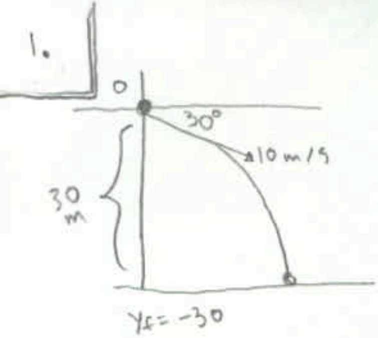
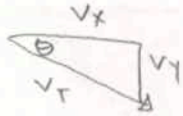
1.



free to choose, but
keep your positive and negative signs consistent!!!
here say going ↓ is negative.



How long does it take to hit the ground? Interested in y motion and y velocity, not x.

$V_{y0} = V_T \sin\theta$

$V_{y0} = 10\frac{m}{s} \sin 30 = 5 \, m/s$ → but going down so $\underline{V_{y0} = -5 \, m/s}$!

$a = -9.8 \, m/s^2$
$y_f = -30 \, m$
$y_0 = 0 \, m$
$V_{0y} = -5 \, m/s$

} see how they are all negative? what does that mean...?

$y_f - y_0 = V_{0y} t + \frac{1}{2} a t^2$

$(-30-0) m = -5\frac{m}{s} \cdot t + \frac{1}{2}(-9.8\frac{m}{s^2}) t^2$

$4.9\frac{m}{s^2} t^2 + 5\frac{m}{s} t - 30_m = 0$

(leave aside units for now, will get t in units of s)

$4.9t^2 + 5t - 30 = 0$

looks like $at^2 + bt + c = 0$

which has 2 solutions → $t = \dfrac{-b - \sqrt{b^2 - 4ac}}{2a}$ and $\dfrac{-b + \sqrt{b^2 - 4ac}}{2a}$

↓ negative time, don't count that

↓ positive time makes sense, go with it.

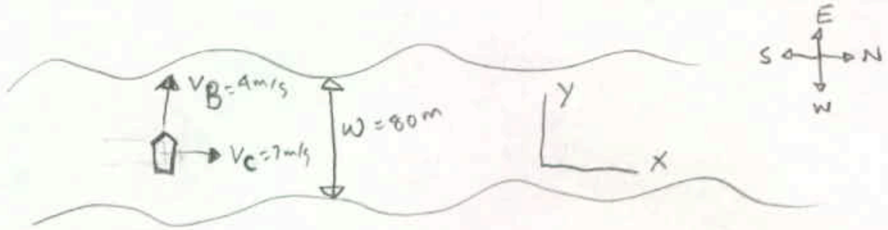
$a = 4.9, \quad b = 5, \quad c = -30$

$t = \dfrac{-b + \sqrt{b^2 - 4ac}}{2a}$ (seconds)

$t = \dfrac{-5 + \sqrt{25 + 4(4.9)(30)}}{2(4.9)} s = \dfrac{-5 + \sqrt{613}}{9.8} s$

$t = 2.0 s$

2.



How far does the boat go downstream, ie - what is its total $\underline{X}$ displacement?

width of river $= w$

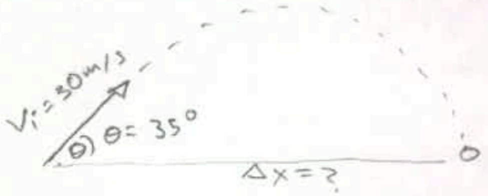
time it takes to cross river $= t = \frac{w}{V_B}$

in time t, how far does the boat travel in the x-direction, aka downstream?

$\Delta x = t \cdot V_c$

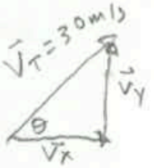
$\Delta x = \frac{w \cdot V_c}{V_B} = 80 \cdot \frac{7}{4}$ m $= 140$ m

3.



How far does ball travel in x direction?

① • Split your velocity into x, y components.
② • Determine how long it is in the air (with V_y)
③ • Plug that time into your velocity, distance equation for Δx



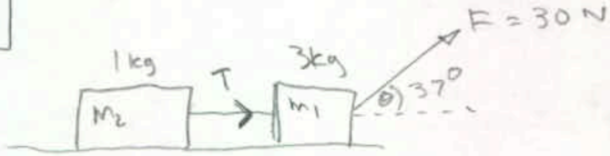
① $\vec{V}_x = V_T \cos\theta = 30\,m/s \cos(35°) = 24.6\,m/s$
$\vec{V}_y = V_T \sin\theta = 30\,m/s \sin(35°) = 17.2\,m/s$

② time to reach top of arc
$\rightarrow t_1 \Rightarrow$
$v_{yf} = V_{y0} + a_y t$
$-v_{y0} = a_y t$
$t_1 = \frac{-V_{y0}}{a_y} = \frac{17.2\,m/s}{9.8\,m/s^2} = 1.76\,s$

t_2 is time to fall down $= t_1$
total t, $t = t_1 + t_2 = 2 \cdot 1.76\,s = 3.52\,s$ in the air

③ $\Delta x = V_x t$
$\Delta x = 24.6\,\frac{m}{s} \cdot 3.52\,s = 86\,m$

4.



$F = ma$

$F_x = m_T a_x$

$F_x = F\cos 37 = 23.96\ N$

$m_T = m_1 + m_2$

$a_x = \dfrac{F_x}{m_T} = \dfrac{23.96\ N}{1kg + 3kg} = 5.99\ m/s^2$

the boxes are both accelerating at $5.99\ m/s^2$ since the rope is taught.

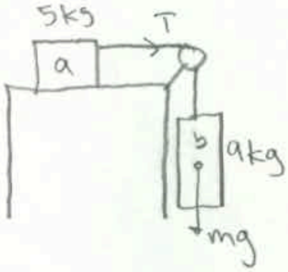
the only thing touching box of m_2 is the rope, so it must be the force in the rope - the tension - that is pulling it.

$F_2 = m_2 a_2$

$T = m_2 a_2$

$T = 1kg \cdot 5.99\ m/s^2 = 5.99\ N \simeq 6\ N$

5.



$F_y = m_b g$

$F_y = 9\,kg \times 9.8\ m/s^2$

$F_y = 88.2\ N$

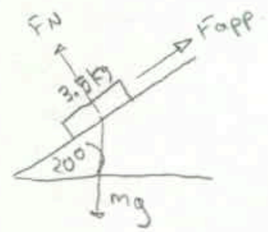
$a = \frac{F}{m_T} = \frac{88.2\ N}{(5+9)\,kg} = 6.3\ m/s^2$

(both blocks accelerate at the same rate.)

$T = m_a a$

$T = 5\,kg\,(6.3\ m/s^2) \approx 32\ N$

6.



Forces acting on box →

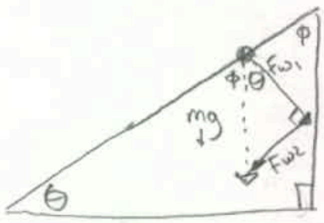
$w = mg$

F_{app}

F_{normal} ~ (not important)

velocity along the ramp is constant.
Therefore there is no acceleration along the ramp and the net force $= 0$

Break gravitational force $= mg$ into component vectors, one acting parrallel to F_{app}



$F_{w1} = mg\cos\theta$ (= normal force, not important here since there is no friction)

$F_{w2} = mg\sin\theta$

On the surface of the ramp

$\Sigma F = F_{app} + F_{w2}$

$\Sigma F = F_{app} - F_{w2} = 0$

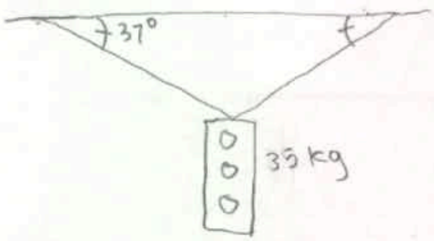
(acts in opposite direction)

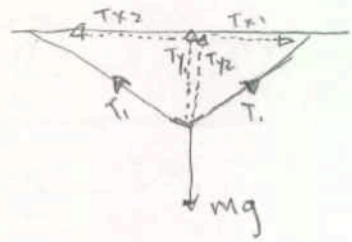
$F_{app} = F_{w2}$

$F_{app} = mg\sin\theta = 3.5\,kg \cdot 9.8\frac{m}{s^2} \cdot \sin(20°)$

$F_{app} = 11.7\ N$

7.





Each Tension can be split into 2 components T_x and T_y. The T_xs cancel each other out since they point in opposite directions and have equal magnitude, (same magnitude because same angle.) The T_ys add up since they act in the same direction.

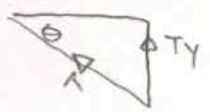
Therefore, $\Sigma F_y = 2T_y - mg$

where $g = +9.8\ m/s^2$ (the magnitude of gravitational acceleration,) and the minus sign indicates it acts oppositely to T_y.

But since nothing is moving

$$\Sigma F_y = 0 = 2T_y - mg$$
$$2T_y = mg$$
$$T_y = \frac{mg}{2}$$

use trig



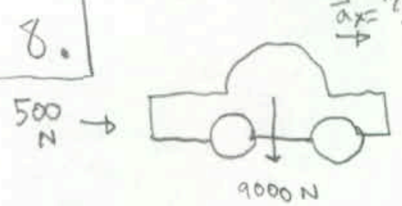
$$\sin\theta = \frac{T_y}{T}$$

$$T = \frac{T_y}{\sin\theta}$$

$$T = \frac{mg}{2\sin\theta} = \frac{(35kg)(9.8\ m/s^2)}{2\sin(37)}$$

$$T = 285\ N$$

8.



9000 N automobile.

N means force. In this case it is weight.

$W = mg$

$9000\ N = m(9.8\ m/s^2)$

$m = 918\ kg$

$F_x = 500\ N$

$F_x = ma_x$

$918\ kg\, a_x = 500\ N$

$a_x = \frac{500\ N}{918\ kg} = .54\ m/s^2$