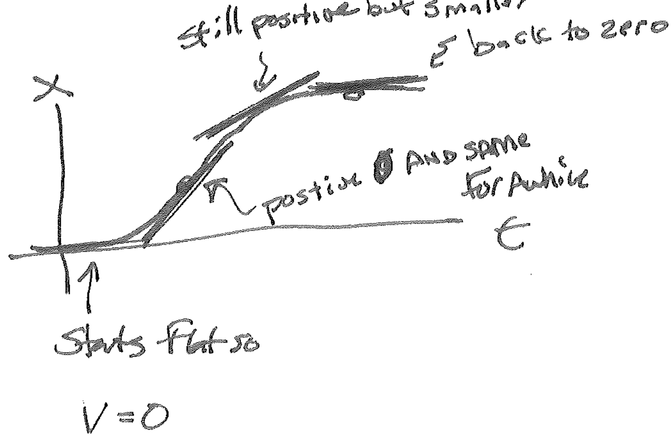
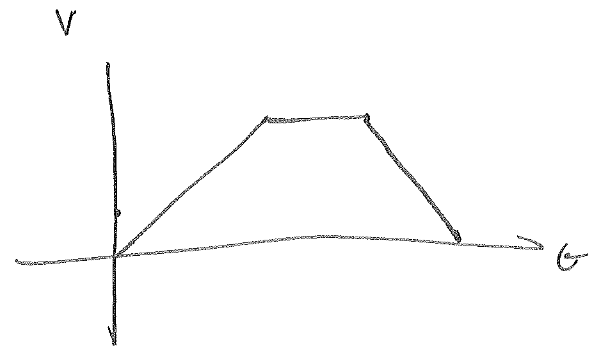
Physics 160,
Extra Credit #3

Given Position, find Velocity, AND Acceleration

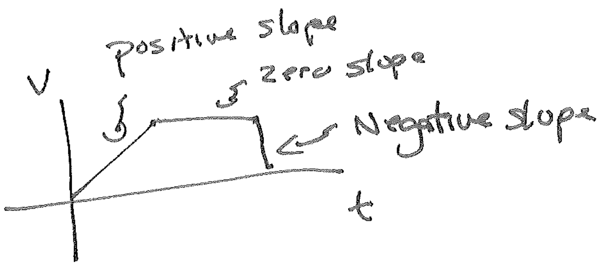
a) Which graph? → 3 AND 4 are wrong Because they don't connect the dots. 1 goes up to 10s which is too far since final data point is 9s.

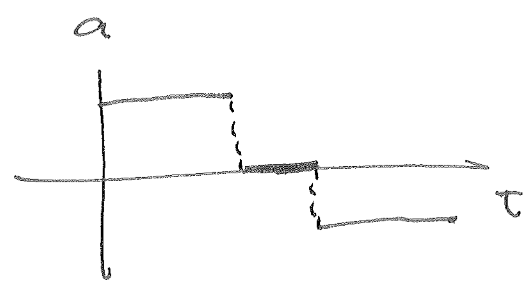
b) Which is best velocity?



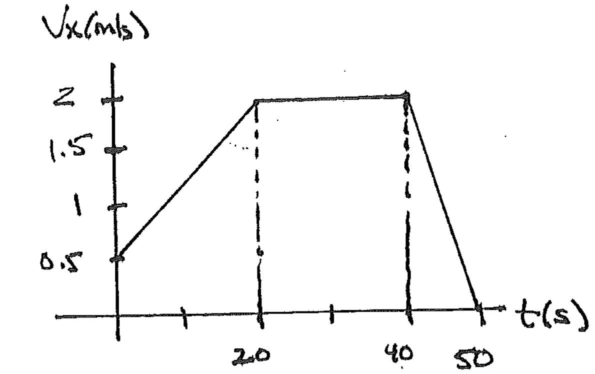


c) Acceleration





WHAT Velocity vs. time graphs ..



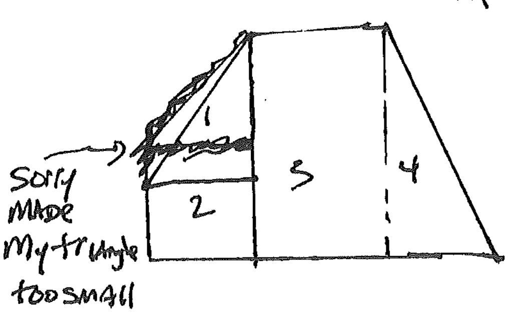
NOTICE: 3 Line segments ⇒ 3 Constant Acceleration Motions

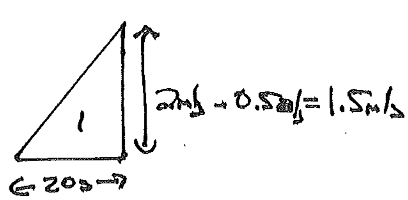
From 20 to 40s, Horizontal line ⇒ Uniform motion ⇒ $a_x = 0$

a) What is initial velocity? ⇒ initial velocity at t=0, Just read off of graph $V_i = 0.5\,m/s$

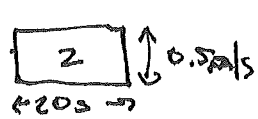
b) What is total distance? → For any type of motion Δx is Area under V_x vs. t. ⇐ Hopefully you read this in a hint or in the textbook.

Split into 4 areas

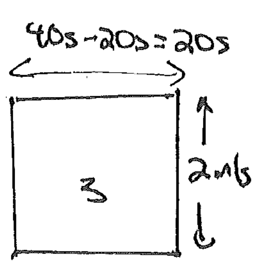




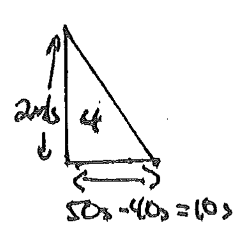
$A_1 = \frac{1}{2}(20s)(1.5m/s)$
$= 15m$



$A_2 = (20s)(0.5m/s) = 10m$



$A_3 = 20s(2m/s) = 40m$



$A_4 = \frac{1}{2}(10s)(2m/s)$
$= 10M$

$\Delta X = A_1 + A_2 + A_3 + A_4 = 15m + 10m + 40m + 10m = 75m$

c) what is a_{av} over first 20s?

$a_{av} = \frac{\Delta V}{\Delta t}$ for $t_1 = 0, t_2 = 20s$

$V_1 = 0.5m/s, V_2 = 2m/s$

$a_{av} = \frac{V_2 - V_1}{t_2 - t_1} = \frac{(2m/s - 0.5m/s)}{(20s - 0)} = \frac{1.5m/s}{20s} = 0.075m/s^2$

This question is a little silly since V_x vs t straight line ⇒ Constant Acceleration, so the instantaneous Acceleration value for $0 < t < 20s$ is also $0.075m/s^2$, and both a_{av} and a_x are the slope of the line.

d) what is instantaneous acc. at $t = 45s$. → Again, straight line for 40s to 50s ⇒ instant. Acc. is Constant for all times between 40s and 50s

And $a_x = \frac{\Delta V}{\Delta t}$ = slope here use $t_1 = 40s, t_2 = 50s$ ⇒ $V_{x1} = 2.0m/s$

$V_{x2} = 0$

⇒ $a_x = \frac{(0 - 2m/s)}{(50s - 40s)} = \frac{-2m/s}{10s} = -0.2m/s^2$

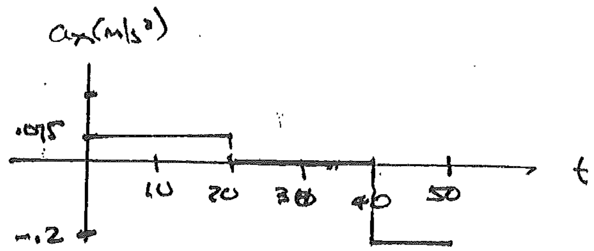
e) which is correct a_x vs t graph?

We know $a_x = 0.075 m/s^2$ for first 20s

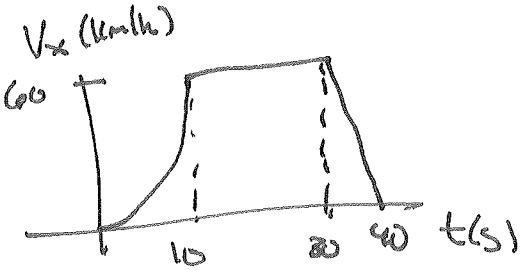
for 40s to 50s, $a_x = -.2 m/s^2$. As I mentioned at very beginning

from 20s to 40s, $a_x = 0$ since V_x graph is horizontal

$\Rightarrow$ 3 constant graphs $\Rightarrow$ 3 horizontal lines



2.12



a) What is Avg. Acceleration for 0 to 10s?

$$a_{av} = \frac{\Delta V}{\Delta t}$$

$V_2 = 60$ km/h, $V_1 = 0$

$\Delta t = 10s$

Have to Use m/s to get m/s²

$$\frac{60km}{h} \times \frac{1000m}{1km} \times \frac{h}{3600s} = 16.667 m/s$$

$$a_{av} = \frac{16.667 m/s}{10s} = 1.6666\ldots m/s^2 = 1.7 m/s^2 \text{ to 2 sig figs}$$

b) what is a_{AV} from 30s to 40s. Now $V_2 = 0$, $V_1 = 60$ km/h $= 16.667$ m/s

$\Delta t = 40s - 30s = 10s$

$$\text{So } a_{AV} = \frac{0 - 16.667 m/s}{10s} = -1.7 m/s^2$$

c) From 10s to 30s : $V = 60$ km/h Constant $\Rightarrow \Delta V = 0 \Rightarrow a_{AV} = 0$

d) From 0 to 40s, $V_2 = 0$ at 40s, $V_1 = 0$ at 0s

$\Rightarrow a_{AV} = 0$

e) What's instant. Acceleration at 20s?

The slope for 10s to 30s is zero at every point so $a = 0$

f What is instant. acceleration at 35s?

From 30s to 40s, plot is straight line ⇒ constant slope

⇒ $a = a_{av}$ for 30s to 40s ⇒ $a = -1.7 m/s^2$