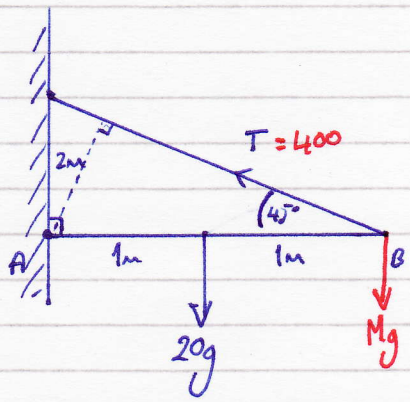
Ex 5A

(1)



(a) $\circlearrowleft C_A \quad 20g \times 1 - 2T \sin 45 = 0$

$$T = \frac{20g}{2\sin 45} = 138.6\,N$$

(b) $\circlearrowleft C_A \quad 20g \times 1 + Mg \times 2 - 2 \times 400 \sin 45 = 0$

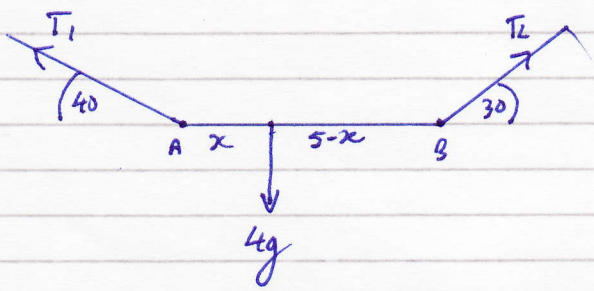
$$20g + 2Mg = 800 \sin 45$$

$\div 2$

$$Mg = 400 \sin 45 - 10g$$

$$M = 18.9\,kg$$

(2)



(a) $\Sigma F_x: \quad T_2 \cos 30 - T_1 \cos 40 = 0 \quad -(1)$

$\Sigma F_y: \quad T_1 \sin 40 + T_2 \sin 30 = 4g \quad -(2)$

$\circlearrowleft C_A: \quad 4gx - T_2 \sin 30 (5) = 0 \quad -(3)$

From (1) $\quad T_1 = \dfrac{T_2 \cos 30}{\cos 40} \quad -(4)$

in (2) $\quad \dfrac{T_2 \cos 30}{\cos 40} \cdot \sin 40 + T_2 \sin 30 = 4g$

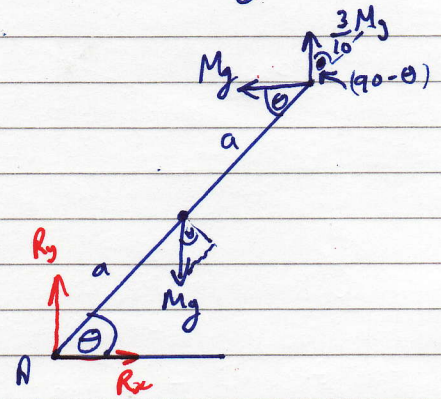
$$T_2 \left[\cos 30 \tan 40 + \sin 30 \right] = 4g$$

$$T_2 = 32.0\,N$$

in (4) $\quad T_1 = \dfrac{32 \times \cos 30}{\cos 40} = 36.1\,N$

2(b) in (4) $x = \dfrac{32 \times \sin 30 \times 5}{4g} = 2.04\text{m}$.

(3) (a)



$= \cos\theta$

C_A: $Mg2a\cos\theta - Mg2a\sin\theta - \dfrac{3}{10}Mg \cdot 2a\sin(90-\theta) = 0$

$\cos\theta - 2\sin\theta - \dfrac{3}{10}\cos\theta = 0$

$\cos\theta - \dfrac{3}{5}\cos\theta = 2\sin\theta$

$\dfrac{2}{5}\cos\theta = 2\sin\theta$

$\tan\theta = \dfrac{1}{5}$

(b) ΣF_x $\quad R_x - Mg = 0$

$R_x = Mg$

ΣF_y $\quad R_y + \dfrac{3}{10}Mg - Mg = 0$

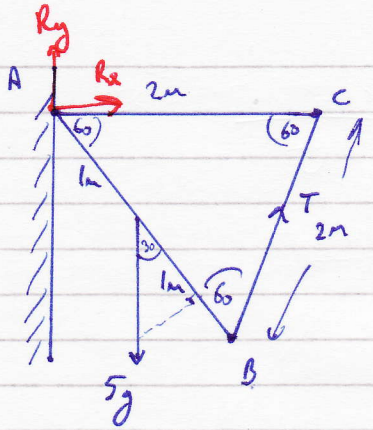
$R_y = \dfrac{7}{10}Mg$

Now $R = \sqrt{(Mg)^2 + \left(\dfrac{7}{10}Mg\right)^2} = \sqrt{M^2g^2 + \dfrac{49}{100}M^2g^2} = \sqrt{\dfrac{149}{100}M^2g^2} = \dfrac{\sqrt{149}}{10}Mg$

$= 1.22Mg$.

$\theta = \tan^{-1}\left(\dfrac{\frac{7}{10}Mg}{Mg}\right) = \tan^{-1}\left(\dfrac{7}{10}\right) = 35^\circ$ to horizontal

(4)



(a) $\circlearrowleft_A$: $5g\sin 30 \times 1 - 2T\sin 60 = 0$

$$T = \frac{5g\sin 30}{2\sin 60} = 14.1N.$$

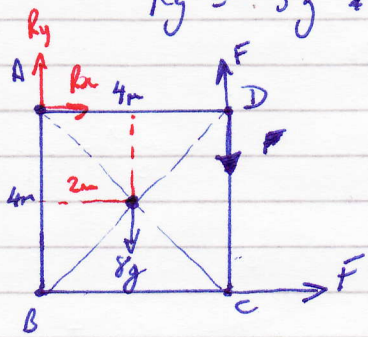
(b) Σf_x $\quad R_x + T\cos 60 = 0$

$$R_x = -14.1\cos 60 = -7.07N$$

Σf_y: $\quad R_y + T\sin 60 - 5g = 0$

$$R_y = 5g - 14.1\sin 60 = 36.8N.$$

(5)



(a) $\circlearrowleft_A$: $-4F + 8g \times 2 - 4F = 0$

$$8F = 16g$$
$$F = 2g = 19.6N$$

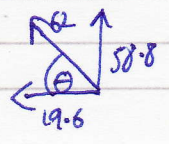
(b) Σf_x: $\quad R_x + F = 0$

$$R_x = -19.6N$$

Σf_y $\quad R_y + F - 8g = 0$

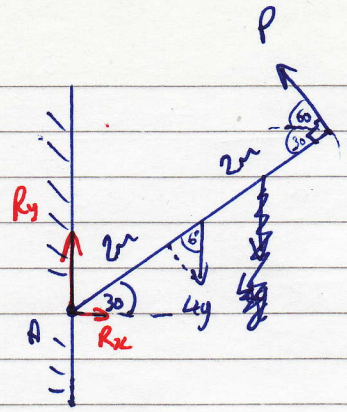
$$R_y = 8g - 19.6 = 58.8\ N$$

$$R = \sqrt{58.8^2 + 19.6^2} = 62.0N$$



$$\theta = \tan^{-1}\left(\frac{58.8}{19.6}\right) = 71.6^\circ \text{ to horizontal}$$

(6)



(a) $\circlearrowleft_A$: $4g \times 2 \times \sin 60 - 4P = 0$

$$P = 2g \sin 60 = 17.0\,N$$

(b) ΣF_x: $R_x - P\cos 60 = 0$

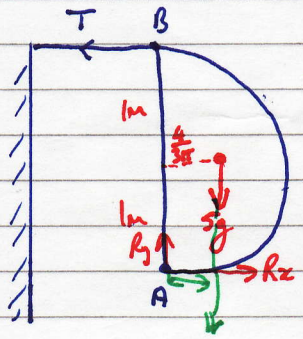
$$R_x = 17\cos 60 = 8.5\,N$$

ΣF_y: $R_y - 4g + P\sin 60 = 0$

$$R_y = 4g - 17\sin 60 = 24.5\,N$$

Now $R = \sqrt{8.5^2 + 24.5^2} = 25.9\,N$

(7)



C.o.M of Semicircle $= \frac{2r\sin\alpha}{3\alpha}$

where $\alpha = \frac{\pi}{2}$

$$= \frac{2r\sin\frac{\pi}{2}}{3\frac{\pi}{2}} = \frac{2r}{\frac{3\pi}{2}} = \frac{4r}{3\pi}$$

$r = 1 \therefore$ com $= \frac{4}{3\pi}$

(a) $\circlearrowleft_A$: $5g \cdot \frac{4}{3\pi} - 2T = 0$

$$T = \frac{20g}{6\pi} = 10.4\,N$$

(b) ΣF_x: $R_x - T = 0$

$$R_x = 10.4\,N$$

ΣF_y: $R_y - 5g = 0$

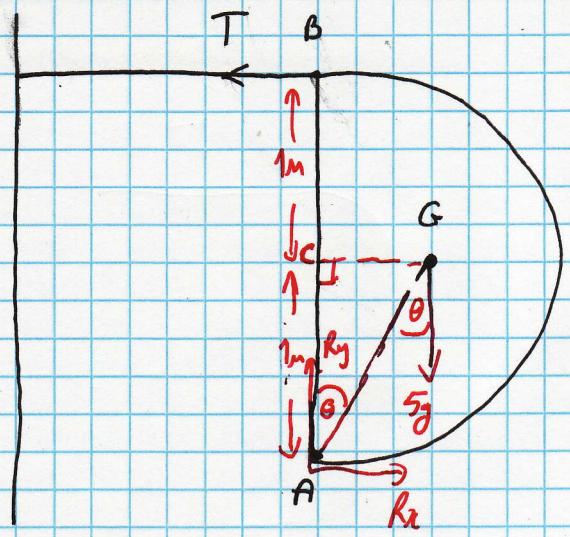
$$R_y = 5g\,N.$$

~~FLUKED~~!

No its ok

perp. to line of force

(4)



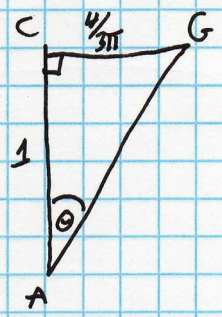
Cen of semi-circle $= \frac{2r\sin\alpha}{3\alpha}$

where $\alpha = \frac{\pi}{2}$ $= \frac{2.1.\sin\frac{\pi}{2}}{3\frac{\pi}{2}} = \frac{4}{3\pi}$

$r = 1$

$\therefore CG = \frac{4}{3\pi}$

(a) Now consider $\triangle ACG$:



$\frac{AC}{AG} = \cos\theta$

$AG = \frac{1}{\cos\theta}$

Now ΣG_A: $2T - AG \times 5g\sin\theta = 0$

$2T - \frac{1}{\cos\theta} \times 5g\sin\theta = 0$

$2T = 5g\tan\theta$

$T = \frac{5g}{2} \times \frac{4}{3\pi/1}$

$T = \frac{20g}{6\pi} = \underline{10.4N}$

(b) Σf_x: $R_x - T = 0$

$\therefore R_x = 10.4N$

Σf_y: $R_y - 5g = 0$

$R_y = \underline{5g\ N}$.