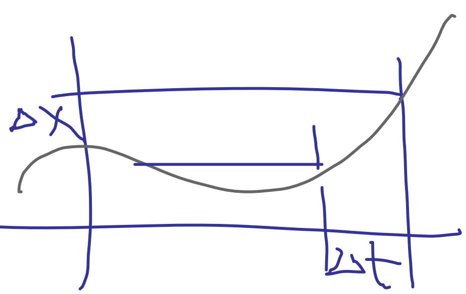
Phys 2110-5   8/31/12

Note Title   8/31/2012

Chap 2 1-Dim motion.

Average velocity

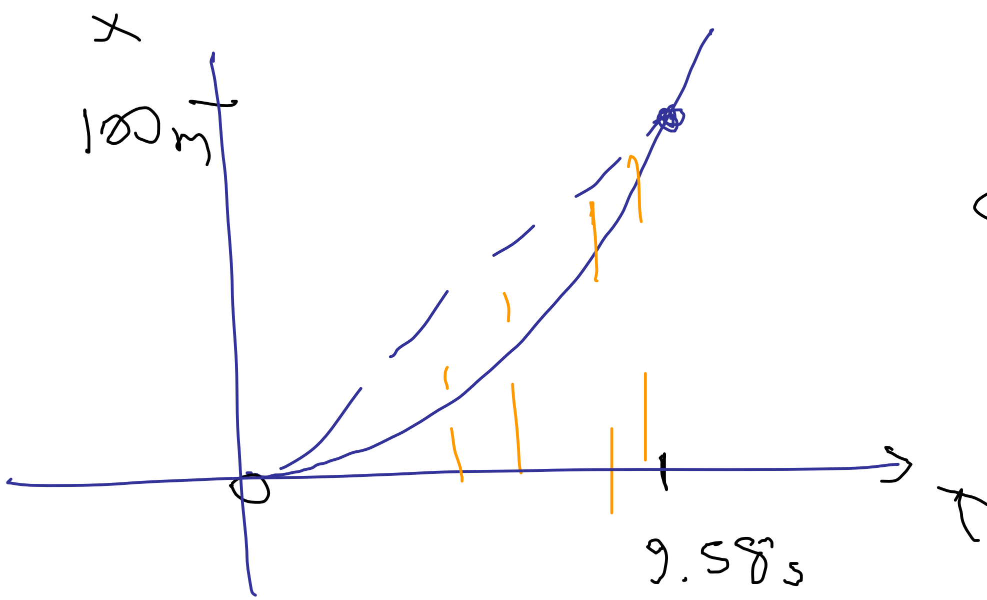


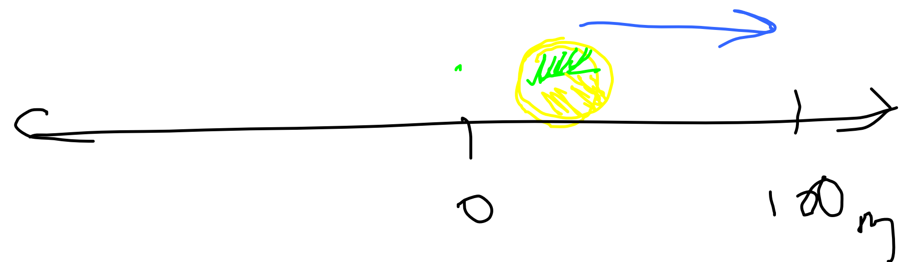
$$\bar{v} = \frac{\Delta x}{\Delta t}$$

Units m/s

2.12 Usain Bolt 100m-dash in 9.58 s. What was his avg speed.

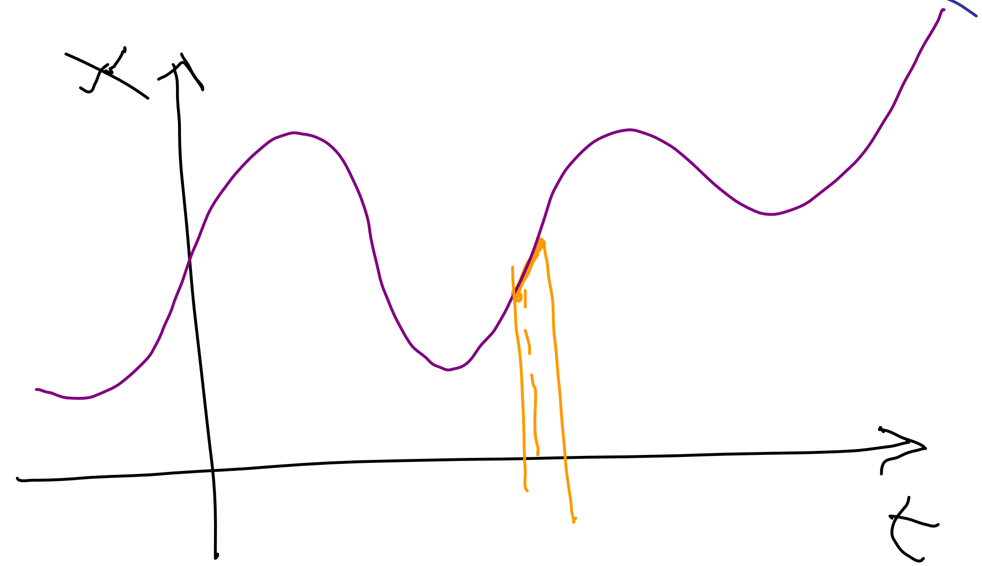
speed $= s = |\bar{v}|$ always positive, m/s





$$\bar{v} = \frac{100\text{ m}}{9.58\text{ s}} = 10.4 \frac{\text{m}}{\text{s}}$$

Instantaneous velocity



$$V = \frac{\Delta x}{\Delta t} = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t}$$

Δt is reeeeely small

Slope at a time t

$$V = \frac{dx}{dt}$$

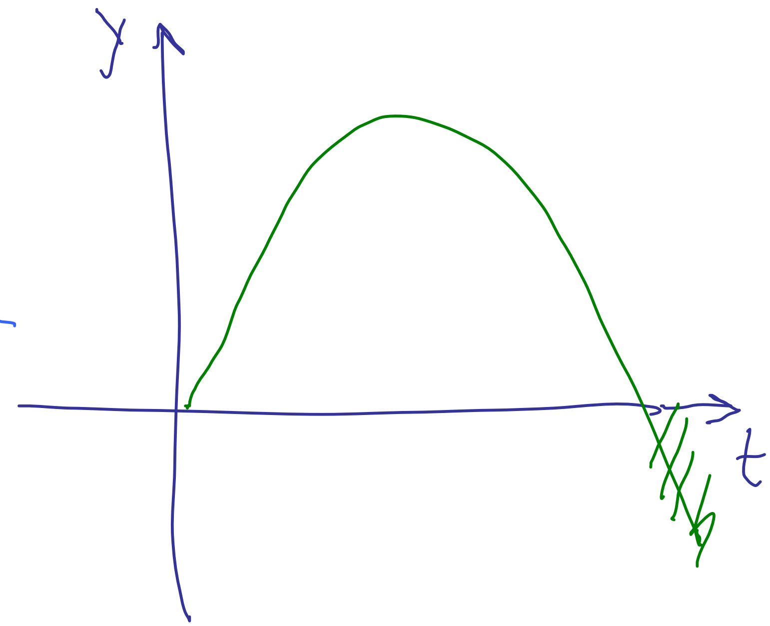
2.2) A model rocket is launched str. upward. Its altitude y is given by

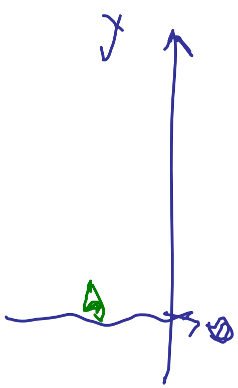
$$y = bt - ct^2$$

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

a) Find $v(t)$

b) When is velocity zero?





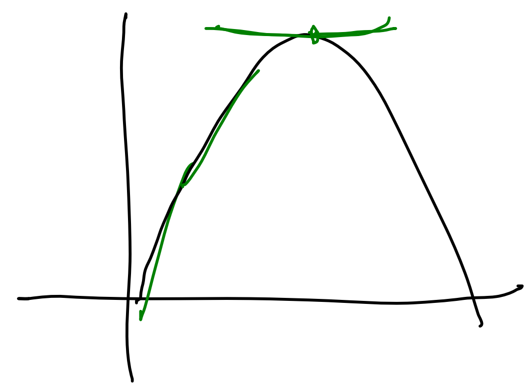
a) $v = \frac{dy}{dt} = b - 2ct$

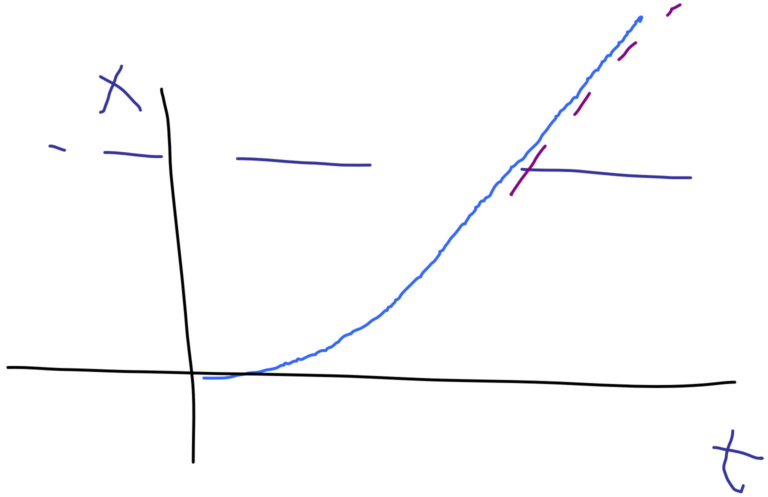
b) $v = b - 2ct$

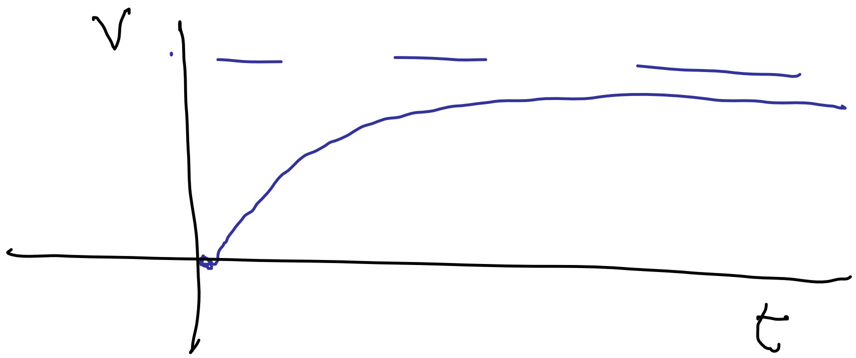
$0 = b - 2ct$

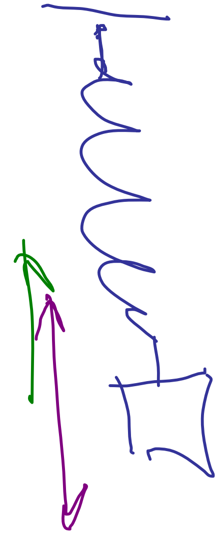
$b = 2ct$

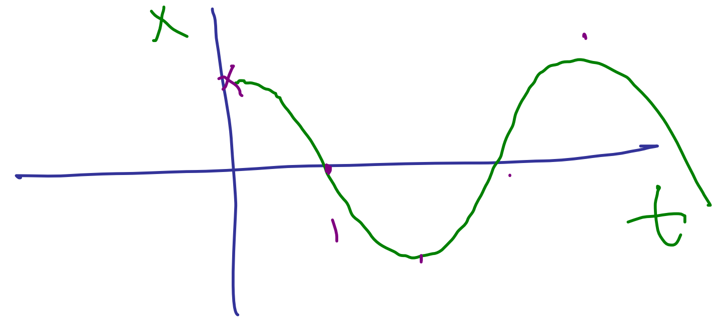
$$t = \frac{b}{2c} = \frac{82 \cancel{\frac{m}{s}}}{2\left(4.9 \cancel{\frac{m}{s^2}}\right)} = 8.4\,s$$

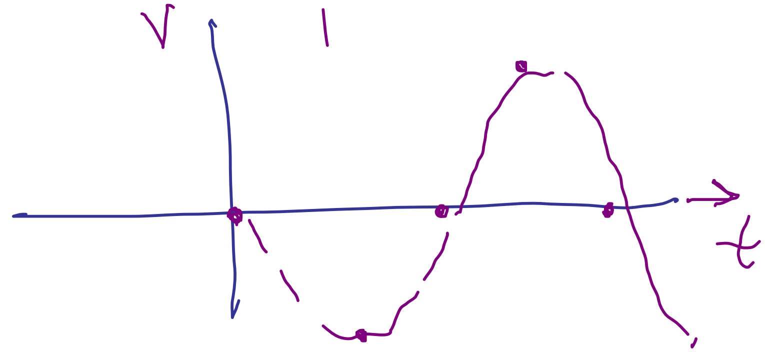








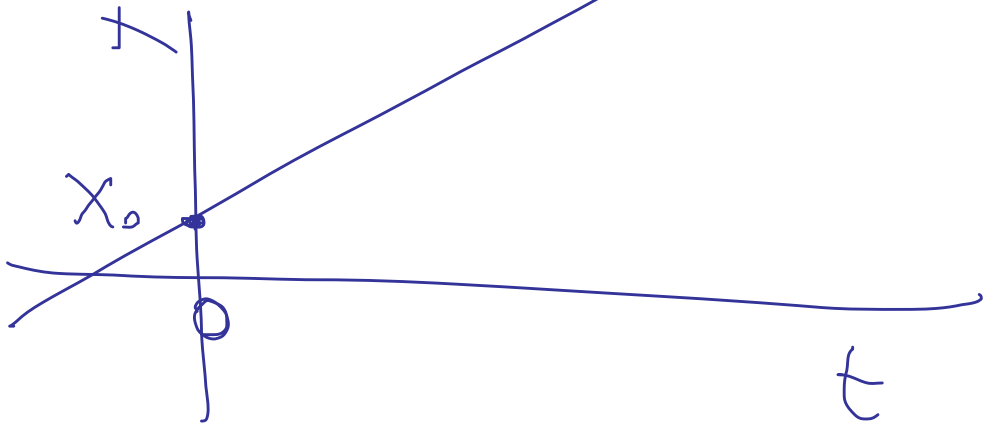




$$x = A\cos\omega t$$

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

Special case



$$\frac{dx}{dt} = \text{constant} = V_0$$

slope

$$x = x_0 + v_0 t$$

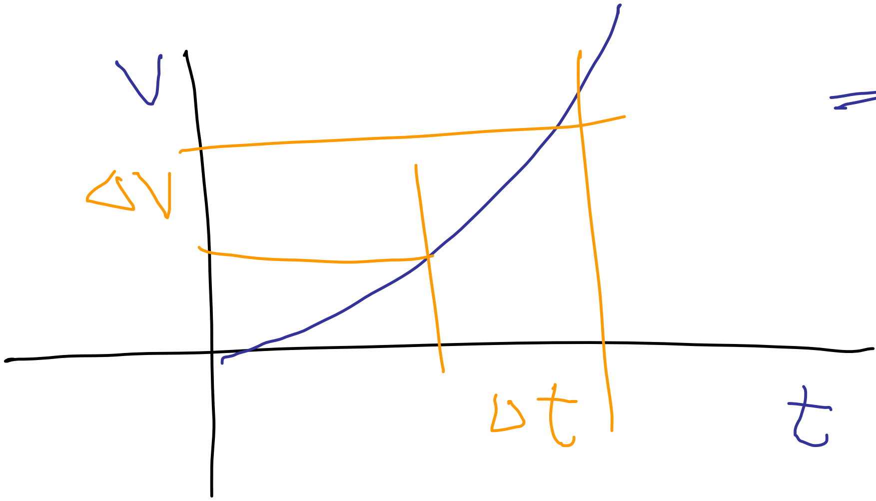
Constant velocity

$$x - x_0 = v_0 t$$

$$v = \frac{x - x_0}{t}$$

In general

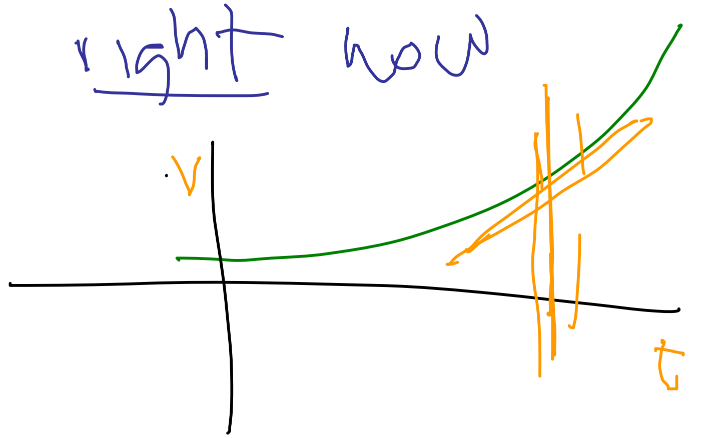
$$\text{dist} \neq (\text{speed})(\text{time})$$



→ How rapidly is velocity changing over Δt

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

How fast is vel changing right now



Units of acceleration $\frac{m/s}{s} = m/s^2$

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

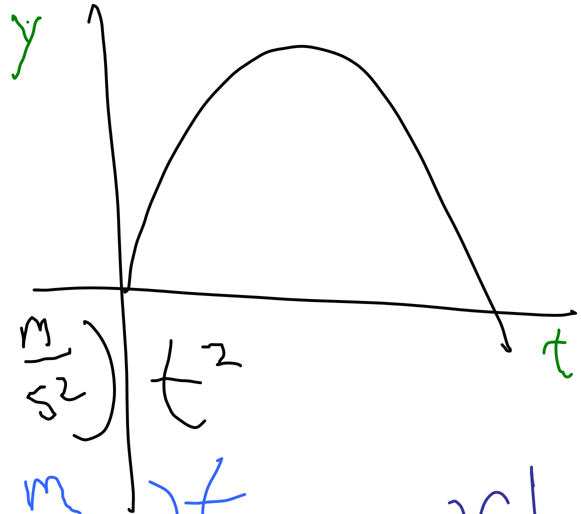
Δt really small

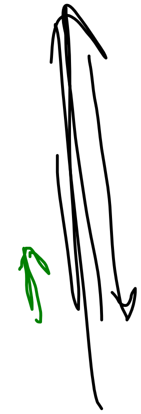
$$= dv/dt$$

Prev. example

2.21

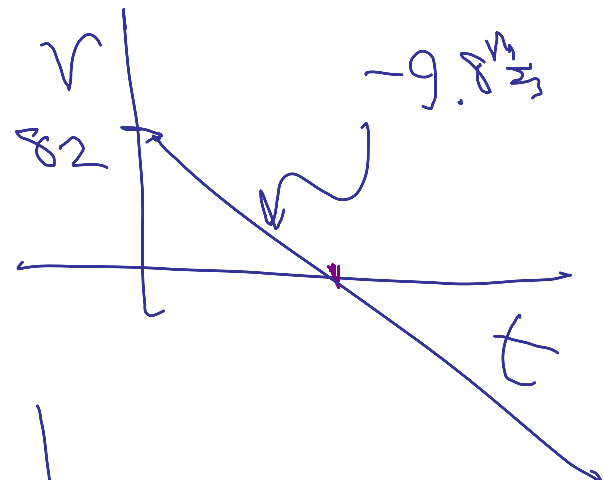
$$y = \left(82\frac{m}{s}\right)t - \left(4.9\frac{m}{s^2}\right)t^2$$

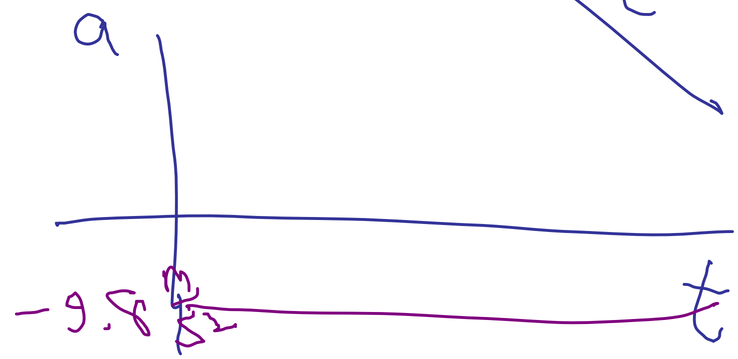


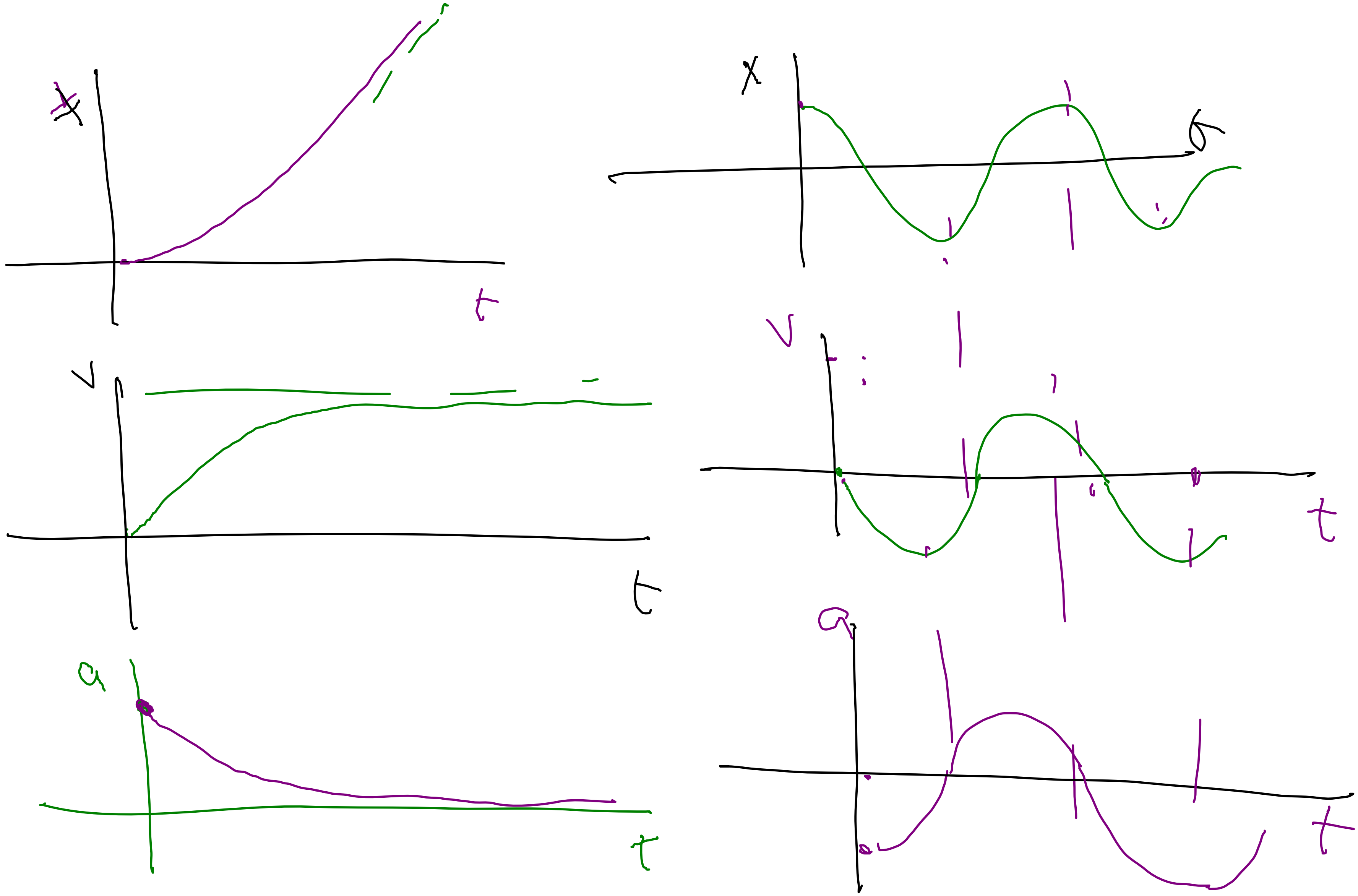


$$v = 82\frac{m}{s} - \left(9.8\frac{m}{s^2}\right)t$$

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






x
t
v
t
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x
v
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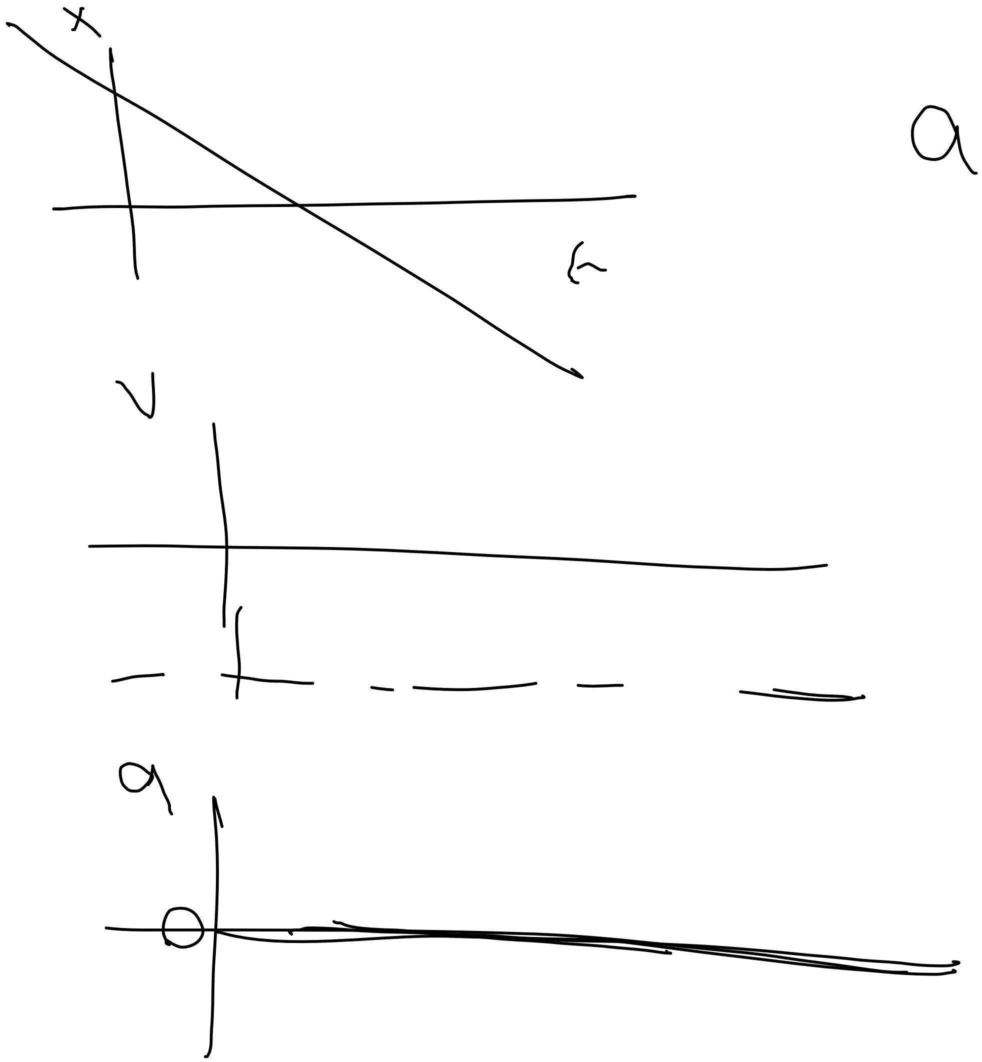


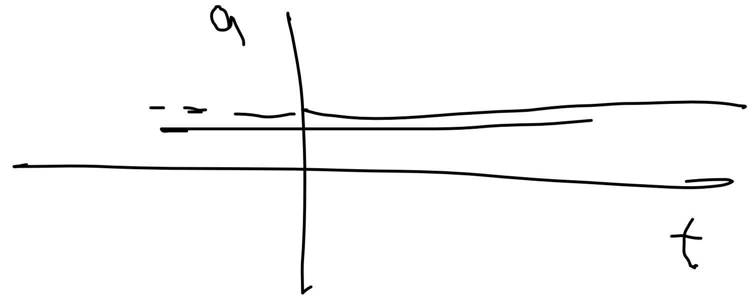
$$a = \frac{d^2x}{dt^2}$$

$$b = \frac{d^3x}{dt^3}$$

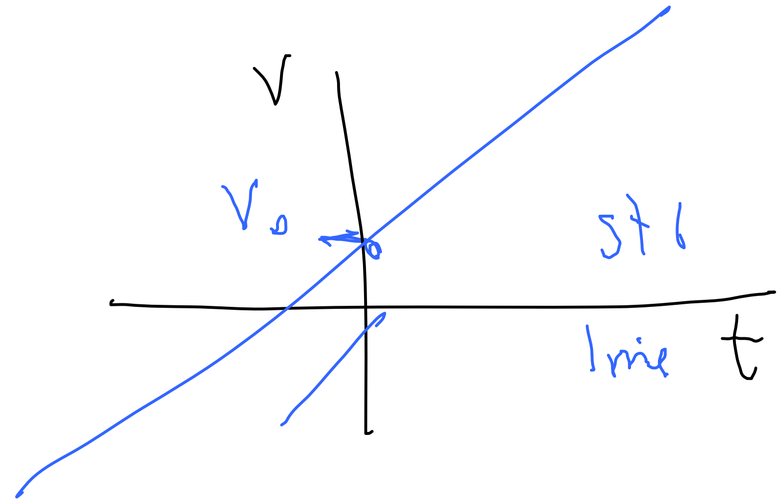
Special case: accel. is const

$$a = \text{const}$$

$a = \text{const} = \frac{dv}{dt}$



$v = at + C$



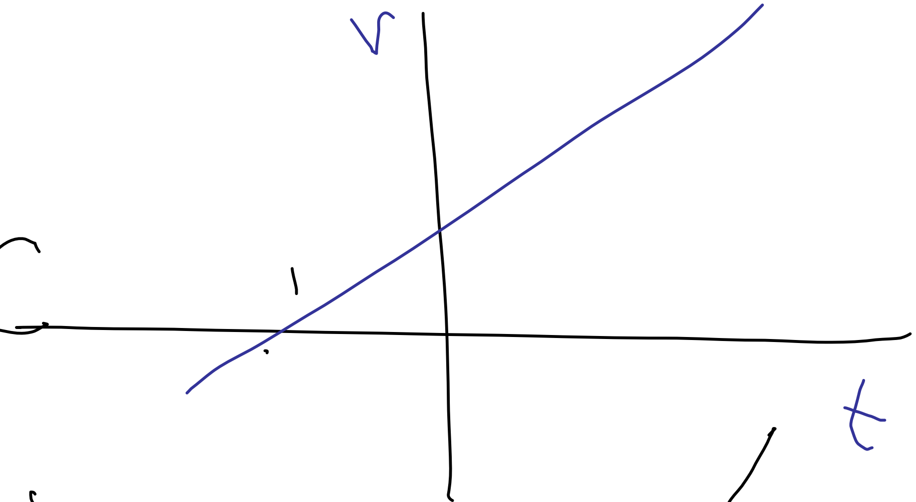
$t = 0 \Rightarrow v = v_0$

$v = at + v_0$

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

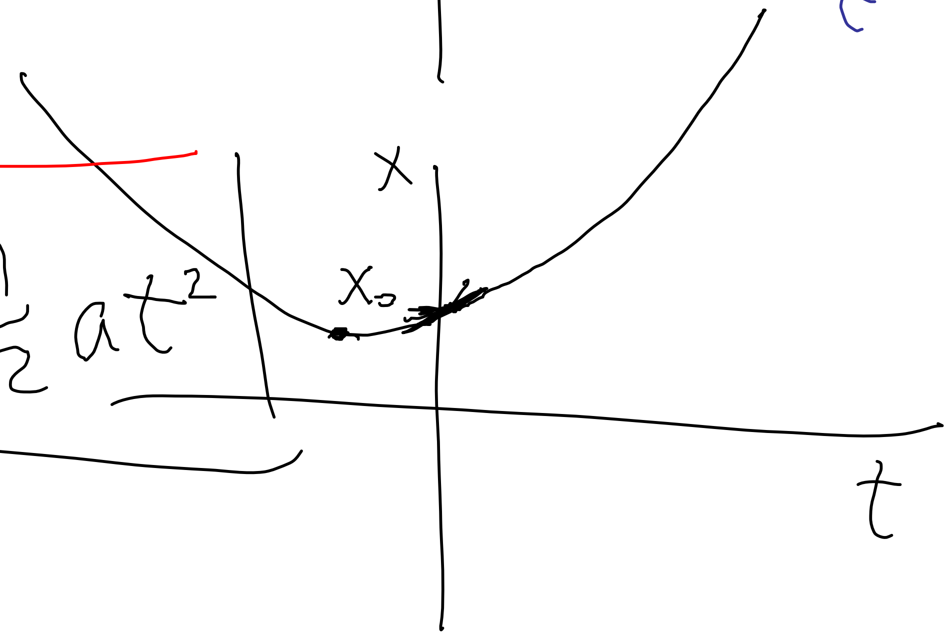
$$v = v_0 + at$$

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



$$C = x_0$$

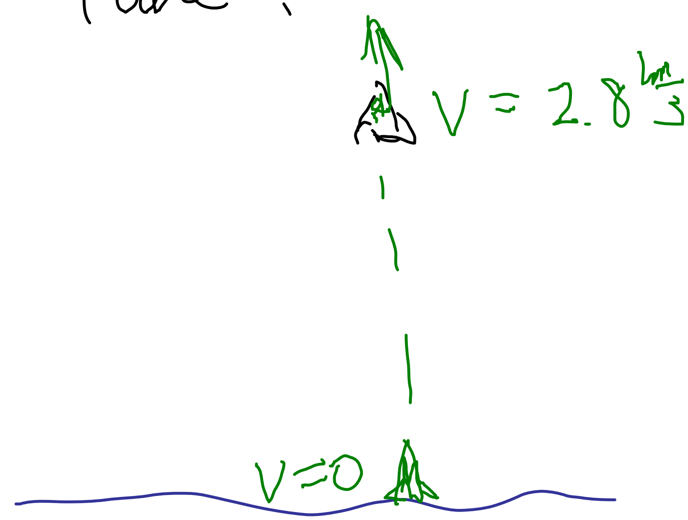
$$\boxed{x = x_0 + v_0 t + \frac{1}{2}at^2}$$



2.31 A rocket rises w/ constant accel. to an altitude of 85 km at which point its speed is 2.8 $\frac{km}{s}$

a) what's its acceleration

b) How long does ascent take?



$v = v_0 + at$

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

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

no t

Another one

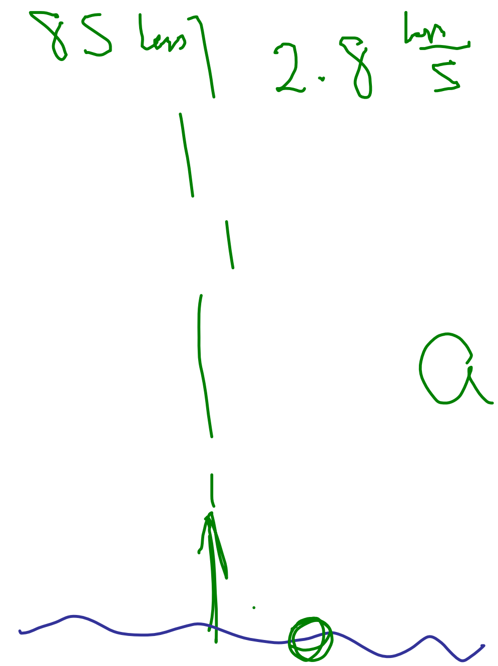
$$\boxed{x = x_0 + \frac{1}{2}(v + v_0)t}$$

find init

only for const accel

$$v^2 = v_0^2 + 2a(y - y_0)$$

$(2.8 \frac{km}{s})^2$ 0 find a 85 km



$$a = \frac{v^2 - v_0^2}{2(x - x_0)} = \frac{\left(2.8\times10^3\,\frac{m}{s}\right) - 0^2}{2\left(85\times10^3\,m\right)}$$

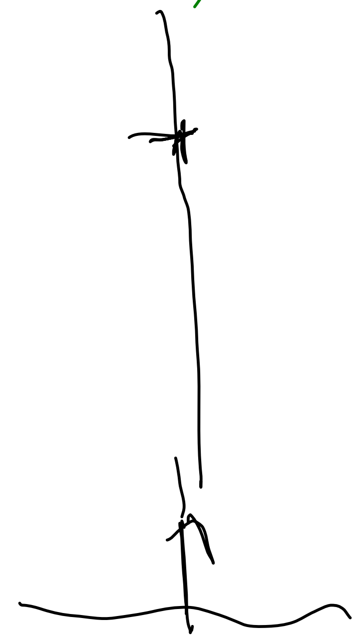
$$a = 4.6\,\frac{m}{s^2}$$

b) How long it take to ascent ?

$$t \leftarrow v = v_0 + at$$

$v = 2.8\,\frac{m}{s}$, $v_0 = 0$, $a = 4.6\,\frac{m}{s^2}$

$$t = 61\,s$$



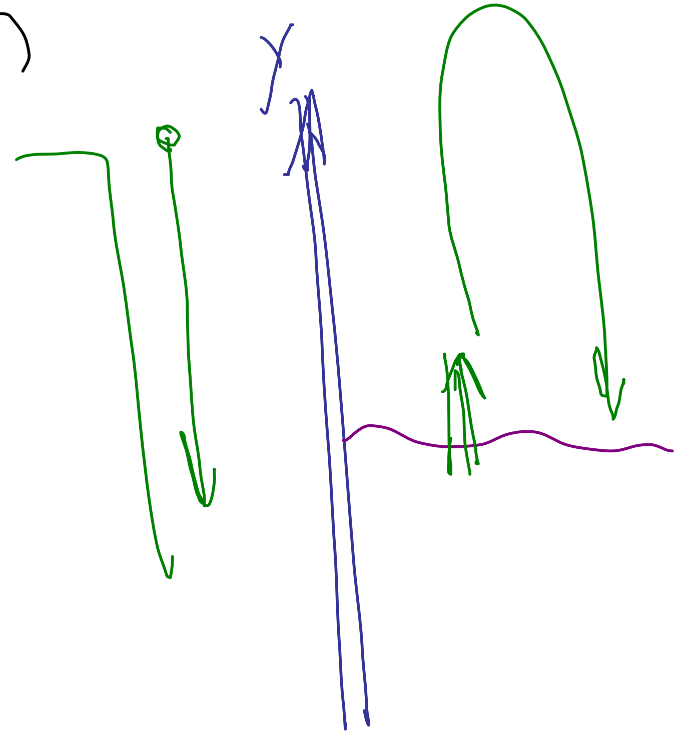
Special kind of problem

free-fall

Acceleration

a is neg.

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



Ignoring air