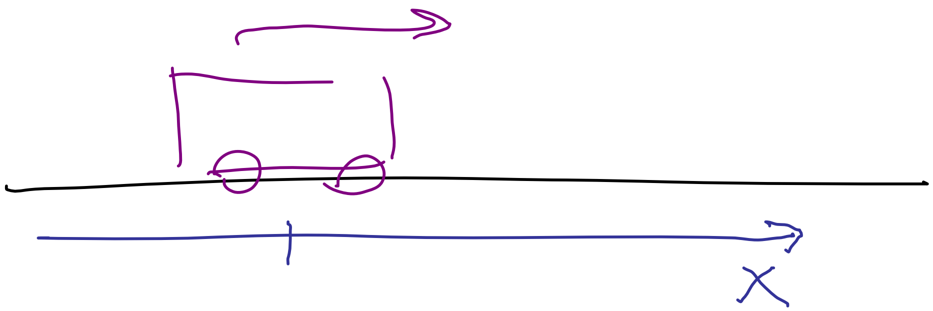
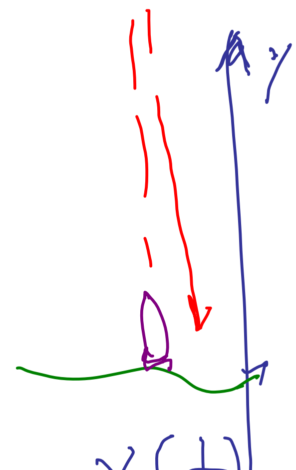
Phys 2110-4 9/2/11

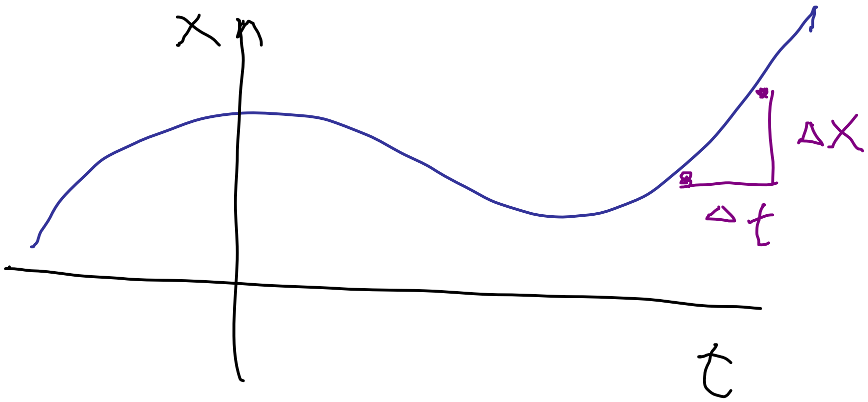
Note Title 9/2/2011

Kinematics Motion 1-Dim.





$x(t)$ $y(t)$



$$\bar{v} = \frac{\Delta x}{\Delta t} \qquad (m/s)$$

Depends on the interval

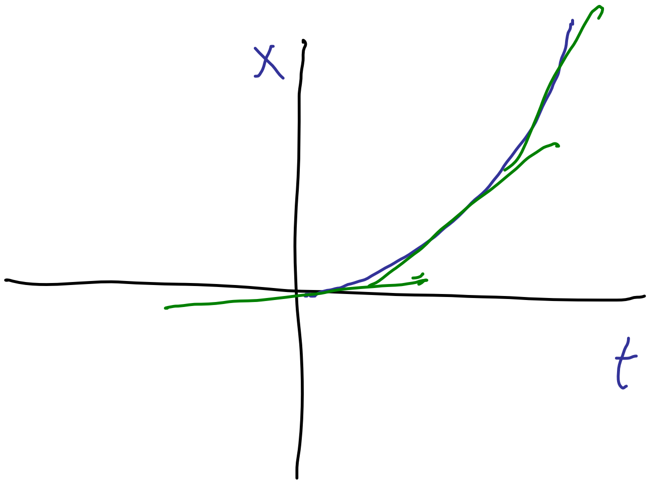
Instantaneous
velocity

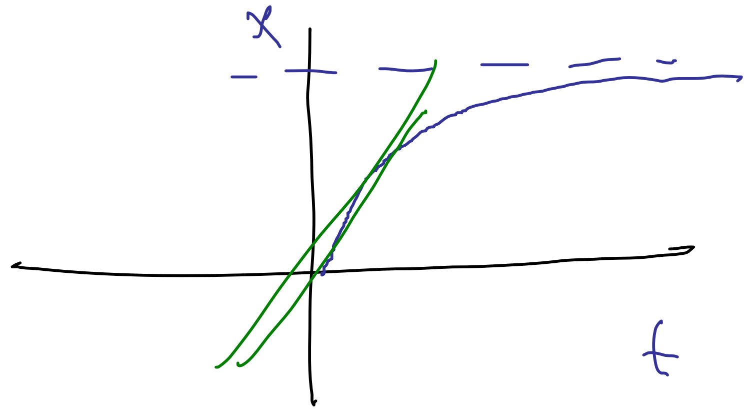
$$v = \frac{\Delta x}{\Delta t} \quad \text{where} \quad \Delta t \to 0$$

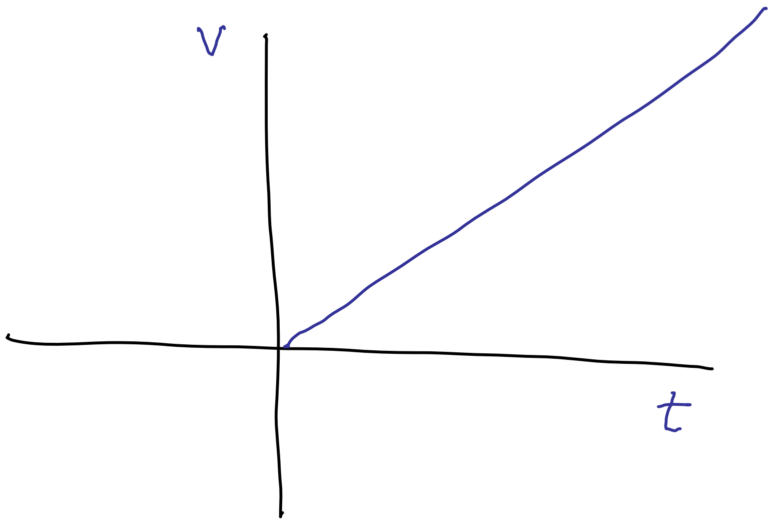
$$= dx/dt$$

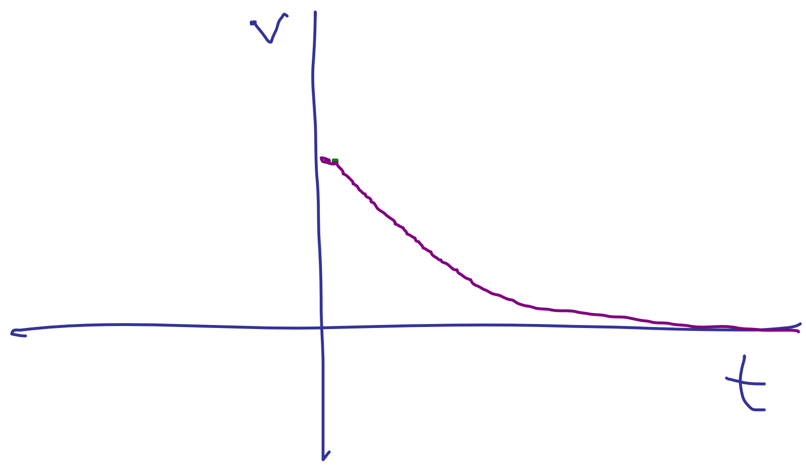
$x(t)$

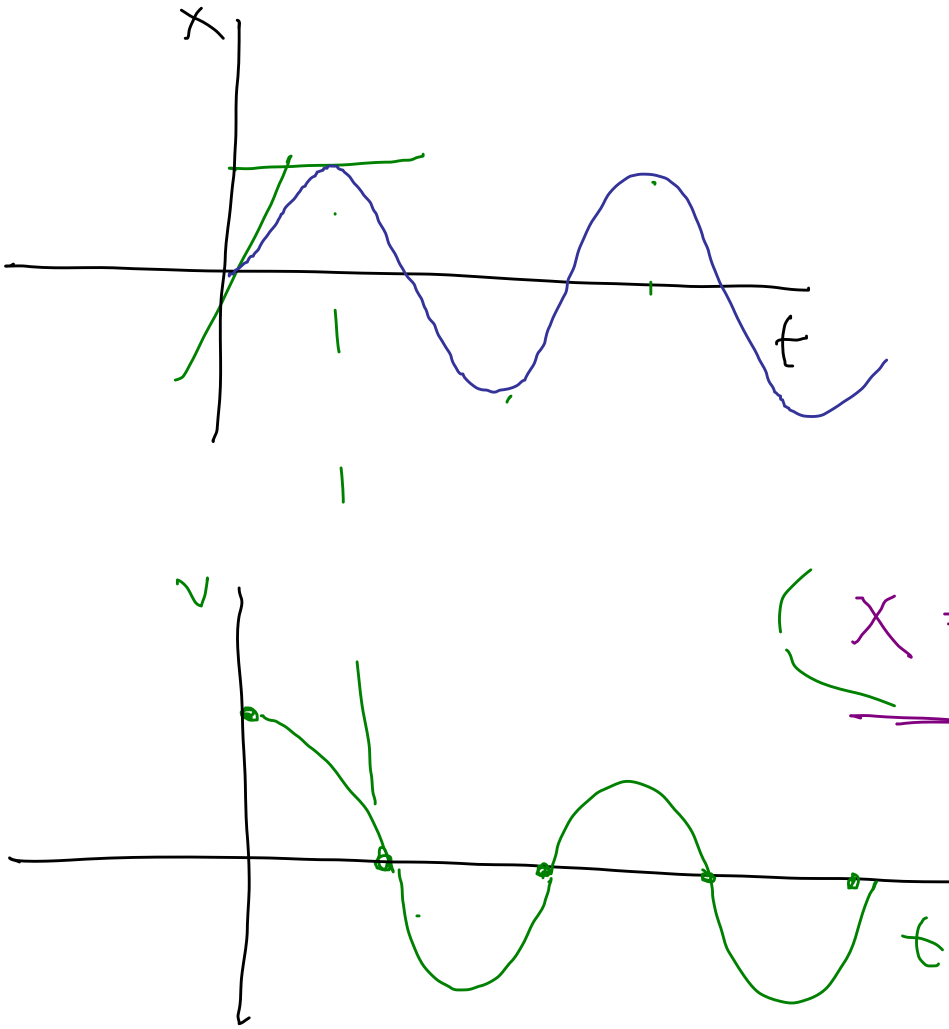
$$v(t) = x'(t)$$


x
t

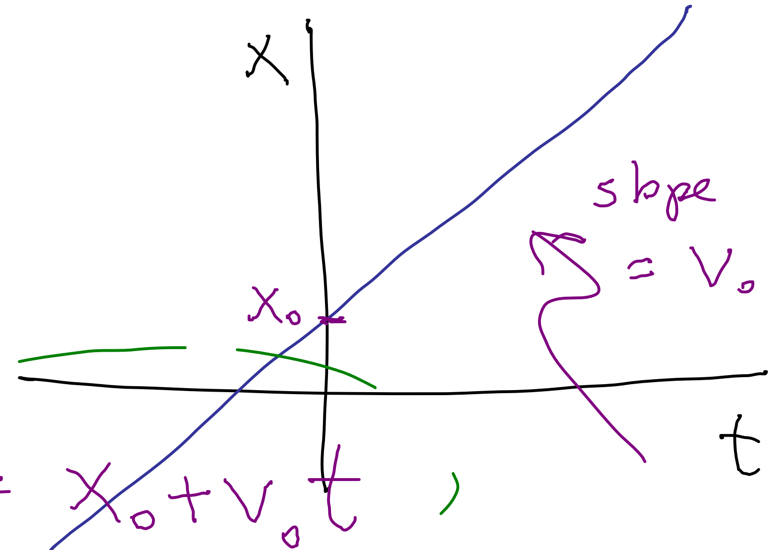

x
t


v
t

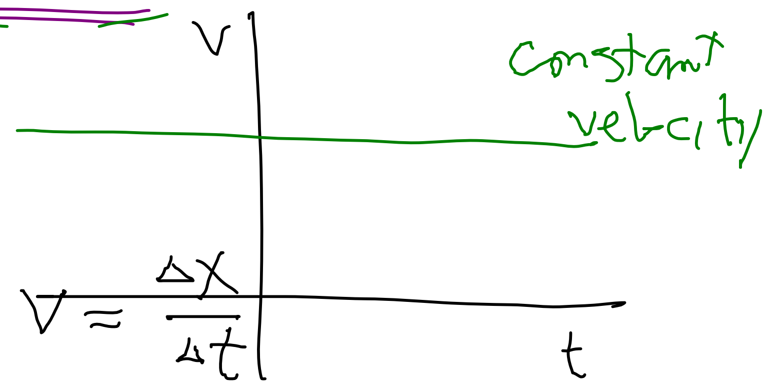

v
t



Simplest case



$$x = x_0 + v_0 t$$

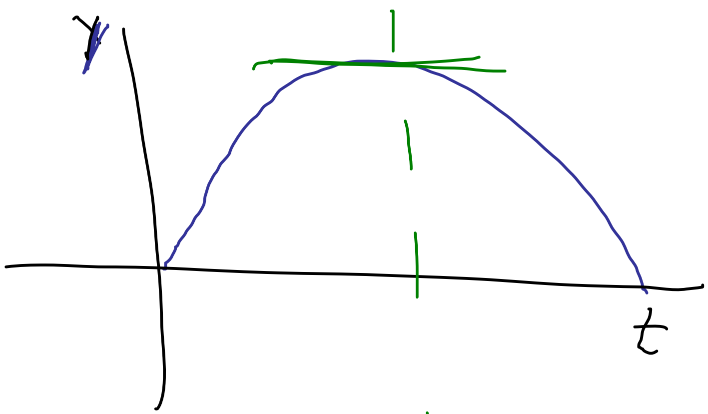


$$v_0 = v = \frac{\Delta x}{\Delta t}$$

2.21 Model rocket lauched up altitude y

is $y = bt - ct^2$ $\qquad b = 82 \, \frac{m}{s}$

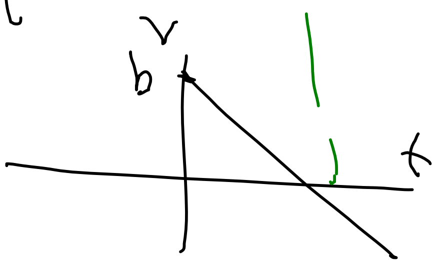
$c = 4.9 \, \frac{m}{s^2}$



a) Use differentiation to get $v(t)$

b) When is vel. zero?

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

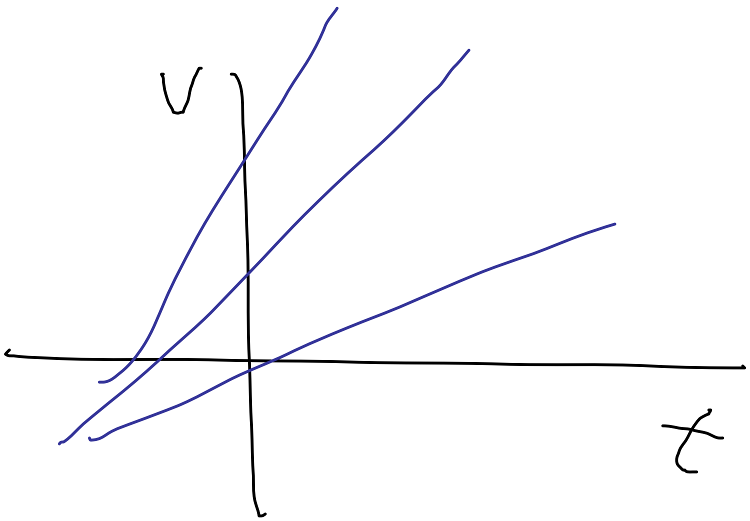


When is v zero

$$b - 2ct = 0$$

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

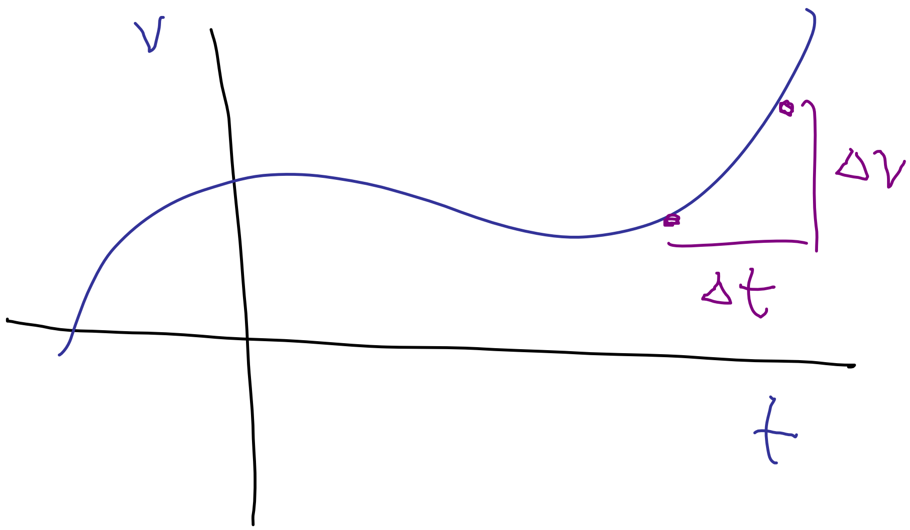
$$\boxed{= 8.4 \, s}$$



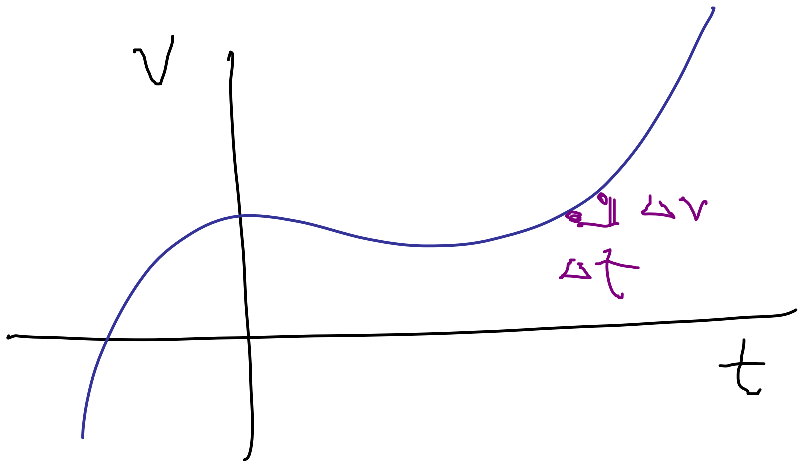
How fast is velocity changing.

average acceleration

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



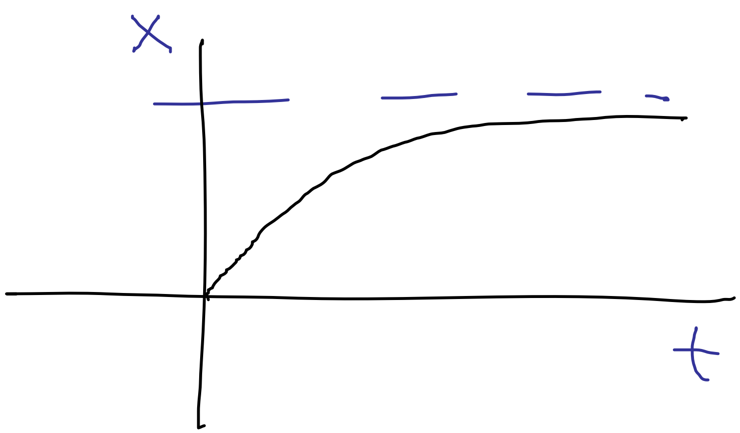
How fast is velocity changing right now

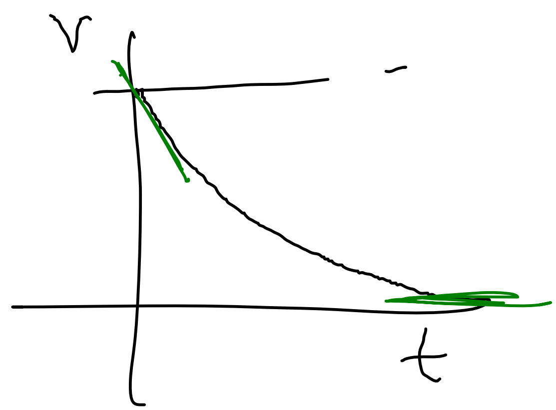


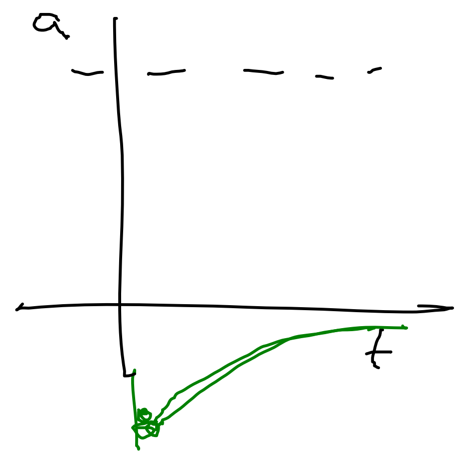
$$a = \frac{\Delta v}{\Delta t} \quad \Delta t \to 0$$

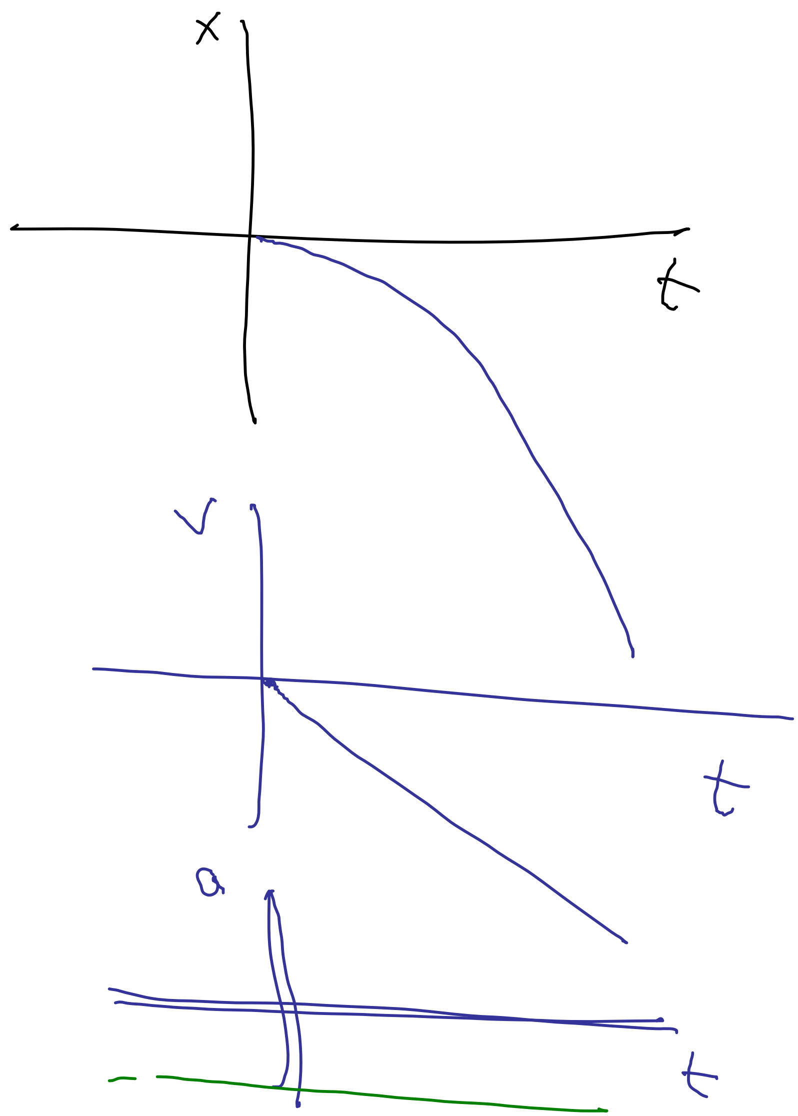
$$v = \frac{dx}{dt} = dv/dt = d^2x/dt^2$$

$$x(t) \qquad v(t) = x'(t) \qquad a(t) = v'(t) = x''(t)$$









$v = \frac{dx}{dt}$ $\quad a = \frac{dv}{dt}$

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

Don't need $\frac{d^3x}{dt^3}$ . . . — -

Special case

$a =$ constant

$a = \text{constant}$ $\quad -9.8\ m/s^2$

$+3.7\ m/s^2$

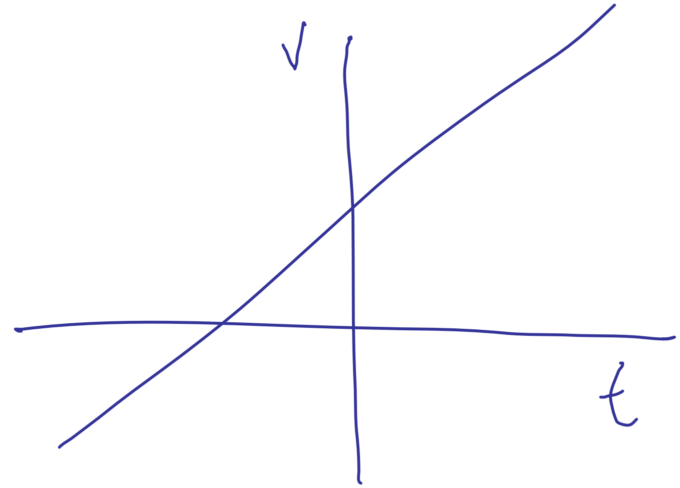
what are $v(t)$, $x(t)$?

$$\frac{dv}{dt} = a \qquad v(t) \text{ is a line}$$

$$v = v_0 + at$$

accel.

value of v at t=0
initial velocity



$x(t)$

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

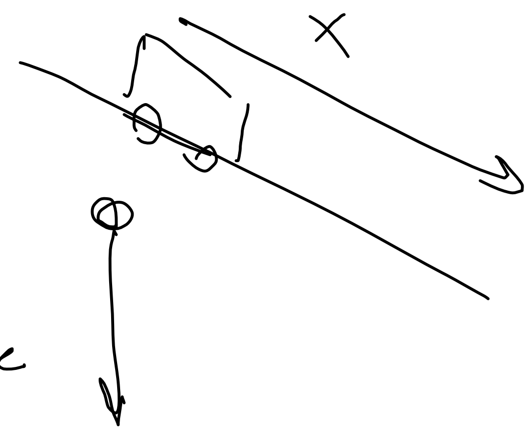
what is x?

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

initial position.

initial

accel



$$\boxed{v = v_0 + at}$$

From these

can derive:

Can show:

$$\boxed{v^2 = v_0^2 + 2a(x - x_0)}$$

velocity

initial velocity

change in position

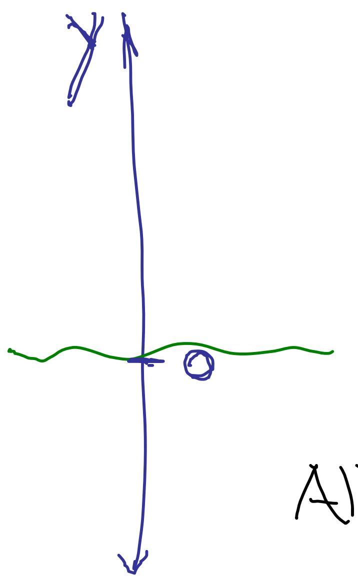
t doesn't appear!

$$x = x_0 + \frac{1}{2}(v_0 + v)t$$

p. 20 margin.

Gravity

Free fall



Acceleration is constant

$$a = -9.80 \frac{m}{s^2}$$

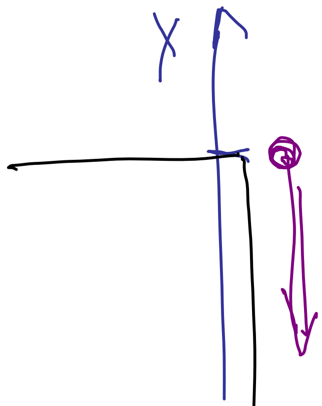
$$= -g$$

$$g = 9.80 \frac{m}{s^2}$$

All objects have this accel in free fall

Ignores air resistance

Drop rock at edge of cliff.



t	v	x
0	0	0
1	$-9.8\frac{m}{s}$	$-4.9\,m$
2	$-19.6\frac{m}{s}$	$-19.6\,m$
3	$-29.4\frac{m}{s}$	$-44.1\,m$

$$a = -9.8\frac{m}{s^2} = -g$$

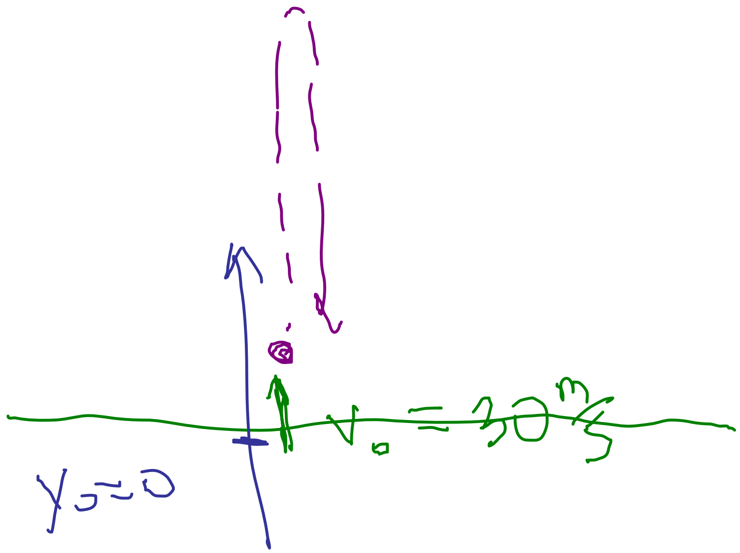
$$v = v_0 + at = \left(-9.8\frac{m}{s^2}\right)t$$

Drop

$v_0 = 0$

$$y = \underset{0}{y_0} + \underset{0}{v_0}t + \frac{1}{2}at^2 = \frac{1}{2}\left(-9.8\frac{m}{s^2}\right)t^2$$

Not prop to time



Toss rock upward at $30\frac{m}{s}$.

a) How high does it go?

b) How long is it in the air?

$$v = \left(30\frac{m}{s}\right) - \left(9.8\frac{m}{s^2}\right)t$$

$$y = \left(30\frac{m}{s}\right)t - \frac{1}{2}\left(9.8\frac{m}{s}\right)t^2$$