AP PHYSICS - CH 8

Q6: ASSUMING IT DOESNT DO ANYTHING NOW...
THE CURRENT $I_{EARTH} = I_{SPHERE} = \frac{2}{5} MR^2 = \frac{2}{5} M_E R_E^2$

$$I_{EARTH} = \frac{2}{5} (5.98 \times 10^{24} \text{ kg})(6.37 \times 10^6)^2 = 4.85 \times 10^{39} \text{ kg m}^2$$

WITH THE WATER DISTRIBUTED WE'D ADD ....

$$I_{SHELL} = \frac{2}{3} MR^2 = \frac{2}{3} (2.3 \times 10^{19})(6.37 \times 10^6)^2 = 6.22 \times 10^{32}$$

NOW THE WATER ADDS ONE PART IN 10 BILLION TO THE MOMENT OF INERTIA ... BY CONSERVATION OF ANGULAR MOMENTUM IF I CHANGES BY 1 IN 10 BILLION THE ANGULAR VELOCITY WILL CHANGE BY THE SAME AMOUNT.
SO OUT OF 24 HRS ... 24×10^{-10} HRS = 8.64 μS (THATS 8 MICRO SECONDS A DAY)

SLOW ROTATION

Q11:

BIG (ROUGHLY SPHERICAL) BUNCH OF GAS

CONDENSES IN ALL DIRECTIONS... (GRAVITY)

BECOMES A PANCAKE...

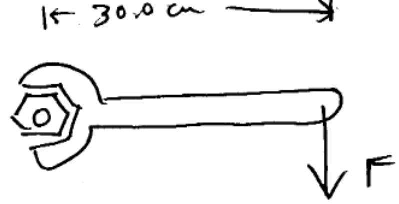
BECAUSE THE RADIAL DIRECTION IS HARDER TO MOVE ALONG (CENTRIPETAL..)

WHEN IT DOES CONDENSE IT SPEEDS UP (CONS OF ANG MOM)

...SOLAR SYSTEM!

FAST ROTATION!

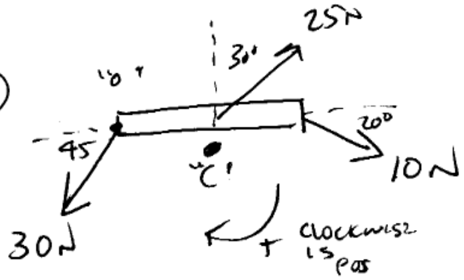
(1)



$$\tau = F \cdot d \Rightarrow F = \frac{\tau}{d} = \frac{40.0\ N\cdot m}{.30\ m}$$

$$F = 133\ N$$

(3) (a)



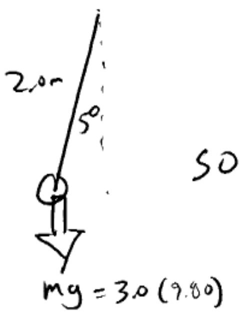
AROUND POINT "O" ....

$$\tau_{NET} = 10N(4m)\sin 20^\circ - 25N(2m)\cos 30^\circ$$
$$= 13.68 - 43.30$$
$$= -29.6\ N\cdot m$$

(b) AROUND POINT "C"

$$\tau_{NET} = 10N(2m)\sin 20^\circ - 30N(2m)\sin 45^\circ$$
$$6.84 - 42.43$$
$$= -35.6\ N\cdot m$$

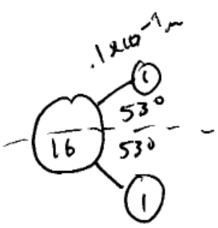
(5)



SO $\tau = F \cdot d \cdot \sin\theta = mg\ell\sin\theta = 3.0(9.80)(2.0)\sin 5^\circ$

$$\tau = 5.12\ N\cdot m$$

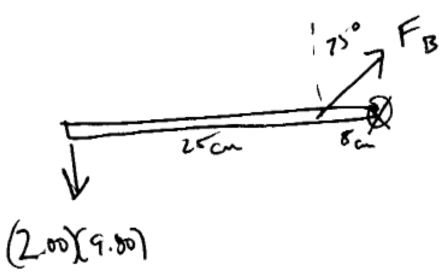
(8)



$$X_{cm} = \frac{16(0) + 2(.1\times10^{-9})\cos 53^\circ}{18} = 6.69\times10^{-12}\ m$$

SO PRACTICALLY INSIDE THE OXYGEN!

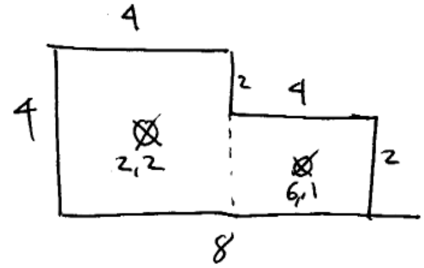
(9)



$$F_B\cos 75^\circ(8\ cm) = 19.6N(33\ cm)$$

$$F_B = 312N$$

(11)

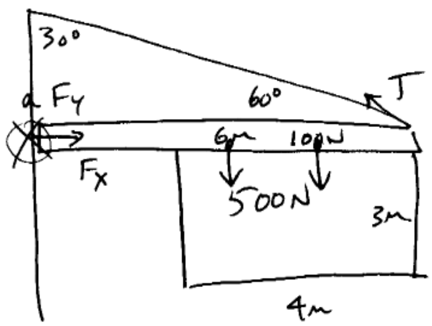


CUT IT INTO 2 BITS ...
ONE w/ CM AT 2,2 AND ONE AT 6,1

$$X_{cm} = \frac{\sum m_i X_i}{M} = \frac{16(2) + 8(6)}{24} = \frac{80}{24} = \frac{10}{3} = 3.33 \text{ ft}$$

$$Y_{cm} = \frac{\sum m_i Y_i}{M} = \frac{16(2) + 8(1)}{24} = \frac{40}{24} = \frac{5}{3} = 1.67 \text{ ft}$$

(17)



X-DIR

$$F_x = T\cos 60^\circ$$

Y-DIR

$$F_y + T\sin 60^\circ = W_B + W_s$$

TORQUE

$$T\sin 60^\circ (6m) = W_B(3m) + W_S(4m)$$

$$T\sin 60^\circ (6) = 300 + 2000$$

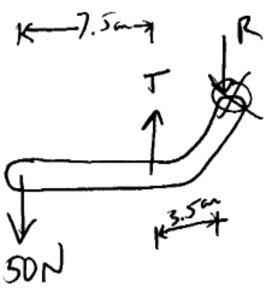
$$T = \frac{2300}{6\sin 60^\circ} = 443N$$ — SUB

$$F_x = (443)\cos 60^\circ = 222N$$

$$F_y + (443)\sin 60^\circ = 600N$$

$$F_y = 216N$$

(19)



Y-DIR

$$T = R + 50N$$

TORQUE

$$T(3.5) = 50(11cm)$$

$$T = \frac{550}{3.5} = 157N$$

$$157 = R + 50$$

$$R = 107N$$

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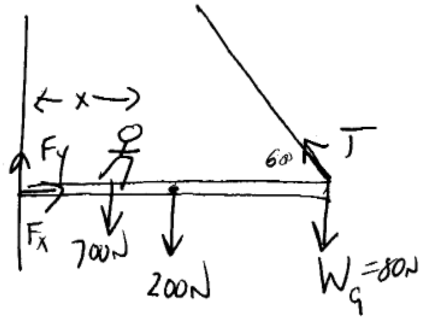

X-DIR

$T\cos 60^\circ \leftarrow \bullet \rightarrow F_x$ so $f_x = T\cos 60^\circ$

Y-DIR

$\uparrow F_y$
$\uparrow T\sin 60^\circ$
$\downarrow 700\,N$
$\downarrow 200\,N$
$\downarrow 80\,N$

so $F_y + T\sin 60^\circ = 980N$

TORQUE (PIVOT AT LEFT)

$$700(x) + 200(3m) + 80(6) = T\sin 60^\circ (6)$$

a) WITH $X = 1$ ...

$$700 + 600 + 480 = T\sin 60^\circ (6) \Rightarrow T = 343N$$

$F_x = 171N$ $\quad F_y = 683\,N$

b) IF $T = 900$ ....

$$700(x) + 600 + 480 = 900\sin 60^\circ (6)$$

$$700(x) + 1080 = 4676.5$$

$$X = 5.14\,m$$

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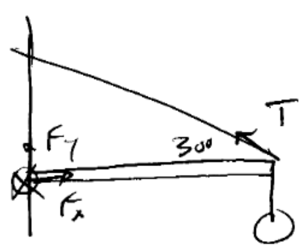


$F_x = T\cos 30^\circ$ $\qquad F_y + T\sin 30^\circ = mg$

$F_x = 392\cos 30^\circ = 339N$ $\qquad F_y + 392\sin 30 = mg$

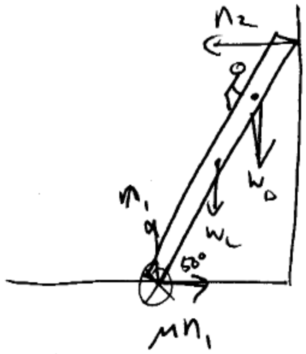
$F_y = 0$

$T\sin 30^\circ l = mgl$

$$T = \frac{mg}{\sin 30} = \frac{20(9.8)}{\sin 30^\circ} = 392N$$

SUB

(25)



$\mu n_1 = n_2$ $\qquad$ $n_1 = W_D + W_L$

$n_1 = 800 + 200 = 1000N$

$.6(1000) = 600N \leftarrow$ $n_1 = 1000N$

$n_2 = 600N$

THAT'S A TOUGHIE!

$$200(4)\cos 50° + 800(\ell)\cos 50° = n_2 \sin 50° (8)$$

$$800 \cos 50° + 800 \cos 50° \, \ell = 600 \sin 50° (8)$$

$$(1+\ell) = \frac{(8)600}{800} \tan 50° = 6 \tan 50°$$

$$\ell = 6 \tan 50° - 1 = 6.13\,m$$

(32)

$I = 12\ kg\ m^2$

50REV/MIN $= 5.23$ RAD/s

SLOWING TO $\omega = 0$ IN 6 s MEANS $\alpha = \frac{5.23}{6} = .872$ RAD/s^2

$$\tau = I\alpha = 12(.872) = 10.47\,N\cdot m$$

BUT WHERE IS THE TORQUE COMING FROM?

FRICTION!!! YOUR HAND PROVIDES THE NORMAL FORCE WHICH IS 70N SO $f = \mu(70)$

$$\tau = \mu(70)(.5) = 10.47$$

$$\mu = \frac{10.47}{35} = .3$$

(41) $W = 800N \Rightarrow m = 80\ kg$ ← YEAH, I'M LAZY

$$\tau = I\alpha$$

$$\alpha = \frac{\tau}{I} = \frac{F\cdot d}{I} = \frac{F\cdot d}{\frac{1}{2}mr^2} = \frac{50(1.5)}{\frac{1}{2}(80)(1.5)^2} = \frac{100}{80(1.5)} = \frac{100}{120} = .833\ kg\ m^2$$

$$\omega_f = \omega_i + \alpha t = .833(3) = 2.5\ \text{RAD/s}$$

$$K_R = \tfrac{1}{2}I\omega^2 = \tfrac{1}{2}(.833)(2.5)^2 = 2.60\,J$$

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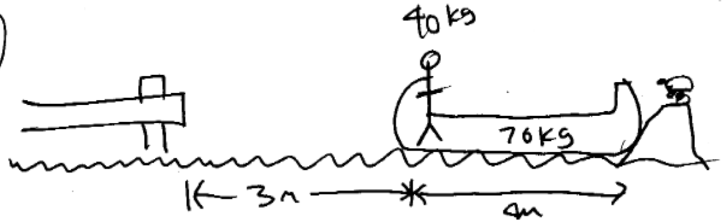
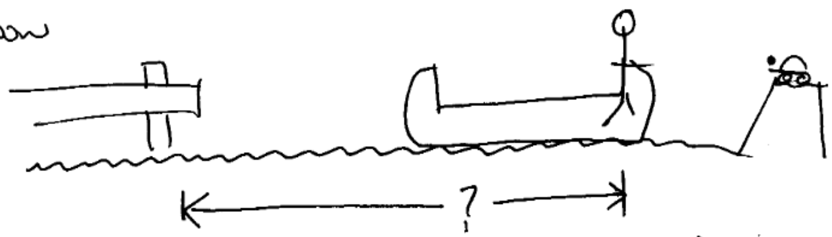


WHEN THE KID MOVES THE CM OF THE SYSTEM WILL NOT

WHERE IS THE CM?

$$X_{cm} = \frac{40(3) + 70(5)}{110} = \frac{470}{110}$$

NOW



$$X_{cm} = \frac{40(?) + 70(? - 2)}{110} = \frac{40? + 70? - 140}{110} = \frac{470}{110}$$

SO $110? - 140 = 470$

$110? = 610 = 5.54 \text{ m}$

MORE IMPORTANTLY FOR THE KID ... THE TURTLE IS AT 7 m AND HE/SHE WILL NEVER REACH IT! BOO HOO :(