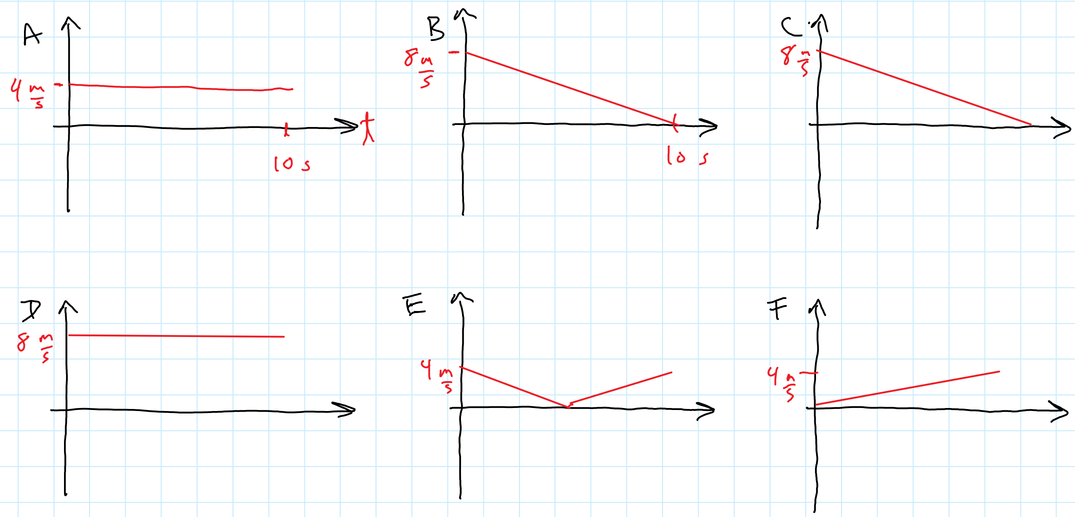
Phy 2A 4/12

Wednesday, April 12, 2017 9:56 AM

Goals for the Lecture:

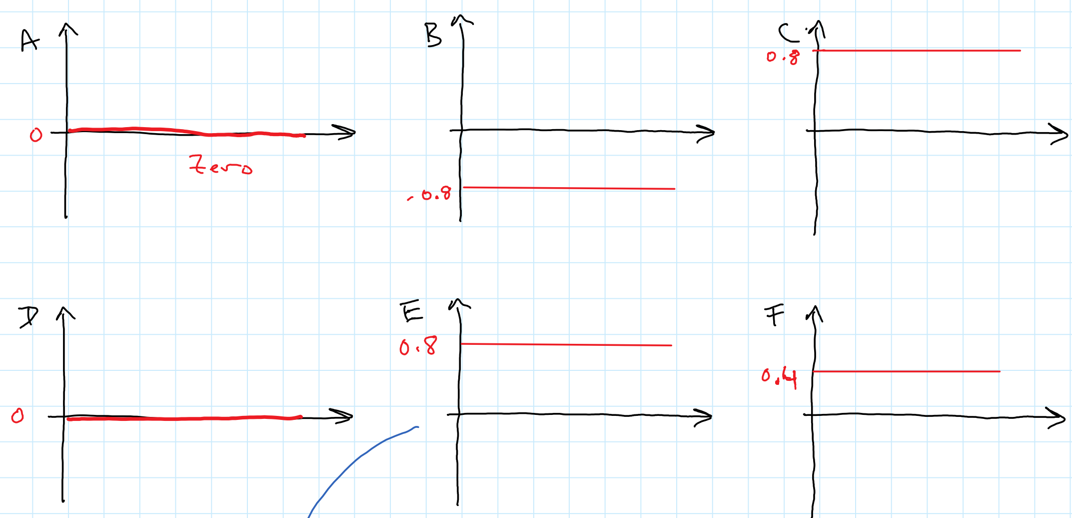
1) Given one of the following three graphs: x vs t, v vs t, and a vs t, be able to draw the other two
2) Be able to solve 1-D kinematics problems (constant acceleration) using the equations and a graphical approach

Worksheet p. 37 given velocity vs. time, draw speed vs. time:



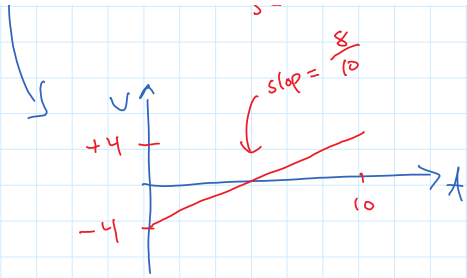
Find: 1) Distance traveled for each one
2) Displacement for each one
3) acceleration for each one
4) graph acceleration vs. time for each

Plot acceleration vs. time:



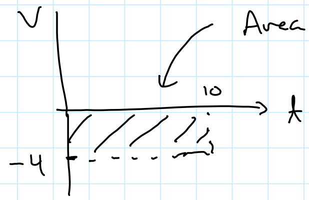
units are $\frac{m}{s^2}$

slope = $\frac{8}{10}$



Find displacement: $\Delta \vec{x}$

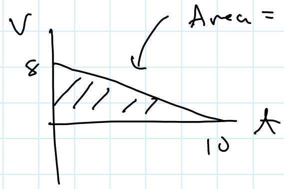
A) area under v vs t gives $\Delta \vec{x}$



Area = $(-4 \frac{m}{s})(10\ s) = -40\ m$

$\Delta \vec{x} = -40\ m$

B)



Area = $\frac{1}{2}(10\ s)(8 \frac{m}{s}) = 40\ m$

$\Delta \vec{x} = 40\ m$

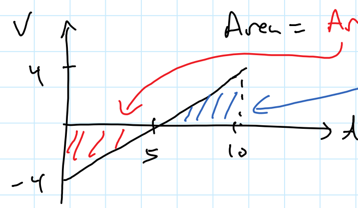
C) Area = $-40\ m$

$\Delta x = -40\ m$

D) Area = $80\ m$

$\Delta x = 80\ m$

E)



Area = Area + Area = $(-10\ m) + (+10\ m) = 0$

$\Delta x = 0$

distance traveled = 10 m in Negative direction + 10 m in positive direction = 20 m

F) Area = Δx = 20 m

From HW

$V_i = 2 \frac{m}{s} \leftarrow$

$V_f = 6 \frac{m}{s} \leftarrow$

if Right is + direction: $\rightarrow +$

$$a = \frac{V_f - V_i}{\ } = \frac{-6 - (-2)}{\ } = \frac{-4}{\ } = -2 \frac{m}{s^2}$$

if Right is + direction:

$$a = \frac{v_f - v_i}{t} = \frac{-6-(-2)}{2} = \frac{-4}{2} = -2 \ \frac{m}{s^2}$$

↑ to the left

if Left is positive: + ⟵

$$a = \frac{6-2}{2} = \frac{4}{2} = 2 \ \frac{m}{s^2}$$

↑ positive, so to the left

$v_i = 2 \ \frac{m}{s}$ ⟶

$v_f = 6 \ \frac{m}{s}$ ⟵

if ⟶ + : $a = \frac{v_f - v_i}{t} = \frac{-6-(+2)}{2} = \frac{-8}{2} = -4 \ \frac{m}{s^2}$

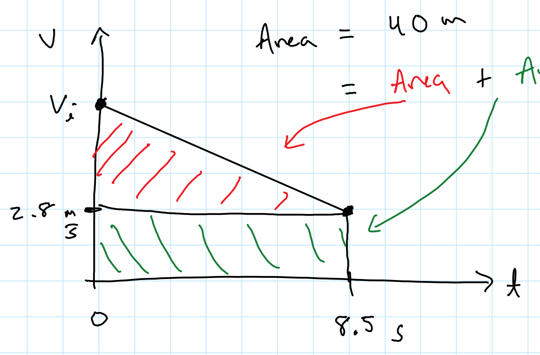
↑ $4 \ \frac{m}{s^2}$ to the left

if + ⟵ : $a = \frac{v_f - v_i}{2} = \frac{+6-(-2)}{2} = +\frac{8}{2} = +4 \ \frac{m}{s^2}$

↑ $4 \ \frac{m}{s^2}$ to the left

Example: A truck goes 40 m in 8.5 s while slowing to a final speed of $2.8 \ \frac{m}{s}$. If a is constant, find v_i and a.

(1^{st}) using graphs to solve:



Area = 40 m

= Area + Area = $\frac{1}{2}(8.5 \ s)(v_i - 2.8) + (8.5 \ s)(2.8 \ \frac{m}{s}) = 40$

$v_i = 6.61 \ \frac{m}{s}$

a = slope of v vs t

$$= \frac{v_f - v_i}{t} = \frac{2.8 - 6.61}{8.5}$$

$$= -0.448 \ \frac{m}{s^2}$$

2nd) using equations:

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

$$at = \Delta v$$

$$at = v_f - v_i$$

Kinematics Equations

$$\boxed{v_f = v_i + at}$$

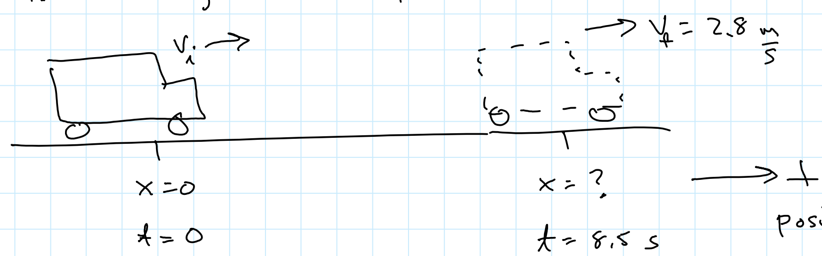
$$\boxed{x_f = x_i + v_i t + \frac{1}{2} a t^2}$$

$$\boxed{v_f^2 = v_i^2 + 2a\,\Delta x}$$

$$\boxed{x_f - x_i = \left(\frac{v_i + v_f}{2}\right) t}$$

} True only for constant acceleration

1st → Define origin and positive direction



X-motion

Δx {	x_i	0
	x_f	40 m
	v_i	?
	v_f	2.8 $\frac{m}{s}$
	a	?
	t	8.5 s

To find v_i (use an equation missing a)

$$x_f - x_i = \left(\frac{v_i + v_f}{2}\right) t$$

$$40 - 0 = \left(\frac{v_i + 2.8}{2}\right)(8.5)$$

$$v_i = 6.61\ \frac{m}{s}$$

To get a:

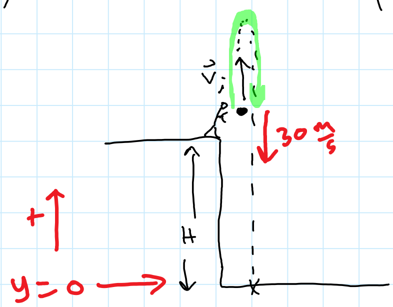
$$v_f = v_i + at$$

$$2.8 = 6.61 + a\,(8.5)$$

$$a = -0.448\ \frac{m}{s^2}$$

More Kinematics Problems:

1) Throw a ball up into the air from the top of a cliff:



given: $H = 50$ m

$|\vec{v}_i| = 30 \frac{m}{s}$

find: V_f (the velocity of the ball the split second before it hits the ground)

t (time in air)

1st) Define origin and positive direction

Let's use origin = bottom of cliff

and up = positive direction

2nd) fill in table:

y-motion

Δy {	y_i	$+50$ m
	y_f	0
	V_i	$+30 \frac{m}{s}$
	V_f	?
	a	$-9.8 \frac{m}{s^2}$
	t	?

Find V_f using:

$$V_f^2 = V_i^2 + 2a\Delta y$$

$$= (30)^2 + 2(-9.8)(0-50)$$

$$V_f^2 = \sqrt{1883}$$

$$V_f = \pm 43.4 \frac{m}{s}$$

$$V_f = -43.4 \frac{m}{s}$$ (going down, so pick the Negative Root)

Find t:

$$V_f = V_i + at$$

$$-43.4 = 30 + (-9.8)t$$

$$t = 7.48 \text{ s}$$

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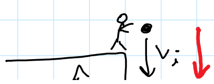
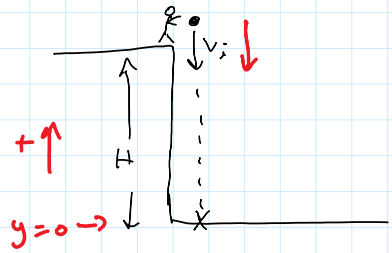
2) Throw a ball downward from top of cliff:

given: $H = 50$ m

$|\vec{v}_i| = 30 \frac{m}{s}$





given: $H = 50$ m

$|\vec{v}_i| = 30 \frac{m}{s}$

find: v_f, t

1st) Define origin and positive direction

origin = bottom of cliff

up = positive

2nd) Fill in table:

y-motion	
y_i	+50 m
y_f	0
v_i	$-30 \frac{m}{s}$
v_f	?
a	$-9.8 \frac{m}{s^2}$
t	?

Find v_f:

$$v_f^2 = v_i^2 + 2 a \Delta y$$

$$= (-30)^2 + 2(-9.8)(0-50)$$

$$v_f = \pm 43.4$$

$$v_f = -43.4 \frac{m}{s}$$

To get time:

$$v_f = v_i + at$$

$$-43.4 = -30 + (-9.8)\, t$$

$$t = 1.37 \text{ s}$$

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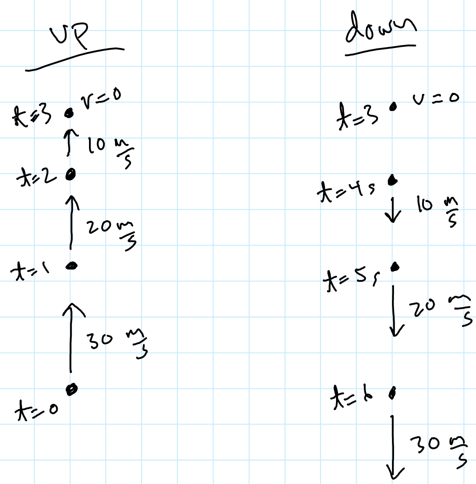
using $g = 10 \frac{m}{s^2}$



(+20) − (+10) = 10 m

worksheet p. 41

Top:

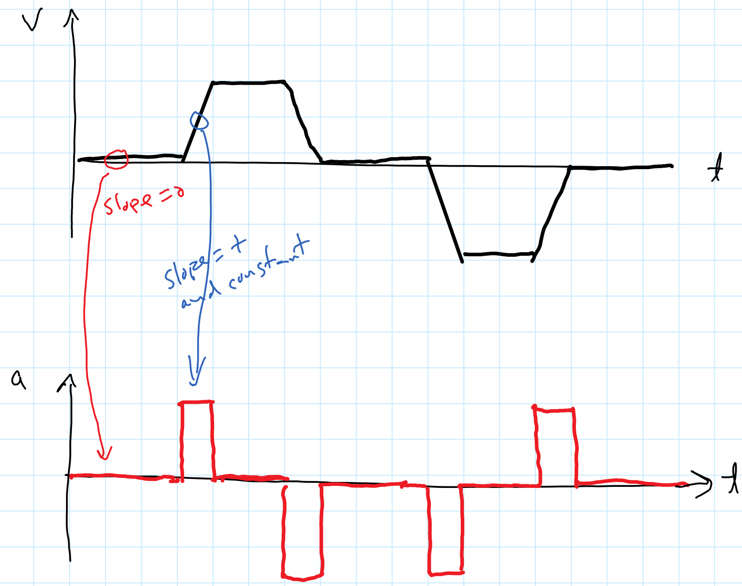
A) $\Delta V = V_f - V_i = (+20) - (+10) = 10 \ \frac{m}{s}$

B) $\delta V = V_f - V_i = 0 - 10 = -10 \ \frac{m}{s}$

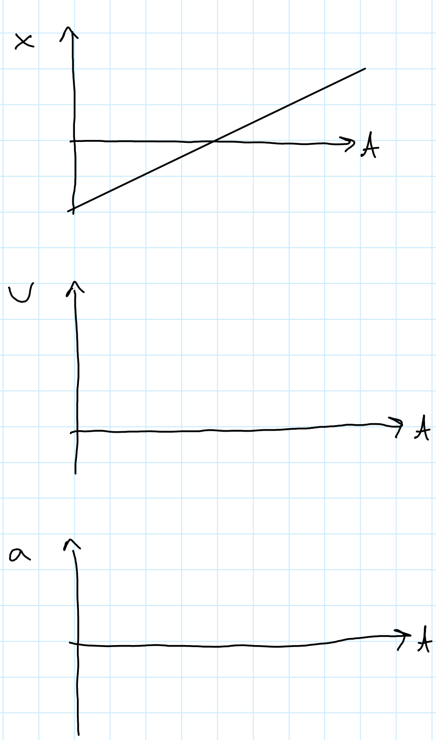
C) $V_f - V_i = (-10) - (+10) = -20 \ \frac{m}{s}$

D) $V_f - V_i = (+20) - (+30) = -10 \ \frac{m}{s}$

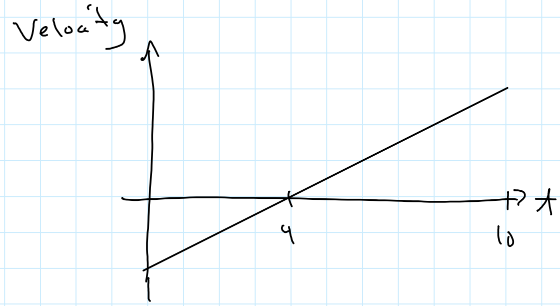
bottom:



worksheet p. 50



Change the graph to v vs t



and answer all the same questions if you were given v vs t instead of x vs t