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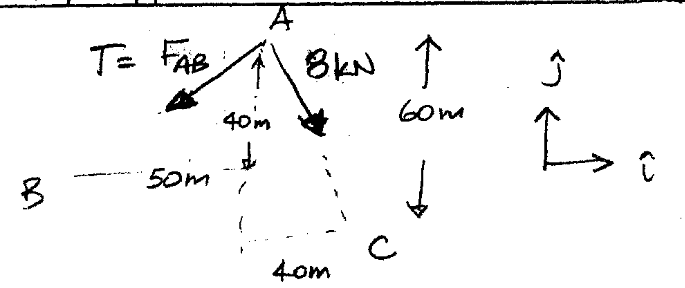

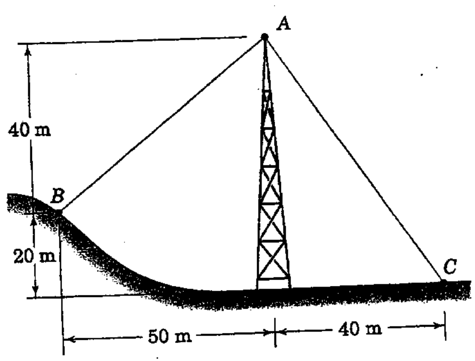

We want $F_{AB} + F_{AC} = F\hat{j}$ (vertical component only)

This means $-F_{AB_x} = F_{AC_x}$

$$F_{AB}\frac{50}{\sqrt{40^2+50^2}} = 8 \cdot \frac{40}{\sqrt{40^2+60^2}}$$

$$\therefore F_{AB} = 8\left(\frac{40}{50}\right)\left(\frac{\sqrt{40^2+50^2}}{\sqrt{40^2+60^2}}\right)$$

$$\text{or } T = 6.4\sqrt{\frac{41}{52}} = \boxed{5.68 \text{ kN}}$$

$$R = T_y + 8_y$$

$$= 5.68\left(\frac{4}{\sqrt{4^2+5^2}}\right) + 8\frac{6}{\sqrt{4^2+6^2}}$$

$$\boxed{R = 10.21 \text{ kN}}$$

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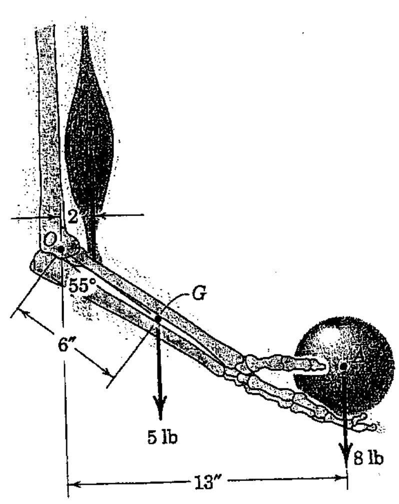

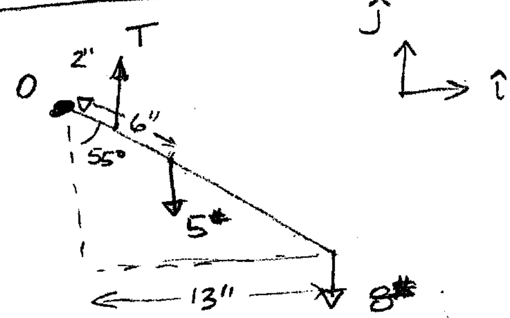

$$\Sigma \underline{M}_o \cdot \hat{k} = -8^{\#}(13") - 5^{\#}(6 \sin 55°)$$

$$\boxed{= -128.6 \text{ \#-in}}$$

into paper

If biceps resists

$$\Sigma \underline{M}_o \cdot \hat{k} = 0 = -128.6 + 2T$$

$$\therefore \boxed{T = 64.3^{\#}}$$

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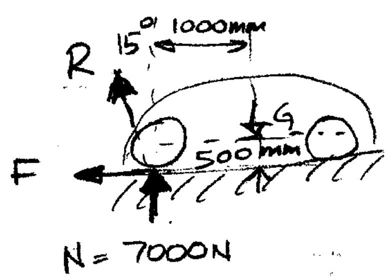
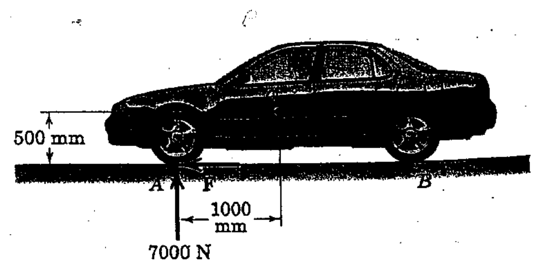


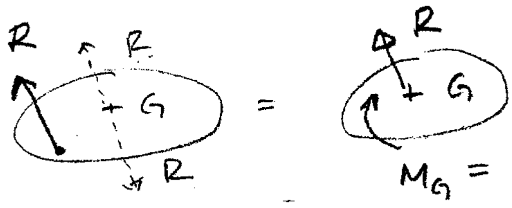


$\underline{N} + \underline{F} = \underline{R}$

To find F : $\frac{F}{N} = \tan 15$

$\therefore$ $F = N \tan 15$

$= 1875$ Newtons



$M_G = F\bar{y} + N\bar{x}$ since F is only x
N is only y

$R = \sqrt{7000^2 + 1875^2}$

$\boxed{R = 7250\text{ N}}$

$= 1875(0.5m) + 7000(1)$

$\boxed{M_G = 7940\text{ N-m CW}}$

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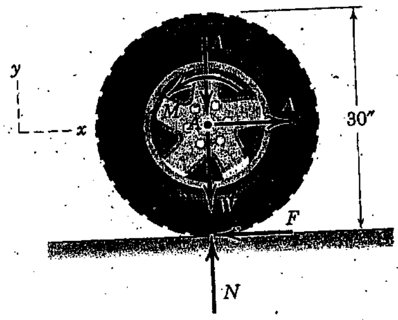
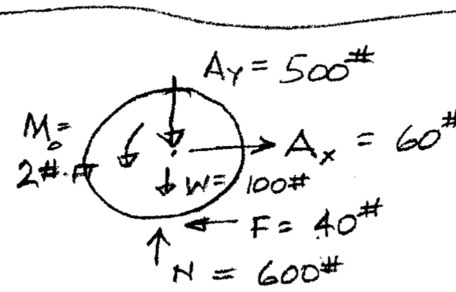
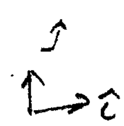






$\underline{R} = \Sigma \underline{F} = \underline{A} + \underline{F} + \underline{W} + \underline{N} = 60\hat{i} - 500\hat{j} + 600\hat{j} - 100\hat{j} - 40\hat{i}$

$\boxed{\underline{R} = 20\hat{i}\ \#}$

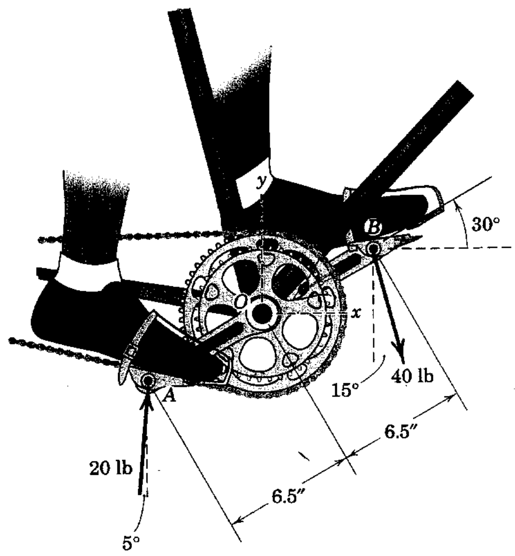
Where should $\underline{R}$ be placed to give the same $\underline{M}$?

$\left(-\frac{15}{12}\hat{j} \times -40\hat{i}\right) + M_o\hat{k} = \underline{r} \times \underline{R} = (x\hat{i} + y\hat{j}) \times 20\hat{i}$

location rel to A

$-50\hat{k} + 2\hat{k} = -48\hat{k} = -20y\,\hat{k} \Rightarrow \boxed{y = 2.4\text{ FT}}$

2/92 The pedal-chainwheel unit of a bicycle is shown in the figure. The left foot of the rider exerts the 40-lb force, while the use of toe clips allows the right foot to exert the nearly upward 20-lb force. Determine the equivalent force–couple system at point *O*. Also, determine the equation of the line of action of the system resultant treated as a single force **R**. Treat the problem as two-dimensional.



Problem 2/92

Goal: Find $\underline{R}$ and line of action for no moment.

Find x- and y- components of individual forces;

$F_{Ax} = 20\text{ lb} \cdot \sin 5° \approx 1.74\text{ lb.}$

$F_{Ay} = 20\text{ lb} \cdot \cos 5° \approx 19.92\text{ lb.}$

$F_{Bx} = 40\text{ lb} \cdot \sin 15° \approx 10.35\text{ lb.}$

$F_{By} = 40\text{ lb} \cdot \cos 15° = -38.64\text{ lb.}$

Now find resultant as sum of individual forces:

$\underline{R} = \Sigma \underline{F}$

$R_x = \Sigma F_x = 1.74\text{ lb} + 10.35\text{ lb.} = 12.09\text{ lb}$

$R_y = \Sigma F_y = 19.92\text{ lb} - 38.64\text{ lb.} = -18.72\text{ lb}$

In vector form, we see

$\boxed{\underline{R} = (12.09\hat{i} - 18.72\hat{j})\text{ lb}}$

Now determine moment about O:

$\underline{M}_O = \Sigma(\underline{r}_{i/O} \times \underline{F}_i)$

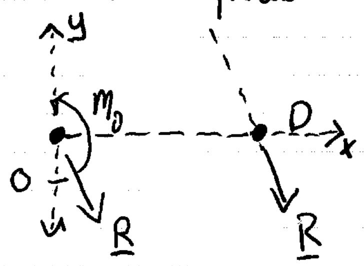
$\underline{M}_O = [6.5\text{ in}(-\cos 30°\hat{i} - \sin 30°\hat{j}) \times 20\text{ lb}(\sin 5°\hat{i} + \cos 5°\hat{j})]$
$+ [6.5\text{ in}(\cos 30°\hat{i} + \sin 30°\hat{j}) \times 40\text{ lb}(\sin 15°\hat{i} - \cos 15°\hat{j})]$
$= (-106.5\hat{k} - 251.1\hat{k})\text{ in} \cdot \text{lb.}$

$\boxed{\underline{M}_O = (-357.6\hat{k})\text{ in} \cdot \text{lb}}$

Continued

Find points D where equivalent moment = $\underline{0}$

i.e.



at D, $\underline{M}_D = \underline{0}$

$$\underline{0} = \underline{M}_D = \underline{r}_{O/D} \times \underline{R} + \underline{M}_O$$

$$\underline{r}_{O/D} \times \underline{R} = -\underline{M}_O$$

here, $\underline{r}_{O/D} = -\underline{r}_{D/O}$

$$\underline{r}_{D/O} \times \underline{R} = +\underline{M}_O$$

$$\underline{r}_{D/O} = x\hat{\imath} + y\hat{\jmath}$$

Now, we can solve for the line of action where $\underline{M}_D = 0$.

$$\underline{r}_{D/O} \times \underline{R} = \underline{M}_O$$

$$(x\hat{\imath} + y\hat{\jmath}) \times (12.09\hat{\imath} - 18.72\hat{\jmath})\ \text{lb} = (-357.6\hat{k})\ \text{in}\cdot\text{lb}$$

$$\left[(-18.72x - 12.09y)\hat{k}\right]\text{lb} = (-357.6\hat{k})\ \text{in}\cdot\text{lb}$$

Thus, equation of line is:

$$(-18.72x - 12.09y) = (-357.6)\ \text{in}$$

Note: x and y in equation of line carry units of length (i.e. inches)

Line of action in a different form is

$$x = 19.1\ \text{in} - 0.65y$$

Here, we see that the slope of the line of action is the direction of $\underline{R}$.