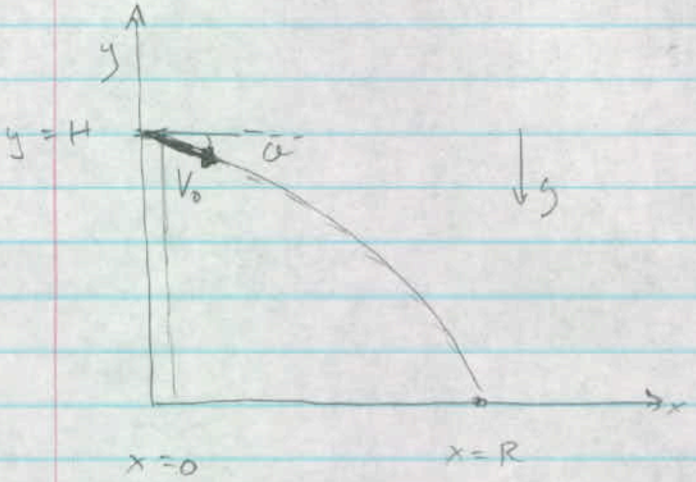
①

$\boxed{\#1}$



$\vec{V}_0 = (V_{0x}, -V_{0y})$,

$V_{0x} = (10)\cos(30°) = 8.7 \text{ m/s}$

$V_{0y} = -(10)\sin(30°) = -5 \text{ m/s}$

$y(t) = -V_{0y}t - \frac{1}{2}gt^2 + H \quad ; \quad x(t) = V_{0x}t$

We want to Range (when $y = 0$):

$t(x) = x/V_{0x}$; $y(t(x)) = H - \frac{V_{0y}x}{V_{0x}} - \frac{1}{2}g\frac{x^2}{V_{0x}^2} = y(x)$

At zero height: $y(x=R) = 0$, then

$$\underbrace{R^2\left(\frac{g}{2V_{0x}^2}\right)}_{a} + \underbrace{R\left(\frac{V_{0y}}{V_{0x}}\right)}_{b} \underbrace{- H}_{c} = 0 \quad w/$$

$a = \frac{g}{2V_{0x}^2} = \frac{9.8}{2(8.7)^2} = 0.0647$

$b = \frac{V_{0y}}{V_{0x}} = \frac{\cancel{V_0}\sin(30°)}{\cancel{V_0}\cos(30°)} = \tan(30°) = \frac{1}{\sqrt{3}}$

$c = -H = -30$

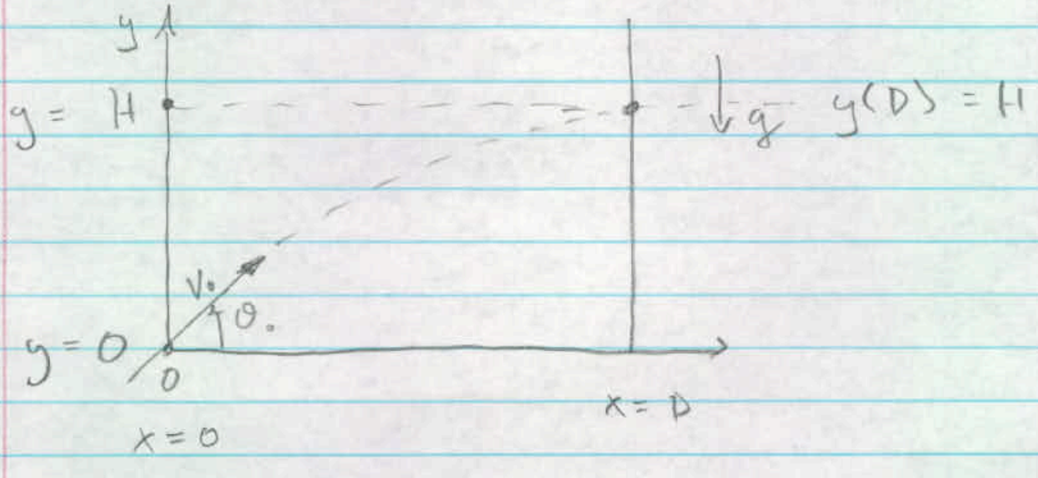
Using the Quadratic Formula:

$$x = \frac{-b \pm (b^2 - 4ac)}{2a} \quad , \text{ we have}$$

$$R = \frac{-1/\sqrt{3} \pm \left(1/3 + 4H \cdot 0.0647\right)^{\frac{1}{2}}}{2 \cdot 0.0647}$$

$$R = \frac{-1/\sqrt{3} \pm 2.84}{0.1294} = \frac{-1/\sqrt{3} + 2.84}{0.1294} = \boxed{177 \text{ m}}$$

#2



$$y(t) = V_{0y} t - \tfrac{1}{2} g t^2 \quad , \quad x(t) = V_{0x} t$$

As before, $t(x) = x/V_{0x}$, $y(t(x)) = y(x) \Rightarrow$

$$y(x) = \frac{V_{0y} x}{V_{0x}} - \frac{1}{2} g \frac{x^2}{V_{0x}^2}$$

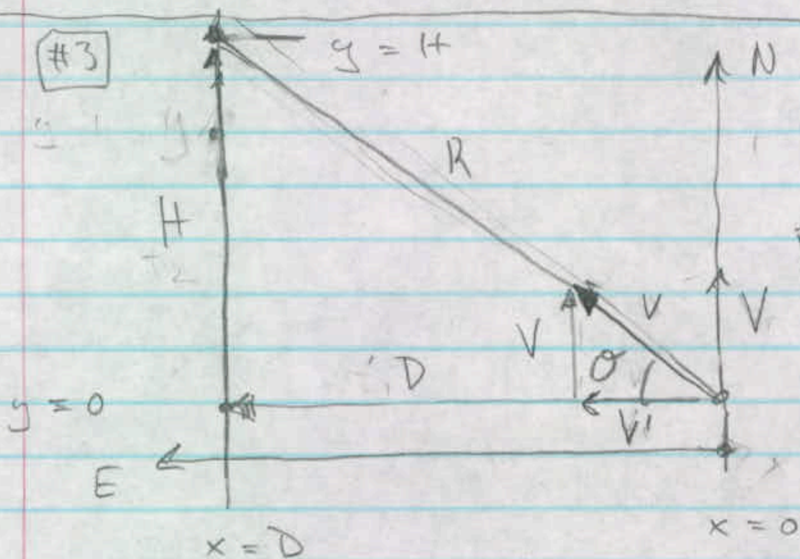
#2 - cont'd So at $x = D$:

$$y(x=D) = \tan(\theta_0)D - \left(\frac{1}{2}g\right)\frac{D^2}{V_0^2\cos^2(\theta_0)} = H$$

$$H = 27.15\text{m} - \frac{8561.5\text{ m}}{1282.4}$$

$$H = 27.15 - 6.675 = \boxed{20.5\text{ m} = H}$$

#3



$\vec{v}' = 4\,\text{m/s}\ \hat{x}$

$\vec{V} = 7\,\text{m/s}\ \hat{y}$

$\tan(\theta) = \frac{V}{v'} = \frac{7}{4} \Rightarrow$

$\theta = 60.3°$

Relative to the ground, the swimmer's velocity is: $\vec{v} = \vec{V} + \vec{v}'$ where

$\vec{v}'$ = swimmer relative to the river $= (v_x', 0)$

$\vec{V}$ = velocity of river relative to ground $= (0, V_y)$

$\vec{v}$ = swimmer relative to ground $= (v_x', V_y)$

$\boxed{\#\text{-}3\text{-cont.}}$ total velocity: $V = \sqrt{V^2 + V'^2} = \sqrt{V_x^2 + V_y^2}$

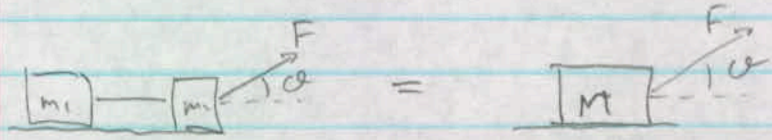
$V = 8.06$ m/sec & distance one must travel a

distance: $R = D / \cos(\theta) = 80 / \tfrac{1}{2} = 160$ m.

Time, $t = R/v = 160/8 = \boxed{20 \text{ sec} = t}$

$\boxed{\#4}$

Both Boxes have equal accelerations due to the rope. Thus consider the it as a single particle w/ $M = m_1 + m_2$.

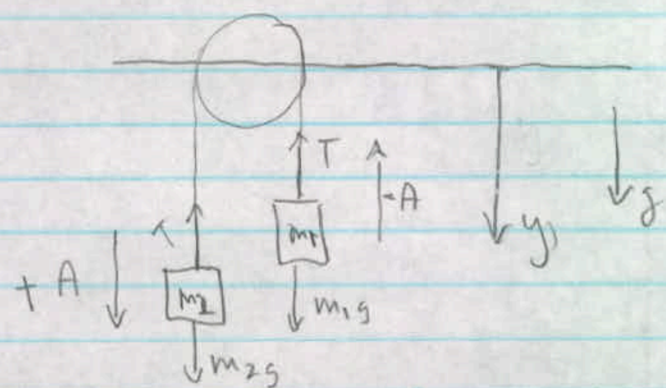


$A_x = F_x / M = \dfrac{30N \cos(37°)}{4 kg} = \boxed{6 \text{ m/s}}$

$\boxed{\#5}$

$m_1 g = 250$ N

$m_2 g = 350$N



Since the string has a fixed length: $\Delta y_1 = -\Delta y_2$. $(\Delta l_{string} = \Delta y_1 + \Delta y_2 = 0)$.

#5 - cont.

Thus they have equal but opposite accelerations. We have (positive $\hat{y}$ is down):

$$\left.\begin{array}{l} (-m_1 A = m_1 g - T) \\ (m_2 A = m_2 g - T) \end{array}\right\} \text{ 2 equations, } \underline{1} \text{ unknown } (\vec{T})$$

<u>Eliminate A</u> : $A = \frac{1}{m_2}(m_2 g - T)$;

$-m_1 \frac{1}{m_2}(m_2 g - T) = m_1 g - T$; <u>Solve for</u> T :

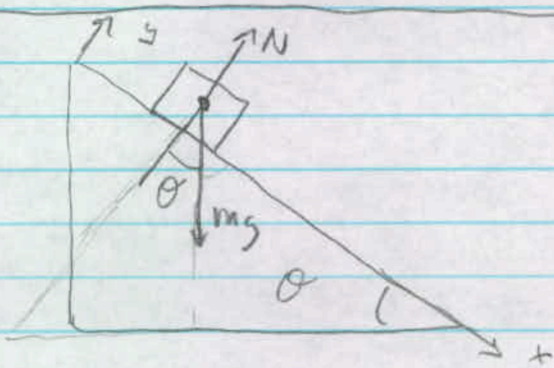
$-m_1 g + \frac{m_1 T}{m_2} = m_1 g \mp T$; $T\left(\frac{m_1}{m_2} + T\right) - m_1 g = m_1 g$

$T\left(+\frac{m_1}{m_2} + 1\right) = +m_1 g + m_1 g = 2m_1 g$

$T = 2m_1 g / (1 + m_1/m_2)$

$T = 2 \cdot 250 / (1 + 250/350) = \boxed{291 N}$

#6



<u>No Friction!</u>

#6-cont. We have $x(t) = v_{0x}t + \frac{1}{2}a_x t^2 = \frac{1}{2}a_x t^2$

& $v_x(t) = a_x t$ w/ $F_x = \cancel{m}g\sin(\theta) = \cancel{m}a_x$.

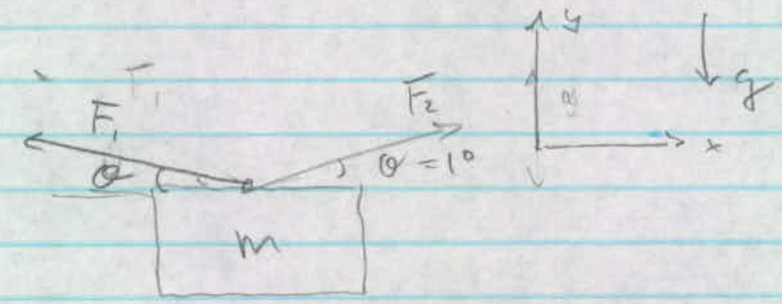
Then, $x = \frac{1}{2}a_x t^2 \Rightarrow t(x) = \left(\frac{2x}{a_x}\right)^{1/2}$

& we have $v_x(t(x)) = v_x(x) = a_x\left(\frac{2x}{a_x}\right)^{1/2}$

$v_x(x) = \sqrt{2x\,a_x}$. $a_x = 4.14$, $x = 5$

$\boxed{v_x(5) = 6.4\ m/s}$

#7



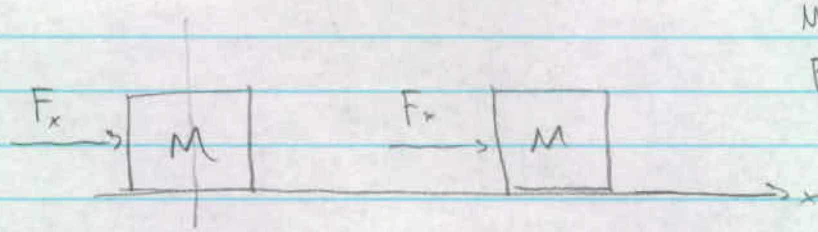
The two large forces (F_1 & F_2) act on the massless cable. Tensions are equal & so $T = F_1 = F_2$ since the angles are equal ($F_x = 0 = F_2\cos(\theta) - F_1\cos(\theta)$).

$F_y = 0 \Rightarrow 2T\sin(1°) = mg \Rightarrow \boxed{T = 281\,N}$.

Δt

#8

$M = 16\ Kg$
$F = 8N$
$\Delta t = 4 sec$



· Just constant acceloration (F_x = const. = ma_x)

giving $F_x = M a_x \Rightarrow a_x = \frac{F_x}{M} = \frac{1}{2}\ m/sec^2$

B $a_x = \frac{\Delta V_x}{\Delta t} = \frac{Vf_x - 0}{4} \Rightarrow Vf_x = (4 \cdot a_x)\ m/s$

$\boxed{Vf_x = 2\ m/s}$.