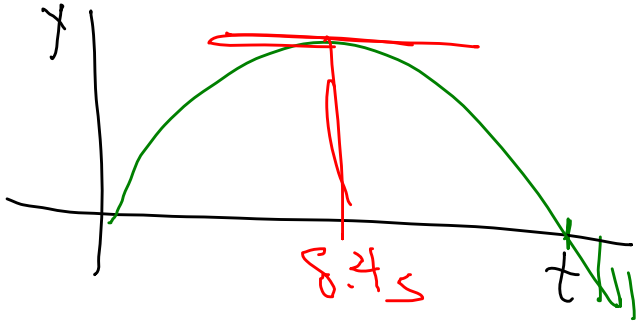
$b = 82\ m/s$ $\quad 2c = 4.9\ m/s^2$



$$\frac{m/s}{m/s^2} \rightarrow s$$

b) Solve for t

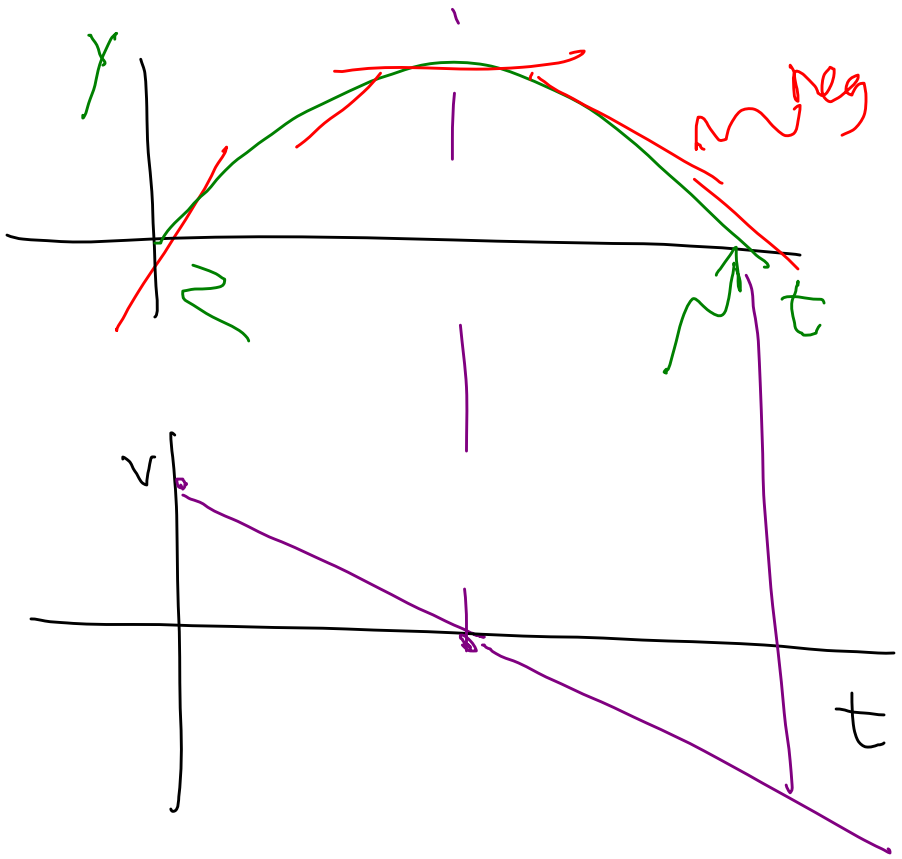
$$0 = b - 2ct$$



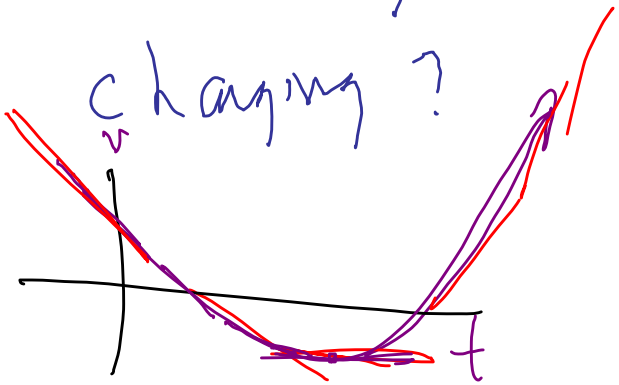
$$2ct = b$$

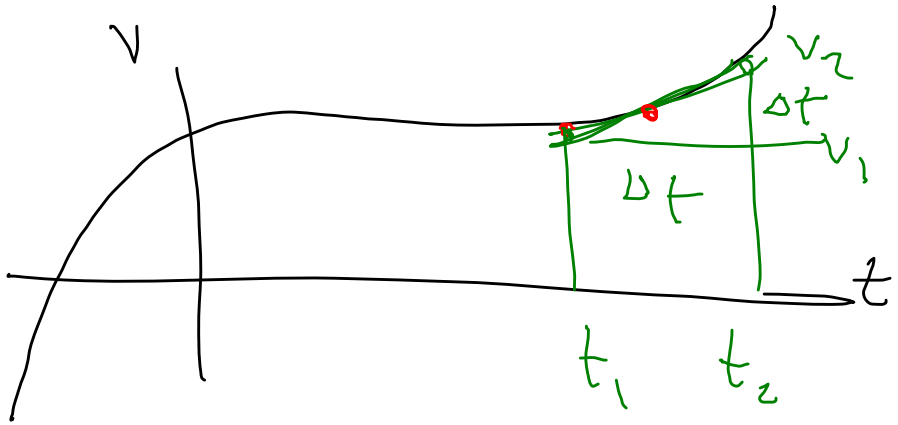
$$t = \frac{b}{2c} = \frac{82\ m/s}{2(4.9\ m/s^2)}$$

$$= 8.4\ s$$



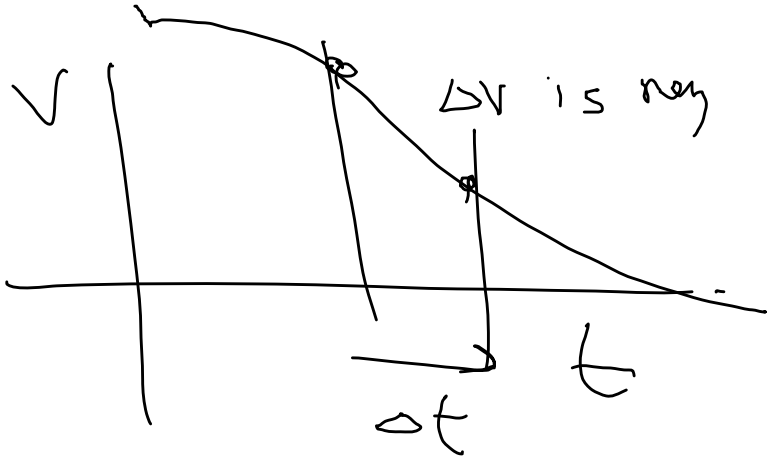
How rapidly is velocity changing?





Acceleration

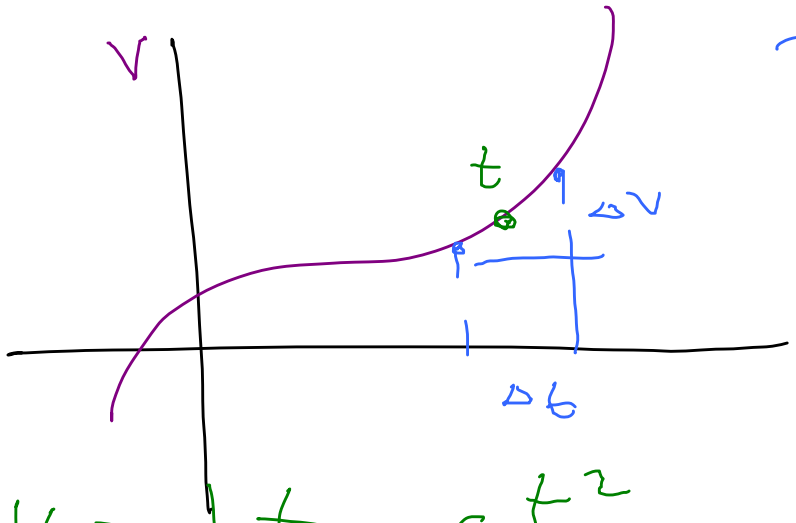
$$\bar{a} = \frac{\Delta v}{\Delta t}$$



Units:

$$[a] = \frac{m/s}{s} = \frac{m}{s^2}$$

How fast is velocity changing right now.



Instantaneous accel.

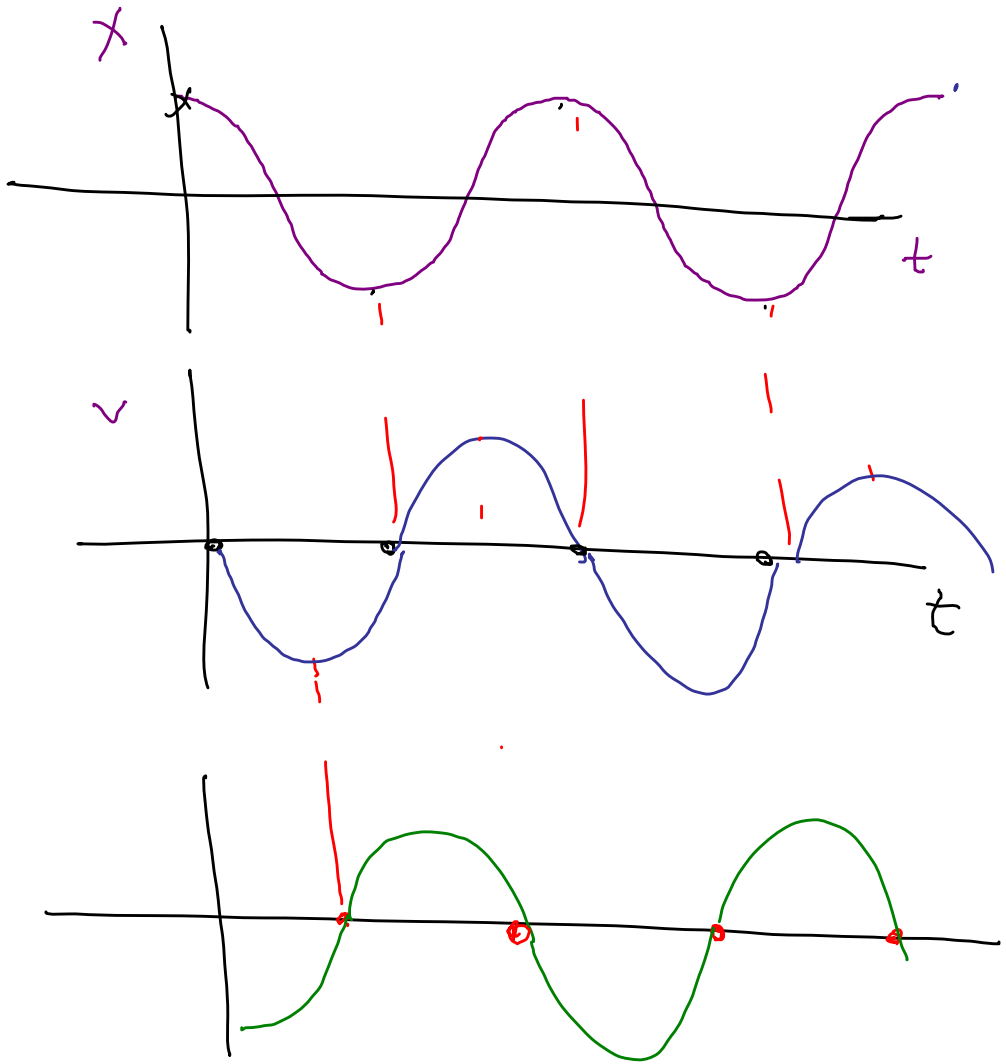
$$a = \lim_{\Delta t \to 0} \frac{\Delta v}{\Delta t} = \frac{dv}{dt}$$

$$= v'(t) = \frac{d^2x}{dt^2}$$

$$y = bt - ct^2$$

$$v = b - 2ct$$

$$a = -2c = -2\left(4.9 \frac{m}{s^2}\right) = -9.8 \frac{m}{s^2}$$



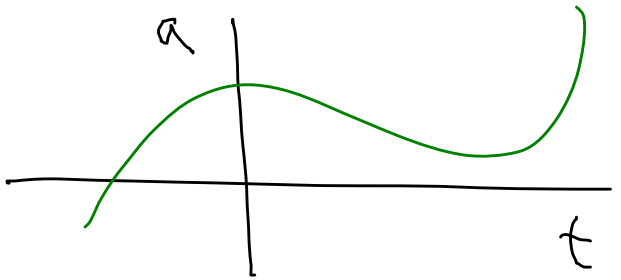
$$x = A\cos(\omega t)$$

$$v = -\omega A\sin(\omega t)$$

$$a = -\omega^2 A\cos(\omega t)$$

Special Case

Go further:

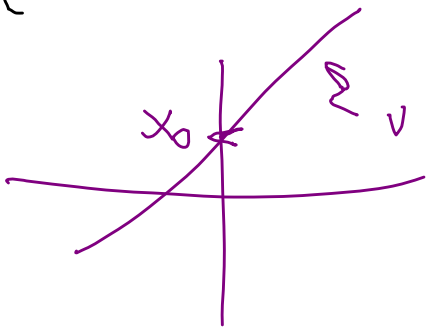


$$\frac{da}{dt} = b$$

Really special case:

$$a = 0 = \frac{dv}{dt}$$

$$v = \text{const} = \frac{dx}{dt}$$



$$x = vt + C \Rightarrow x = x_0 + vt$$

x_0: initial position

Special Case, accel = const

$= a$

$a = \frac{dv}{dt}$ $\quad v = at + C$

$v = v_0 + at$

$t = 0$

$v = C$

v_0

$a = \text{const}$

$v = v_0 + at$ $\quad = \frac{dx}{dt}$ $\quad dx = at$

x_0 $\quad C = x(0)$

$= x_0$

$x = v_0 t + \frac{1}{2} a t^2 + C$

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

$$v = v_0 + at$$

init pos.

init vel.

accel const.

It can be shown

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

Const accel.

~~Does~~ not contain time.

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Also can be shown:

$$X = X_0 + \frac{1}{2}(v + v_0)t$$

Const accel

"avg" veloc.

$\frac{\Delta x}{\Delta t}$