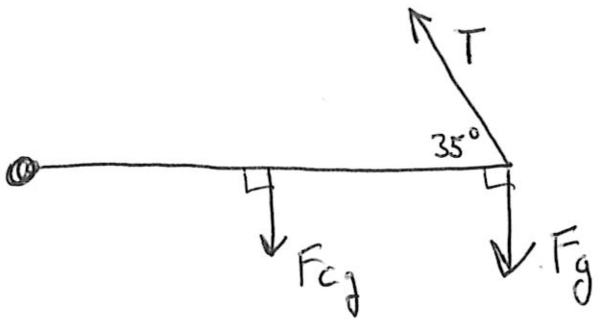
Rotational Equilibrium Solutions

13. → Keep the diagram simple – a pivot point and the lever arm!



$r_{cg} = 1.3\,m$
$r_T = 2.6\,m$
$r_m = 2.6\,m$

Two forces produce a clockwise torque and the tension produces a counter-clockwise torque:

$$\tau_c = \tau_{cc}$$

$$r_{cg} F_{cg} \sin\theta + r_m F_g \sin\theta = r_T T \sin 35^\circ$$

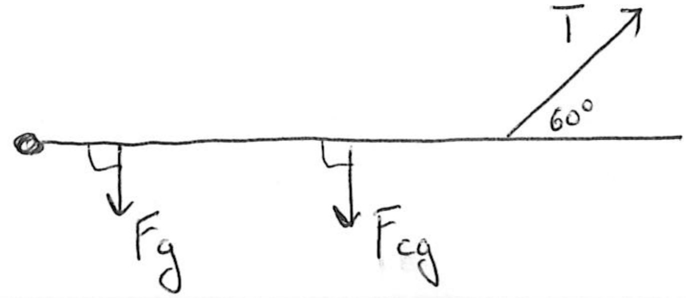
$$T = \frac{(1.3)(1.8)(9.8)\sin 90^\circ + (2.6)(6.0)(9.8)\sin 90^\circ}{(2.6)(\sin 35^\circ)}$$

$$T = 118$$

tension in cable = 120 N.

note → $\sin 90^\circ = 1$

14.



$r_m = 1.2\,m$
$r_{cg} = 2.0\,m$
$r_T = 3.2\,m$

$$\tau_c = \tau_{cc}$$

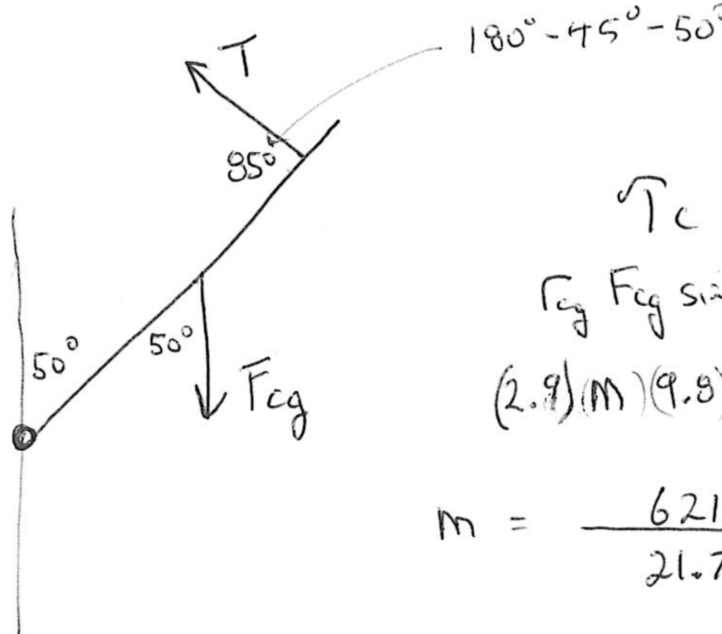
$$r_m F_g(\sin 90^\circ) + r_{cg} F_{cg}(\sin 90^\circ) = r_T T \sin 60^\circ$$

$$\frac{1.2(2.3)(9.8) + 2.0(2.3)(9.8)}{3.2(\sin 60^\circ)} = T$$

$$T = 115.9$$

Tension in rope is 120 N

15.



$r_{cg} = 2.9\,m$
$r_T = 4.8\,m$

$$\tau_c = \tau_{cc}$$

$$r_{cg} F_{cg} \sin 50^\circ = r_T T \sin 85^\circ$$

$$(2.9)(m)(9.8)\sin 50^\circ = (4.8)\,1300 \sin 85^\circ$$

$$m = \frac{6216}{21.77}$$

$$M = 285.5$$

Mass = 290 kg

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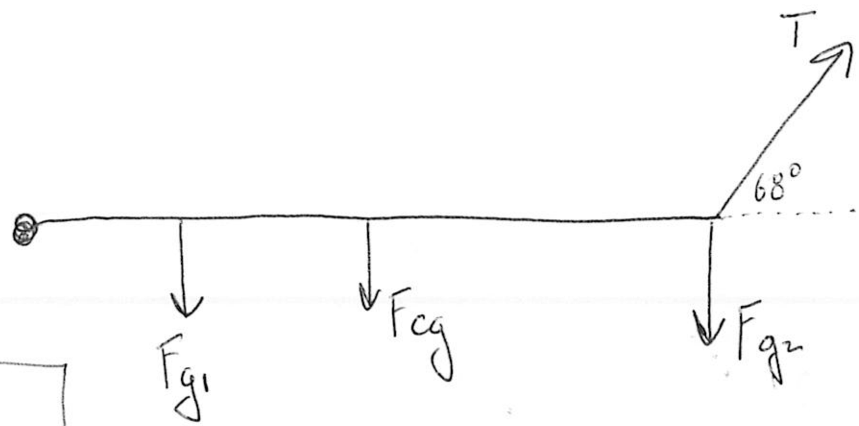

$r_x = ?$

$r_{cg} = 3.0\,m$

$r_T = 6.0\,m$

$r_{Fg} = 6.0\,m$

$$\tau_c = \tau_{cc}$$

$$r_x F_{g1} \sin 90^\circ + r_{cg} F_{cg} \sin 90^\circ + r_{Fg} F_{g2} \sin 90^\circ = r_T T \sin 68^\circ$$

$$r_x mg + r_{cg} M_B g + r_{Fg} Mg = r_T T \sin 68^\circ$$

$$r_x (52) 9.8 + 3.0(14)(9.8) + 6.0(2.6) 9.8 = 6.0(540) \sin 68^\circ$$

$$(509.6) r_x + 411.6 + 152.9 = 3004$$

$$(509.6) r_x = 3004 - 152.9 - 411.6$$

$$r_x = \frac{2439.5}{509.6}$$

$$r_x = 4.787$$

The maximum distance that the painter can walk out on the scafford is 4.8 m