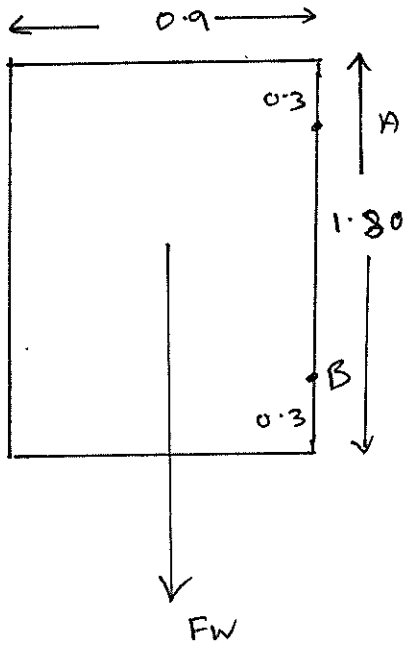
PHYSICS 12 JA 3B Set 5 Q 23-29

23/ Torques about A.



a) $\sum ACT = \sum CT$

$206 \times 0.45 = 1.8 \times F_B$

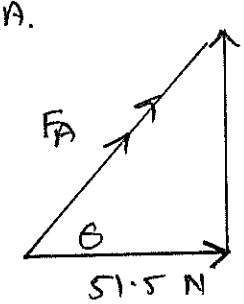
$F_B = 51.5$ N horizontally to Left.

b) To find force at A.

$\sum F_{Right} = \sum F_{left}$.

$F_A = 51.5$ N horizontaly to Right.

$F_{V\ at\ A} = 103$ N. vertical force at A.



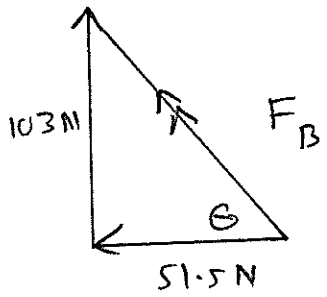
$R^2 = 103^2 + 51.5^2$

$F_A = R = \underline{115\ N\ at\ 63.4^\circ\ right.}$

$TAN\ \theta = \frac{103}{51.5}$

$\angle\theta = 63.4^\circ$

$F_B = \underline{115\ N\ at\ 63.4^\circ\ to\ left.}$

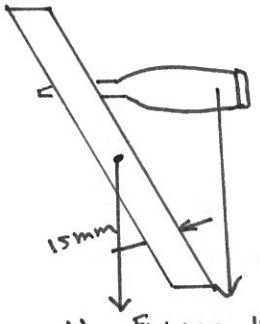


M.Grail

STAWA SET 5

Q 22.

WIDTH = 80 mm
Thickness = 15 mm
length = 200 mm

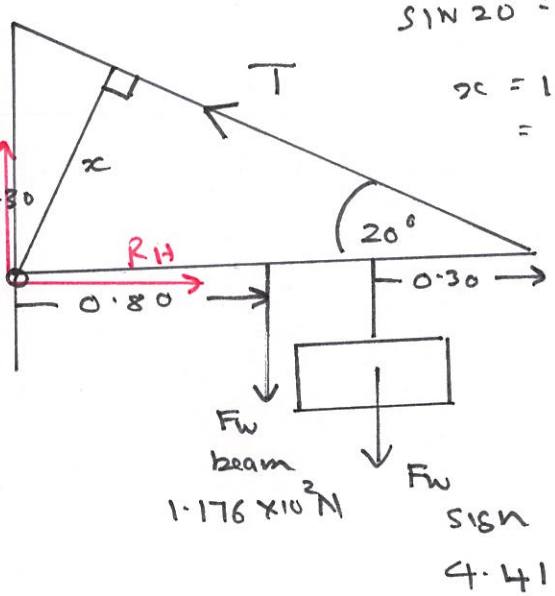


Torque generated by the bottle is balanced by the torque generated by the stand. Pivot point lies within the Fw wire wrack. base. Bottle size and mass must be such that the $F_{w(bottle)}$ can produce an clockwise torque to balance the weight. Overall centre of mass of the system (wrack + bottle must lie within the base) thus ensures No torque can be generated to topple the wrack + bottle. Not all bottles (different size)

Q24

Take moments about P.

$$\sum M_{AC} = \sum M_C$$



$\sin 20 = \frac{x}{1.60}$

$x = 1.60 \sin 20^\circ$
$= 0.5472322$

$T \times 1.60 \times \sin 20^\circ = 1.176 \times 10^2 \times 0.8 + 4.41 \times 10^2 \times 1.30$

$T \times 5.47 \times 10^{-1} = 9.408 \times 10^1 + 57.33 \times 10^1$

$T = \frac{667.38}{0.5472322}$

$= 1.2195 \times 10^3$ N ✓

1.176×10^2 N

4.41×10^2 N

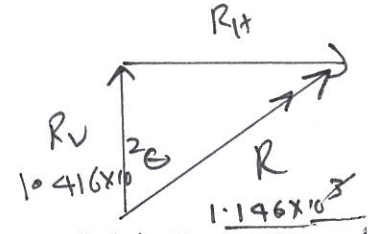
$R_H = T \cos 20^\circ$
$= 1.146 \times 10^3$ N → ✓

$\sum F_{up} = \sum F_{down}$

$R_V + T \sin 20^\circ = 1.176 \times 10^2 \text{ N} + 4.41 \times 10^2 \text{ N}$

$R_V + 4.17 \times 10^2 = 5.586 \times 10^2$

$R_V = 1.416 \times 10^2$ N ↑

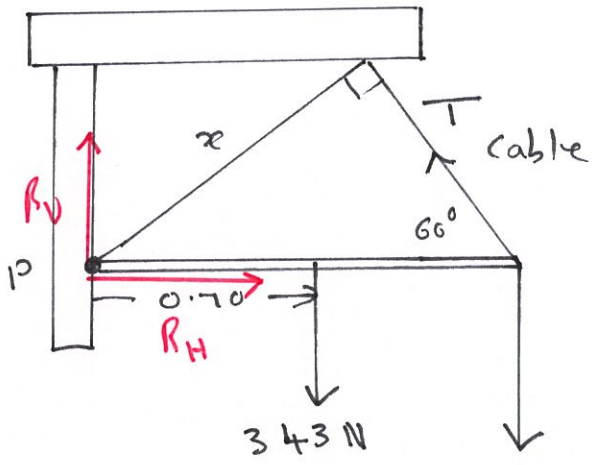


$R^2 = (1.416 \times 10^2)^2 + (1.146 \times 10^3)^2$

$R = 1.16 \times 10^3$ N at 7.04° above the horizontal. ✓

$\tan \theta = \frac{1.146 \times 10^3}{1.416 \times 10^2}$
$= 8.09322$
$= 82.96^\circ$

25/.



TAKE MOMENTS about P.

$$\sum M_{AC} = \sum M_C$$

$$T \times 1.212436 = 343 \times 0.7 + 500 \times 1.40$$

$$= 240.1 + 700$$

$$T = \frac{940.1}{1.212436}$$

$$= 775.3811 \text{ N}$$

$$= \underline{775 \text{ N}} \quad \checkmark$$

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

$$= 775.3811 \times \cos 60^\circ$$

$$= 387.6906 \text{ N} \rightarrow \quad \checkmark$$

$$\sum F_{up} = \sum F_{down}$$

$$R_V + T_V = 343 + 500$$

$$R_V + 775.3811 \times \sin 60^\circ = 843$$

$$R_V + 671.4997 = 843$$

$$R_V = 171.5 \text{ N} \uparrow$$

$$R^2 = (3.876906 \times 10^2)^2 + (1.715 \times 10^2)^2$$

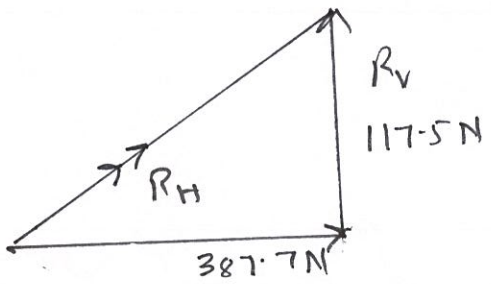
$$R = 423.9290 \text{ N}$$

at 23° above horizontal. $\checkmark$

$$\sin 60 = \frac{x}{1.40}$$

$$x = 1.40 \times \sin 60^\circ$$

$$x = 1.212436 \text{ m.}$$



$$\tan \theta = \frac{R_V}{R_H}$$

$$= \frac{171.5}{387.6906}$$

$$= 0.423631$$

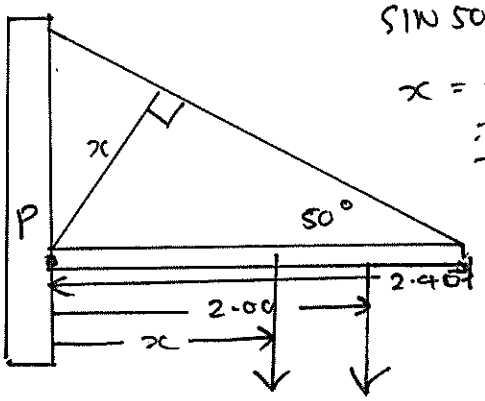
$$= 22.959^\circ$$

26/.

Breaking tension = 1.36×10^3 N.

Take moments about point P.

$\sum M_C = \sum M_{AC}$



$\sin 50^\circ = \frac{x}{2.4}$

$x = 2.4 \times \sin 50^\circ$

$= 1.838507$

From 50×9.8

$F_{beam} = 490$ N

$735x + 490 \times 2.00 = 1.36 \times 10^3 \times 1.838507$

$735x + 980 = 2.50037 \times 10^3$

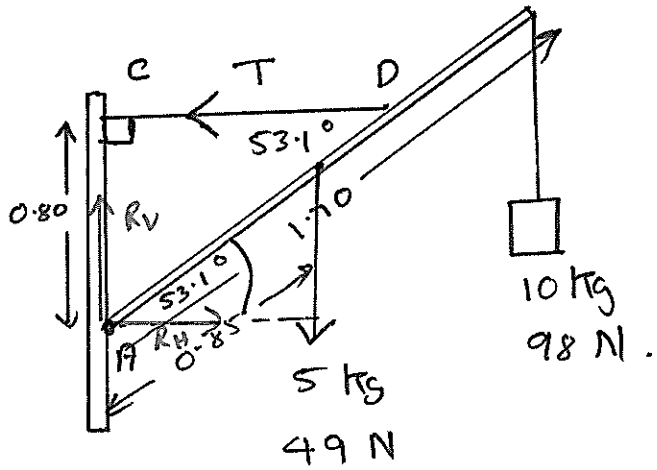
$x = \frac{1.52037 \times 10^3}{735}$

$= 2.0685$ m

$= 2.07$ m.

Set 5

27/



TAKE Moments about point A.

$$\sum T_{AC} = \sum T_C$$

$$T \times 0.80 = 49 \times 0.85 \times \cos 53.1 + 98 \times 1.70 \times \cos 53.1$$

$$0.80\,T = 25.0075 + 100.03$$

$$T = \frac{125.0375}{0.8}$$

$$= 156.3 \text{ N}$$

$$= 156 \text{ N}$$

$R_H = T = 156.3$ N →

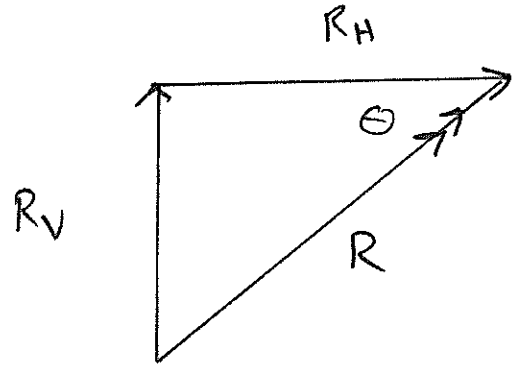
$R_V = 49 + 98$

$= 147$ N ↑

$R^2 = 147^2 + 156.3^2$

$R = 214.5663$ N

$R = 215$ N at 43.2° above the horizontal. ✓



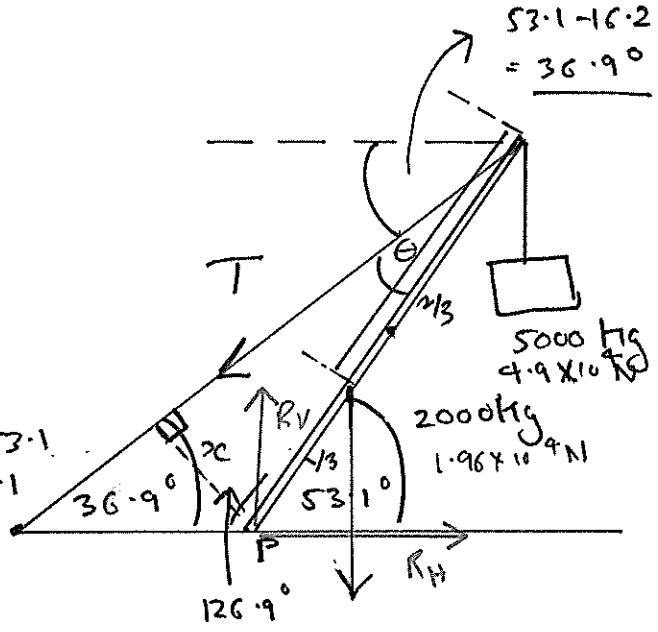
$$\tan\theta = \frac{147}{156.3}$$

$$= 0.940499$$

$$\angle\theta = 43.2437^\circ$$

Set 5 Q 28

Let length of boom be 1.



Take moments about base of boom. P

$$\sum M_A = \sum M_C$$

$$T \times 0.2789911 = 2000 \times 9.8 \times 0.333 \times \cos 53.1 + 5000 \times 9.8 \times 1 \times \cos 53.1$$

$$0.2789911\,T = 3918.823 + 29420.59$$

$$T = \frac{33339.41}{0.2789911}$$

$$= 1.1999 \times 10^5 \text{ N}$$

$$= 1.20 \times 10^5 \text{ N}$$

$$R_H = T \cos 36.9$$

$$= 1.1999 \times 10^5 \times 0.7996847$$

$$= 9.555 \times 10^4 \text{ N} \rightarrow$$

$$\theta = 180 - (36.9 + 126.9)$$

$$\theta = 16.2^\circ$$

$$\sin\theta = \frac{x}{1}$$

$$x = \sin 16.2 \times 1$$

$$= 0.2789911$$

$$R_V = 2000 \times 9.8 + 5000 \times 9.8 + T \sin 36.9^\circ$$

$$= 19600 + 49000 + 1.1949 \times 10^5 \times 0.6009202$$

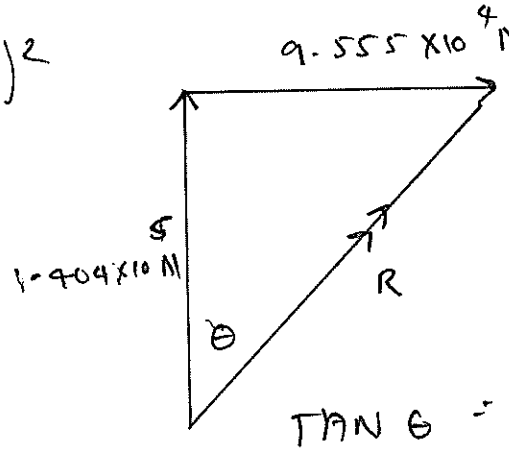
$$= 19600 + 49000 + 71744.21$$

$$R_V = 1.40 \times 10^5 \text{ N} \uparrow$$

$$R^2 = (1.404 \times 10^5)^2 + (9.555 \times 10^4)^2$$

$$R = 1.70 \times 10^5 \text{ N at}$$

55.7° above the horizontal.



$$\tan\theta = \frac{9.629 \times 10^4}{1.404 \times 10^5}$$

$$= 0.68547$$

$$\theta = 34.4^\circ$$

Set 5

Q 29. a)

TAKE MOMENTS about point P.

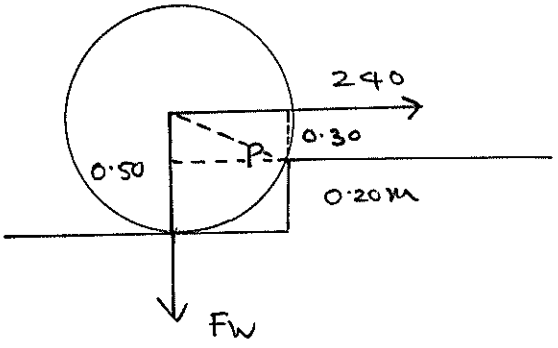
$$\sum M_{AC} = \sum M_C$$

$$F_W \times 0.40 = 240 \times 0.3$$

$$F_W = 180 \text{ N}$$

$$m = 18.37 \text{ kg}$$

$$M_{\text{metal wheel}} = 18.4 \text{ kg}$$



b) Take moments about point P.

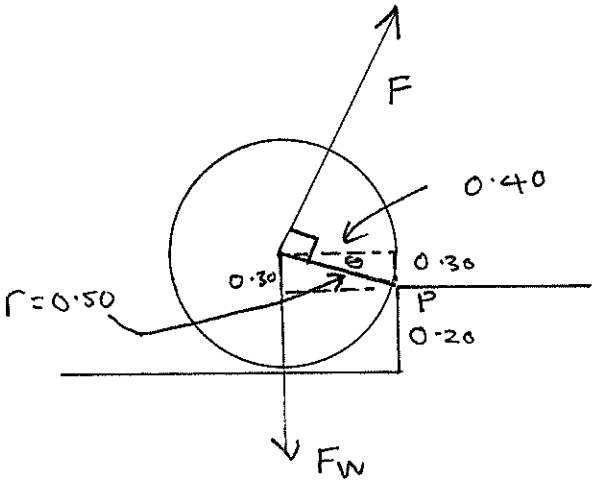
$$\sum M_C = \sum M_{AC}$$

$$F \times 0.50 = F_W \times 0.40$$

$$F = \frac{180 \times 0.40}{0.50}$$

$$= 144 \text{ N}$$

at 53.13° above the horizontal. ✓



$$\sin\theta = \frac{0.3}{0.5}$$

$$= 0.60$$

$$\sin^{-1} = 36.8699^\circ$$

$$90^\circ - 36.8699$$

$$53.13^\circ$$