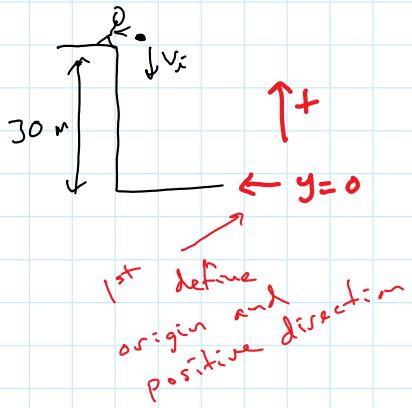
Phy 2A Review 4/14

Friday, April 14, 2017 10:00 AM

Example Problem:

i) A ball is thrown downward with initial speed 8 $\frac{m}{s}$ from a height of 30 m.

How long does it take to strike the ground?



1st define origin and positive direction

y-motion ← 2nd fill in table

y_i	30 m
y_f	0
v_i	$-8 \frac{m}{s}$
v_f	?
a	$-9.8 \frac{m}{s^2}$
t	?

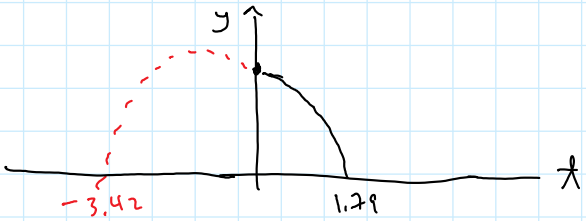
3rd solve for t:

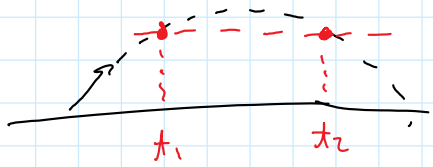
$$y_f = y_i + v_i t + \frac{1}{2} a t^2$$

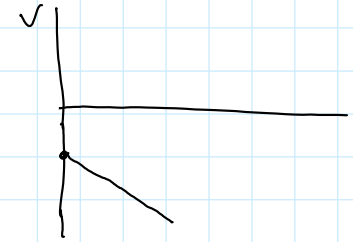
$$0 = 30 + (-8)t + \frac{1}{2}(-9.8)t^2$$

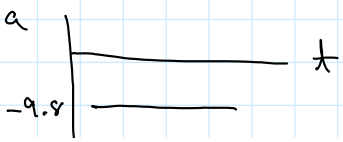
$$t = \begin{cases} -3.42 \text{ s} \\ 1.79 \text{ s} \leftarrow \text{positive root} \end{cases}$$

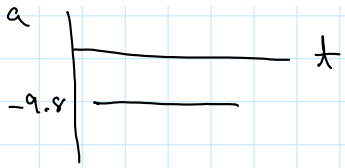
$$t = 1.79 \text{ s}$$







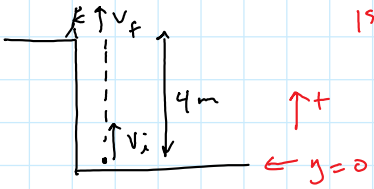




2) A student throws a ball upward to someone 4 m above them. The second person catches the ball 1.5 s later.

a) find v_i of the ball

b) find v_f (the speed of the ball the instant before it was caught)



1st - Define origin and positive direction

2nd - fill in table

y-motion

y_i	0
y_f	4 m
v_i	?
v_f	?
a	$-9.8 \frac{m}{s^2}$
t	1.5 s

3rd - Solve equation

solve for v_i:

$$y_f = y_i + v_i t + \frac{1}{2} a t^2$$

$$4 = 0 + v_i (1.5) + \frac{1}{2}(-9.8)(1.5)^2$$

$$v_i = 10.0 \ \frac{m}{s} \ \uparrow$$

solve for v_f:

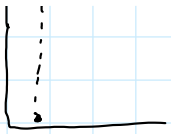
$$v_f = v_i + at$$

$$= 10 + (-9.8)(1.5)$$

$$= -4.7 \frac{m}{s} \text{ or } 4.7 \frac{m}{s} \text{ downward}$$

So, actually looks like this:

ball caught on the way back down



Find max height the ball reaches and the time it takes to get to the max height

y-motion to max. height

y_i	0
y_f	?
v_i	$+10 \frac{m}{s}$
v_f	0 ← zero at max height
a	$-9.8 \frac{m}{s^2}$
t	?

find y_f:

$$v_f^2 = v_i^2 + 2a(y_f - y_i)$$

$$0 = (10)^2 + 2(-9.8)(y_f - 0)$$

$$y_f = \frac{100}{19.6} = 5.1 \text{ m}$$

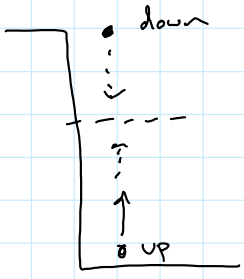
time to max height:

$$v_f = v_i + at$$

$$0 = 10 + (-9.8)t$$

$$t = 1.02 \text{ s}$$

3) A ball is thrown upward from the ground with initial speed $25 \frac{m}{s}$. At the same instant, another ball is dropped from a height of 15 m. After how long will the balls be at the same height?



↑+

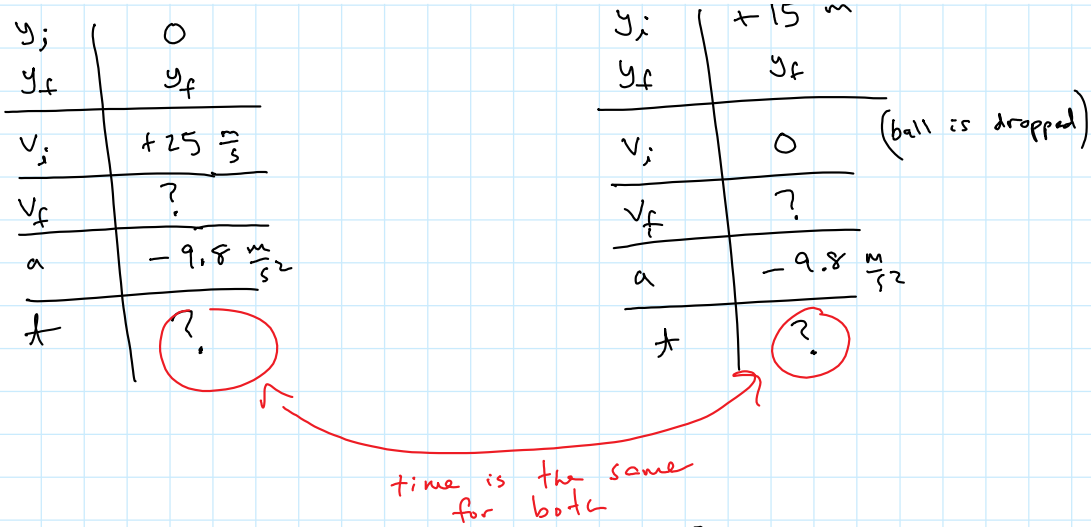
← y=0

1st - define origin and positive direction

2nd - fill in tables (make one for each ball)

y-motion for ball going up

y-motion for ball going down



$$y_f = y_i + v_i t + \frac{1}{2} a t^2$$

$$y_f = 0 + 25t + \frac{1}{2}(-9.8)t^2$$

$$y_f = 15 + 0 + \frac{1}{2}(-9.8)t^2$$

Set them equal and solve for t

$$25t - 4.9t^2 = 15 - 4.9t^2$$

$$t = \frac{15}{25} = 0.6 \text{ s}$$

Now, find y_f

$$y_f = 15 - 4.9(0.6)^2$$

$$= 13.2 \text{ m}$$