Physics 200 — Exam 1 Review

Topics

Vectors: conversion
adding

Constant $\vec{a}$

1-D: horiz → ??
vertical → $a = -g$ if under gravity only

2-D: projectile → $a_x = 0$, $a_y = -g$

(I) $v(t) = v_0 + at$

$(I)_x$ $v_x(t) = v_{0x} + a_x t$

$(I)_y$ $v_y(t) = v_{0y} + a_y t$

(II) $x(t) = x_0 + v_0 t + \frac{1}{2}at^2$

$(II)_x$ $x(t) = x_0 + \ldots$

$(II)_y$ $y(t) = y_0 + v_{0y}t + \frac{1}{2}a_y t^2$

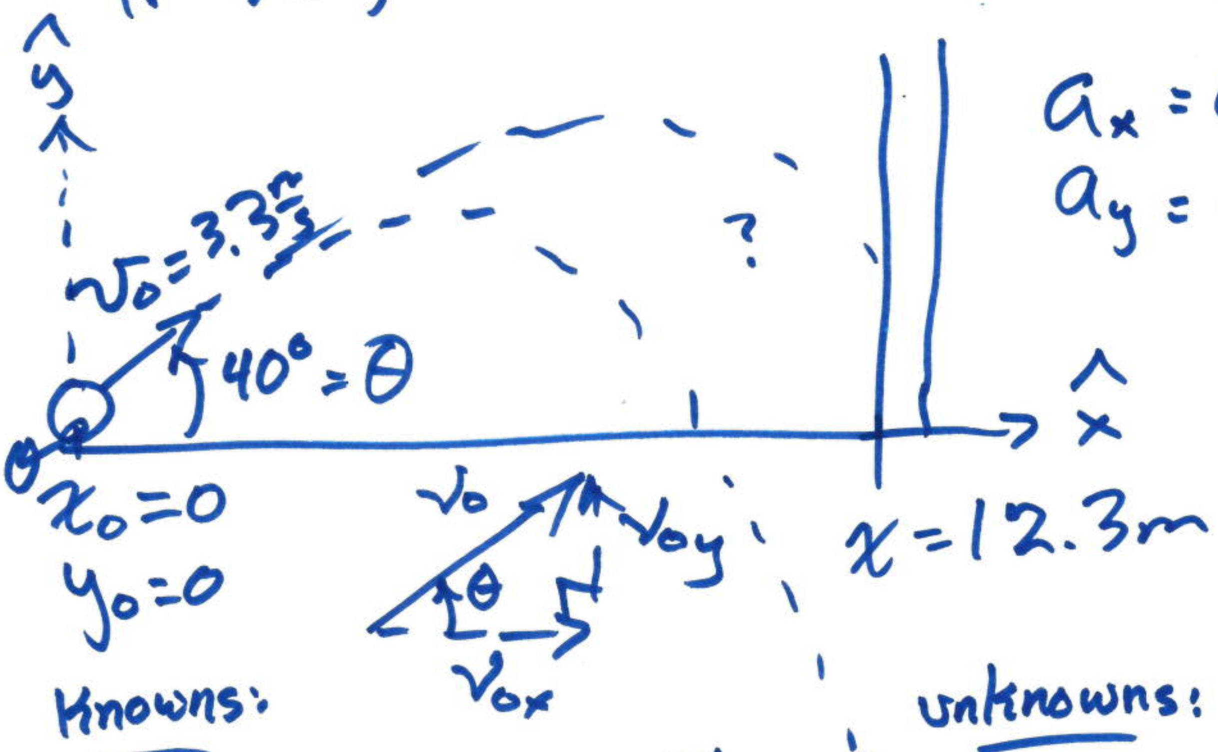
⋮

(III) $v^2(t) = v_0^2 + 2a\,(x(t) - x_0)$

you kick a ball at 3.3 m/s at 40° above horiz. toward a "tall" wall 12.3m distant.

? Does ball hit wall? If so, how high?

If not, where does it land?



$a_x = 0$

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

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

Knowns:

$v_0 \big\{ V_{ox} = V_0 \cos\theta = 2.53 \, m/s$

$\theta \big\{ V_{oy} = V_0 \sin\theta = 2.12 \, m/s$

$a_x = 0$

$a_y = -9.8 \, m/s^2$

$x_0 = 0$

$y_0 = 0$

unknowns:

$x(t) \quad y(t)$

$V_x(t) \quad V_y(t)$

t

Can set $x(t) = 12.3\text{m}$. Find t.

$(\text{II})_x$ $x(t) = x_0 + v_{0x} t$

$12.3\text{m} = 0\text{m} + 2.53\frac{\text{m}}{\text{s}} t$

$\frac{12.3\text{m}}{2.53\frac{\text{m}}{\text{s}}} = \boxed{t = 4.86\text{s}}$

Find: $y(t)$

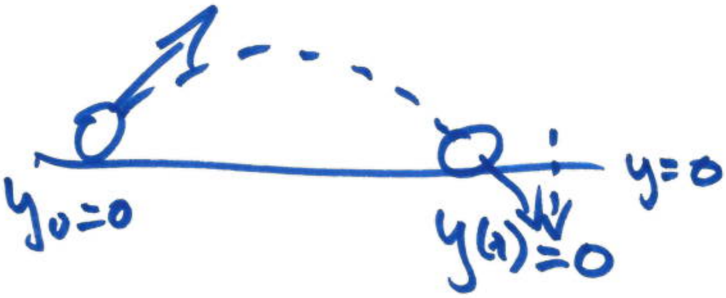
$(\text{II})_y$ $y(t) = y_0 + v_{0y} t + \frac{1}{2} a_y t^2$

$y(t) \cancel{\bigcirc} = 0 + 2.12\frac{\text{m}}{\text{s}}(4.86\text{s}) + \frac{1}{2}\left(-9.8\frac{\text{m}}{\text{s}^2}\right)(4.86\text{s})^2$

$= 0 + 10.30\text{m} - 115.74\text{m}$

$= -105.\text{m}$ Nope - doesn't hit wall.

$y(t) < 0 \rightarrow$ hit ground.



Set $y(t) = 0$. Find: $x(t)$ = where does it land?
find t

$(\mathrm{II})_y$ $\quad y(t) = y_0 + v_{0y} t - \frac{1}{2} g t^2$

$$0 = 0 + 2.12 \tfrac{m}{s} t - 4.9 \tfrac{m}{s^2} t^2$$

2 sol'n's: $t = 0$

$$0 = \underbrace{(t)}_{=0} \underbrace{\left(2.12 \tfrac{m}{s} - 4.9 \tfrac{m}{s^2} t\right)}_{=0}$$

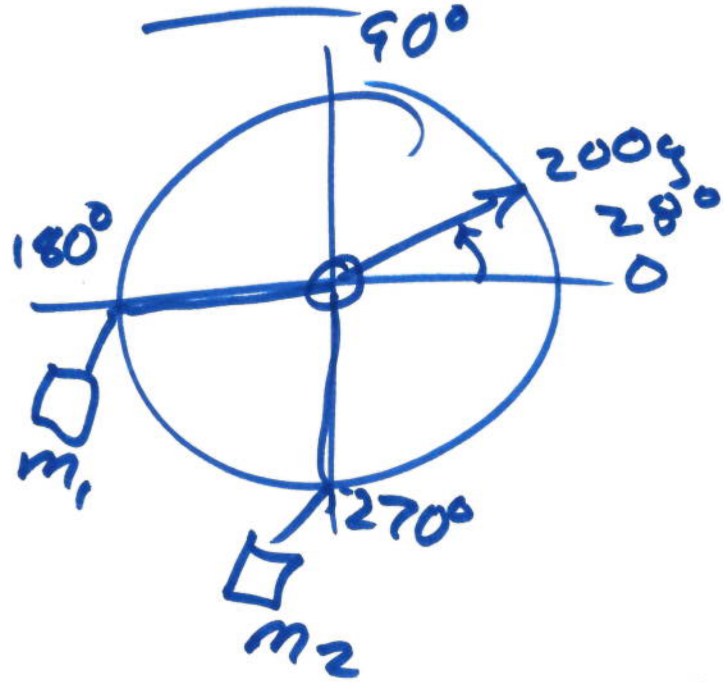
$$0 = 2.12 \tfrac{m}{s} - 4.9 \tfrac{m}{s^2} t$$

$$\frac{-2.12 \frac{m}{s}}{-4.9 \frac{m}{s^2}} = t = 0.43\,s$$

$$x(t) = x_0 + v_{0x} t$$
$$0 + 2.53 \tfrac{m}{s} (0.43\,s) = 1.1\,m$$

kick harder next time.

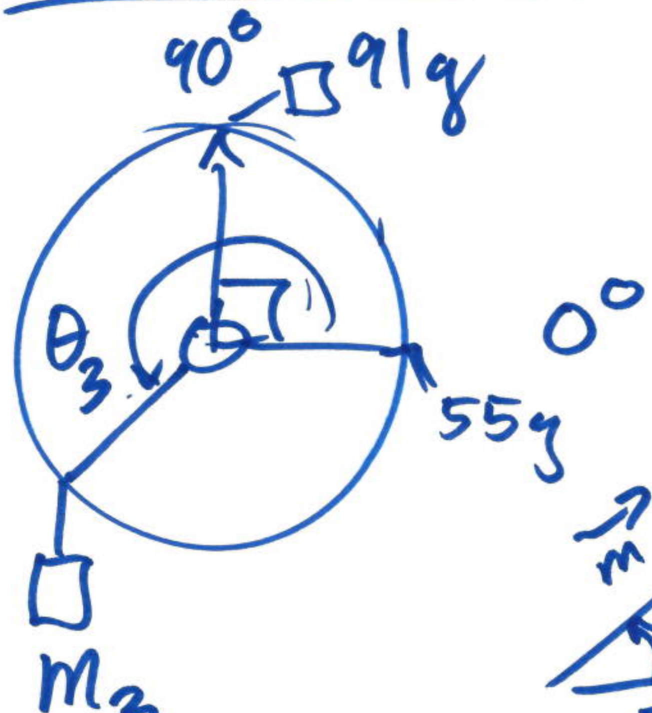
vectors:



find m_1
m_2
to balance $\vec{F}$ table.

$$200g \times \underline{\cos} \, 28^\circ = m_1$$

$$200g \times \underline{\sin} \, 28^\circ = m_2$$

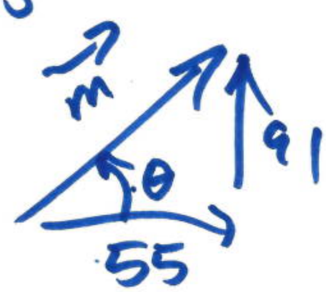


Find m_3 θ_3?

$$m_3 = \sqrt{55^2 + 91^2}$$

$$\boxed{m_3 = 106\,g}$$

$$\theta_3 = \tan^{-1}\left(\frac{91}{55}\right) \begin{matrix} \text{opp} \\ \text{adj} \end{matrix} + 180^\circ$$



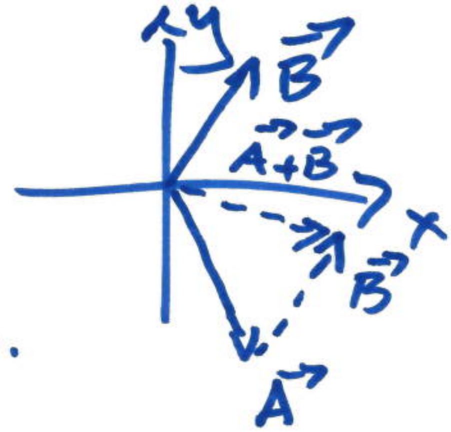
$$\theta_3 = 58.85^\circ + 180^\circ$$

$$\boxed{\theta_3 = 239^\circ}$$

$\vec{A} = (\overset{A_x}{4}, \overset{A_y}{-8})$

$\vec{B} = (9, 70^\circ)$

above $\hat{x}$ axis.

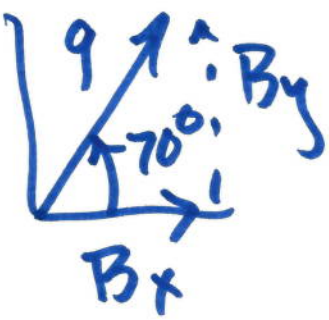


find $\vec{A} + \vec{B} = \vec{C} =$

$$\left.\begin{aligned} C_x &= A_x + B_x \\ C_y &= A_y + B_y \end{aligned}\right\} \text{Know This}$$

$\vec{B} = (9, 70^\circ) \rightarrow B_x = 9 \underline{\cos} 70^\circ$

$B_y = 9 \underline{\sin} 70^\circ$



$B_x = 3.08$

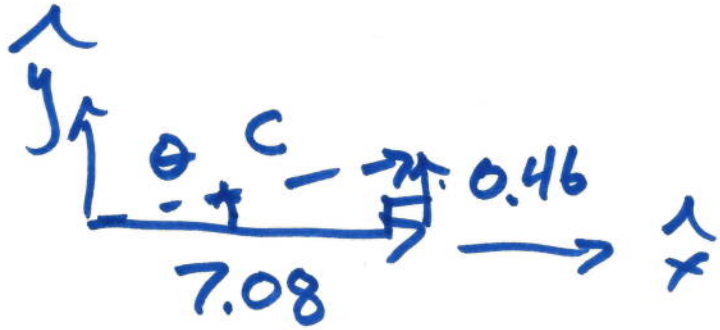
$B_y = 8.46$

$C_x = 4 + 3.08 = 7.08$

$C_y = -8 + 8.46 = 0.46$

$$\boxed{\vec{C} = (7.08, 0.46)}$$

Let's convert $\vec{C}$ to polar.

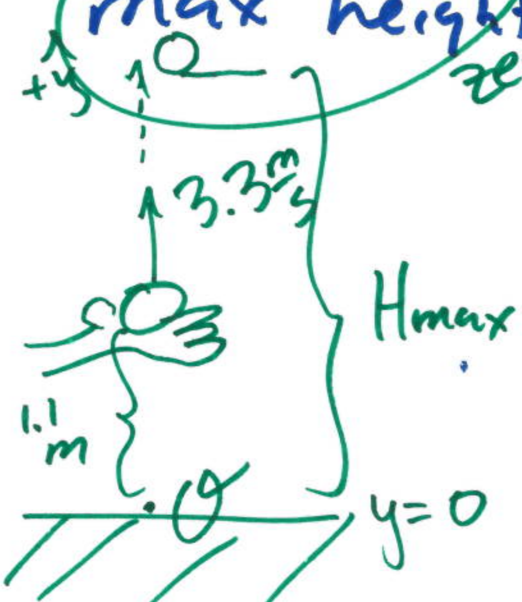


$$C = \sqrt{7.08^2 + 0.46^2} = 7.095$$

$$\theta_c = \mathrm{Tan}^{-1}\left(\frac{0.46}{7.08}\right) = 3.7°$$

Toss ball up from 1.1m high at 3.3 m/s. How high does it reach? (max H). Find time to max H. Find $\vec{v}$ at max height above the ground.

zero duh



$y(t) = H_{max}$ ★

$y_0 = 1.1\,m$

$v_0 = 3.3\,m/s$

$a = -9.8\,m/s^2$

$v(t) = 0$

$$(I)_y \quad v_y(t) = v_{oy} - gt \;\; ★$$

$$0 = 3.3\tfrac{m}{s} - 9.8\tfrac{m}{s^2}t$$

$$\frac{-3.3\,m/s}{-9.8\,m/s^2} = t = 0.34\,s = \boxed{0.337\,s}$$

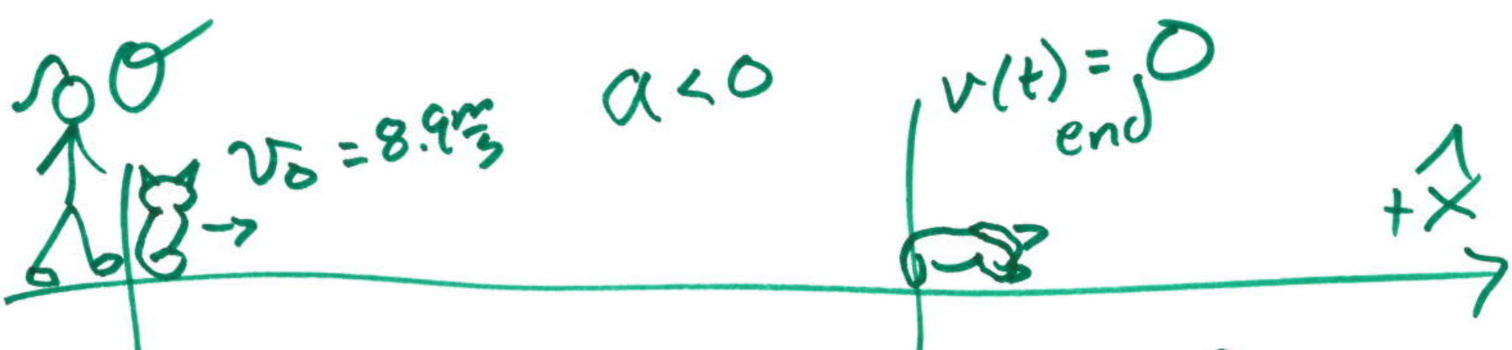
$(\mathrm{II})_y$ $\quad y(t) = y_0 + v_0 t - \frac{1}{2} g t^2$

$$H_{max} = 1.1\,m + 3.3\,\tfrac{m}{s}(0.337\,s) - 4.9\,\tfrac{m}{s^2}(0.337)^2$$

$$H_{max} = 1.1\,m + 1.11\,m - 0.556\,m$$

$$H_{max} = 1.66\,m$$

Yulia kicks a stuffed cat at $8.9\,\frac{m}{s}$ across floor. It comes to rest 13.9 m away. Assume const. a. What is $\vec{a}$?. How long (time) does it take?



$x_0 = 0$ $\qquad\qquad\qquad\qquad$ $x(t) = 13.9\,m$

know		want
x_0	$x(t)$	a
v_0	$V(t)$	t

(III) $v^2(t) = v_0^2 + 2a\left(\cancel{y}x(t) - x_0\right)$

$$0 = \left(8.9\tfrac{m}{s}\right)^2 + 2a\left(13.9m - 0\right)$$

$$\frac{-\left(8.9\tfrac{m}{s}\right)^2}{2\left(13.9m\right)} = \boxed{a = -2.85\tfrac{m}{s^2}}$$

time?

(I) $v(t) = v_0 + at$

$$0 = 8.9\tfrac{m}{s} - 2.85\tfrac{m}{s^2}\,t$$

$$\frac{-8.9\tfrac{m}{s}}{-2.85\tfrac{m}{s^2}} = \boxed{t = 3.12\,s}$$