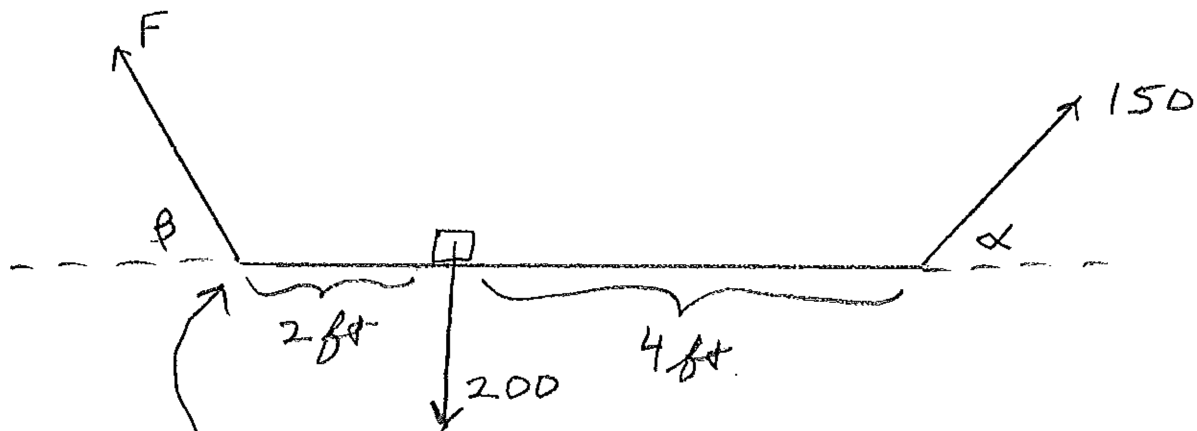
Solutions to HWK 2

(1)



Sum of Torques about left end $= F(0) - 2(200) + 6(150)\sin\alpha = 0$

$$\sin\alpha = \frac{400}{900} \Rightarrow \boxed{\alpha = 26.4^\circ}$$

Sum of Forces in horizontal direction (ΣF_x) $= 150\cos(26.4) - F\cos\beta = 0$

$$F\cos\beta = 134.4$$

Sum of Forces in vertical direction (ΣF_y) $= F\sin\beta + 150\sin(26.4) - 200 = 0$

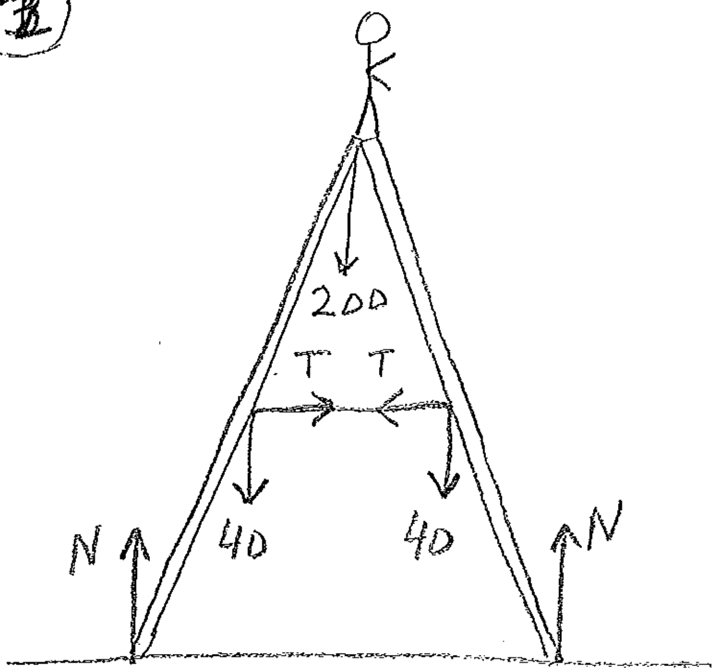
$$F\sin\beta = 133.3$$

$$\frac{F\sin\beta}{F\cos\beta} = \frac{133.3}{134.4}$$

$$\tan\beta = \frac{133.3}{134.4} \Rightarrow \boxed{\beta \simeq 44.8^\circ}$$

$$F = \frac{133.3}{\sin(44.8^\circ)} = \boxed{189 \text{ lbs}}$$

2

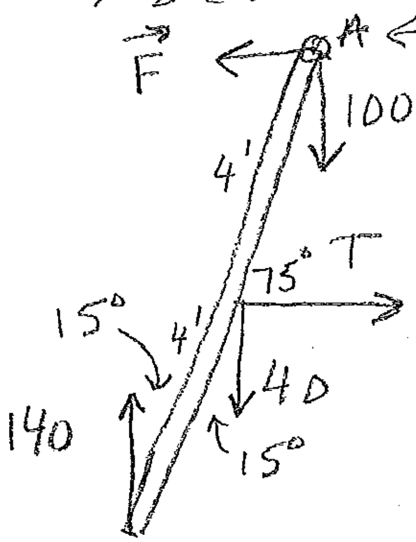


Since the forces must add to zero,

$2N = 280$ lbs

$N = 140$ lbs

one side:



The sum of the torques about A $= +4T\sin 75° + 4(40)\sin 15° - 8(140)\sin 15° = 0$

$$T = \frac{8(140)\sin 15 - 4(40)\sin 15}{4\sin 75°}$$

$$\boxed{T = 64.3 \text{ lbs}}$$

③ assuming v is constant,

$$x = vt$$

$$t = \frac{x}{v}$$

$$t = \frac{18.4\,m}{v}$$

$$v = 160\,\frac{km}{hr}\left(\frac{1000\,m}{1\,km}\right)\left(\frac{1\,hr}{3600\,sec}\right)$$

$$v = 160\left(\frac{1000}{3600}\right)\frac{m}{s}$$

$$v \simeq 44.4\ m/s$$

$$t = \frac{18.4\,m}{44.4\ m/s}$$

$$\boxed{t \simeq .414\ sec}$$

Too short of a time to hit the ball

(4)

$$85\ mph = 85\ \cancel{mph}\left(\frac{88\ ft/s}{60\ \cancel{mph}}\right) = 124.7\ ft/s$$

$$65\ mph = 65\ \cancel{mph}\left(\frac{88\ ft/s}{60\ \cancel{mph}}\right) = 95.3\ ft/s$$

a) $v = v_0 + at$

$$t = \frac{v - v_0}{a} = \frac{(95.3 - 124.7)\ ft/s}{-17\ ft/s^2} = \boxed{1.73\ sec}$$

b) ~~Since~~ $v^2 = v_0^2 + 2a(x - x_0)$

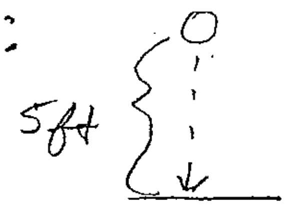
$$x - x_0 = \frac{v^2 - v_0^2}{2a}$$

$$x - x_0 = \left(\frac{95.3^2 - 124.7^2}{2(-17)\ ft/s^2}\right)(ft/s)^2$$

$$\boxed{x - x_0 = 190\ ft}$$

You travel quite far

(5) The time it takes an object to fall 5 feet is:



$$x = \frac{a}{2}t^2$$

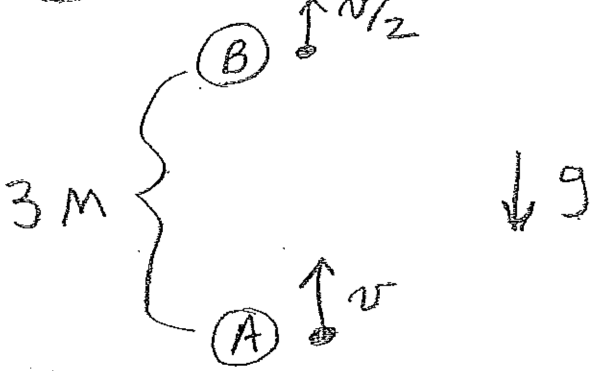
$$5\,ft = \frac{32\,ft/s^2}{2}\,t^2$$

$$t = \sqrt{\frac{10}{32}}\ sec \approx .559\ sec$$

Since the time to go up is the same as the time to come down, the total "hang-time" is

$$2(.559) = \boxed{1.12\ sec}$$

(6)



$$\left(\frac{v}{2}\right)^2 = v^2 - 2g3$$

$$\frac{v^2}{4} = v^2 - 2(9.8)3$$

$$2(9.8)\cancel{3} = \frac{\cancel{3}}{4}v^2$$

$$v = \sqrt{2(9.8)4} = \boxed{8.85\ M/s}$$

7. $a = 4t$

a) $\frac{dv}{dt} = a = 4t$

$\int dv = \int 4t\,dt = \frac{4t^2}{2} = 2t^2 + C$

$v = 2t^2 + C \qquad v(t=0) = 0 \Rightarrow C = 0$

$\boxed{v = 2t^2}$

$v(t=3) = 2(3)^2 = \boxed{18\ m/s}$

b) $\frac{dx}{dt} = 2t^2$

$\int dx = \int 2t^2\,dt = \frac{2t^3}{3} + C$

$x = \frac{2}{3}t^3 + C \qquad x(t=0) = 0 \Rightarrow C = 0$

$\boxed{x = \frac{2}{3}t^3}$

$x(t=3) = \frac{2}{3}(3)^3 = \boxed{18\ m}$

c) $v = 2t^2 \Rightarrow 8 = 2t^2 \Rightarrow t = 2\ sec$

$x = \frac{2}{3}t^3$

$x = \frac{2}{3}(2)^3 = \boxed{\frac{16}{3}\ m}$

B Let d be the ... of ... Sacramento.

a) Let t_A be the total time from L.A. to Sacramento.

$$d = 60\left(\frac{t_A}{2}\right) + 90\left(\frac{t_A}{2}\right)$$

so the average velocity to Sacramento is

$$\bar{v}_A = \frac{d}{t_A} = \frac{60}{2} + \frac{90}{2} = \frac{60+90}{2} = \boxed{75\ \mathrm{KM/hr}}$$

(b) From Sacramento to L.A.

$$t_1 = \frac{d/2}{60} \qquad t_2 = \frac{d/2}{90}$$

So the total time, t_B, from Sacramento to L.A. is $t_B = t_1 + t_2$

or $$t_B = \frac{d}{2(60)} + \frac{d}{2(90)} = \frac{d}{2}\left(\frac{1}{60} + \frac{1}{90}\right)$$

So $$\bar{v}_B = \frac{d}{t_B} = \frac{2}{\frac{1}{60} + \frac{1}{90}} = \frac{2(60)(90)}{90+60} = \boxed{72\ \frac{\mathrm{KM}}{\mathrm{hr}}}$$

(c) The total time for the trip is

$$t = \frac{d}{75} + \frac{d}{72},$$ so the average

velocity is $$\bar{v} = \frac{2d}{t} = \frac{2d}{\frac{d}{75} + \frac{d}{72}}$$

$$\bar{v} = \frac{2}{\frac{1}{75} + \frac{1}{72}} = \frac{2(75)(72)}{75+72} = \boxed{73.47\ \mathrm{Km/hr}}$$

(6) (a) $a = \frac{dv}{dt} = \frac{d}{dt}\left(11(1-e^{-t})\right)$

$a = 11e^{-t}$ m/s²

at $t = 10$ seconds

$a = 11e^{-10} \approx \boxed{.0005 \ m/s^2}$

(b) $\frac{dx}{dt} = 11(1-e^{-t}) = 11 - 11e^{-t}$

$\int_0^x dx' = \int_0^t 11 - 11e^{-t'}\,dt'$

$x = 11t + 11e^{-t'}\Big|_0^t$

$\boxed{X(t) = 11t + 11e^{-t} - 11 \quad \text{meters}}$

(d) after 10 seconds, Ernie is

$X(10) = 110 + 11e^{-10} - 11$

$X(10) \simeq 99$ meters

Ernie does <u>not</u> run the 100 meters in under 10 seconds.