Solutions

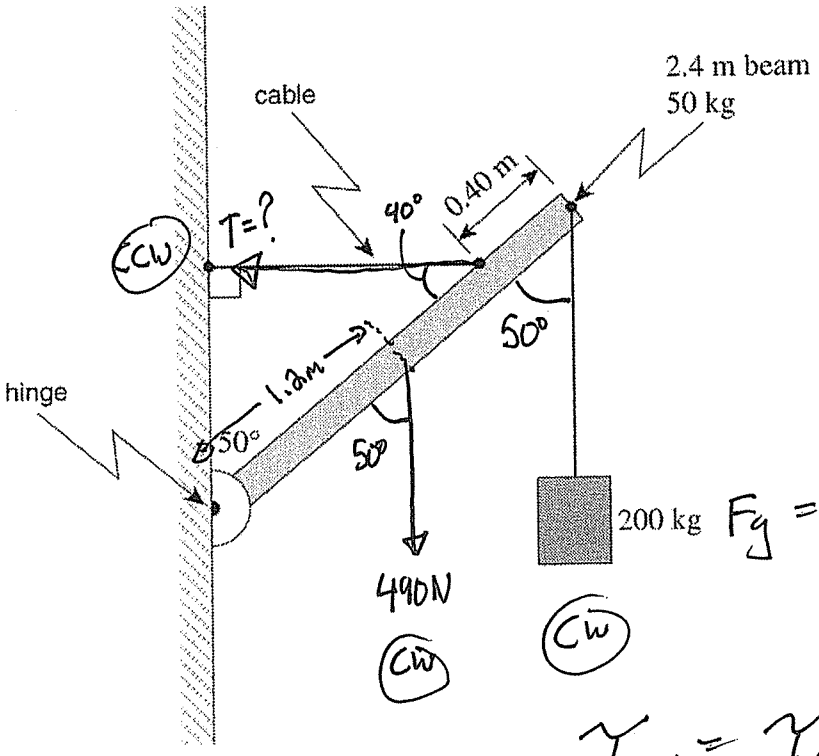
Physics 12 Unit 5 Static Equilibrium Government Problems Worksheet

Name: _____

1. Torque problem, medium difficulty.

(6 marks)

A uniform 50.0 kg beam with a length of 2.4 m supports a 200 kg load. What is the tension in the horizontal cable attached to the beam as shown below?



$\gamma_{cw} = \gamma_{ccw}$.

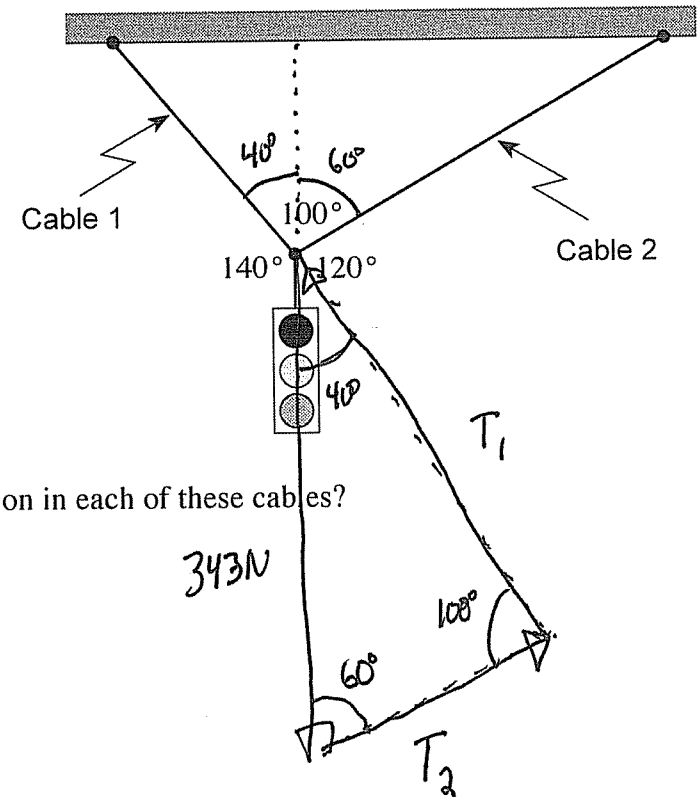
$(490)(1.2)(\sin 50°) + (1960)(2.4)(\sin 50°) = (2)(T)(\sin 40°)$

$4053.9 = 1.28\,T$

$T = 3167\,N$

2. Hanging Mass problem, medium difficulty.

A 35 kg traffic light is suspended from two cables as shown in the diagram.



What is the tension in each of these cables? **(7 marks)**

use sin law.

$$\frac{T_1}{\sin 60^\circ} = \frac{343}{\sin 100^\circ}$$

$T_1 = 302\,N$

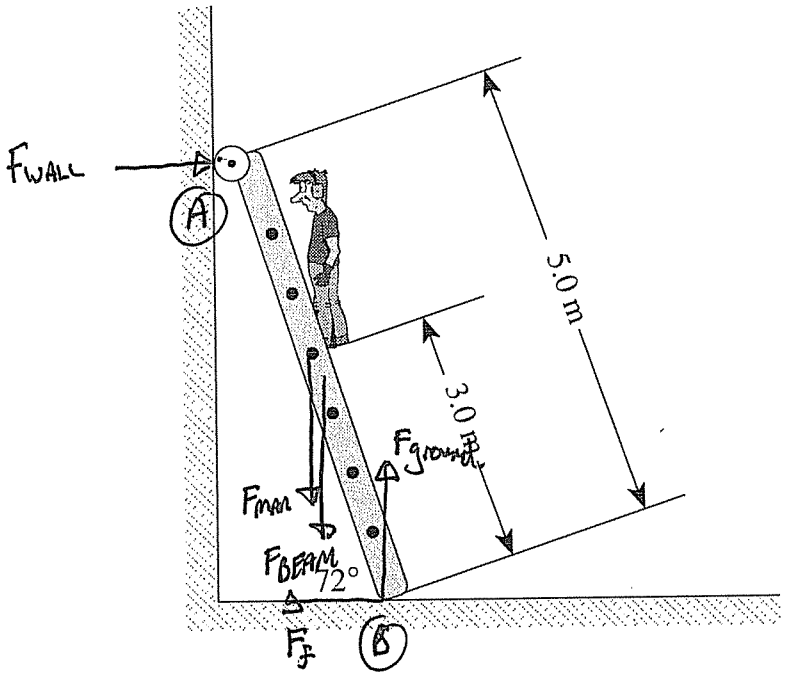
$$\frac{T_2}{\sin 40^\circ} = \frac{343}{\sin 100^\circ}$$

$T_2 = 223.8$

$T_2 = 224\,N$

3. Torque Problem, Hard

A 65 kg man is 3.0 m up a 5.0 m, 16 kg ladder leaning against a smooth wall at an angle of 72° as shown below.

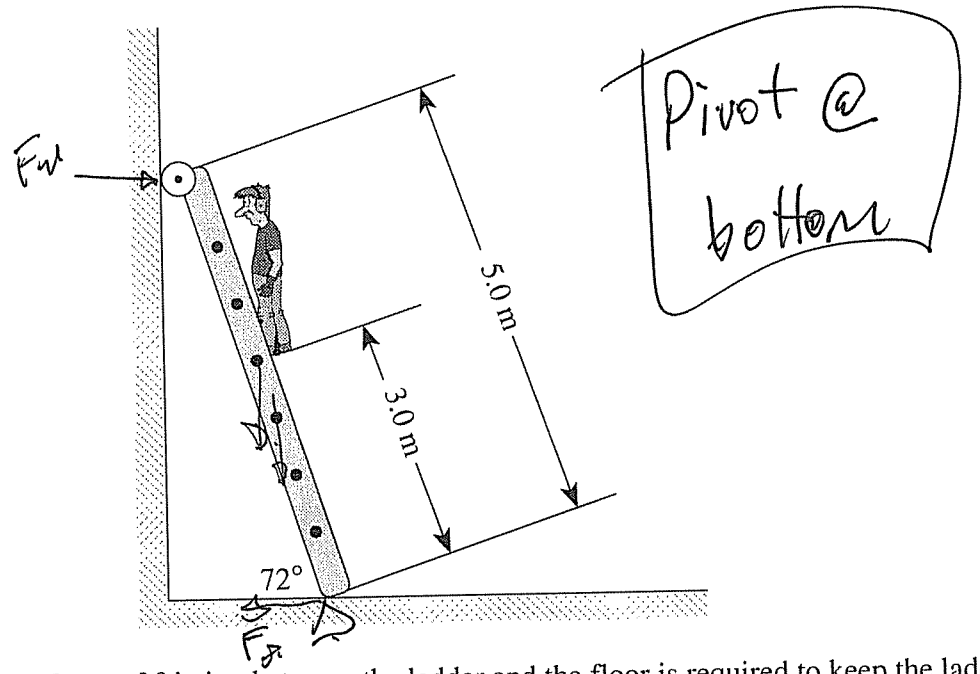


What minimum force of friction between the ladder and the floor is required to keep the ladder from sliding? **(5 marks)**

You can solve this two ways, you can put the pivot @ (A) or (B). Putting the pivot @ (A) is more complicated. I have provided both solutions

$F_f = 150\,N$.

2. A 65 kg man is 3.0 m up a 5.0 m, 16 kg ladder leaning against a smooth wall at an angle of 72° as shown below.



What minimum force of friction between the ladder and the floor is required to keep the ladder from sliding? **(5 marks)**

$$\Sigma\tau = 0$$

$$\tau_c = \tau_{cc} \qquad \leftarrow \textbf{1 mark}$$

$$F_w \times \sin 72° \times 5 = 65 \times 9.8 \times \sin 18° \times 3 + 16 \times 9.8 \times \sin 18° \times 2.5 \qquad \leftarrow \textbf{2 marks}$$

$$F_w \times 4.755 = 590.53 + 121.13 \qquad \leftarrow \textbf{1 mark}$$

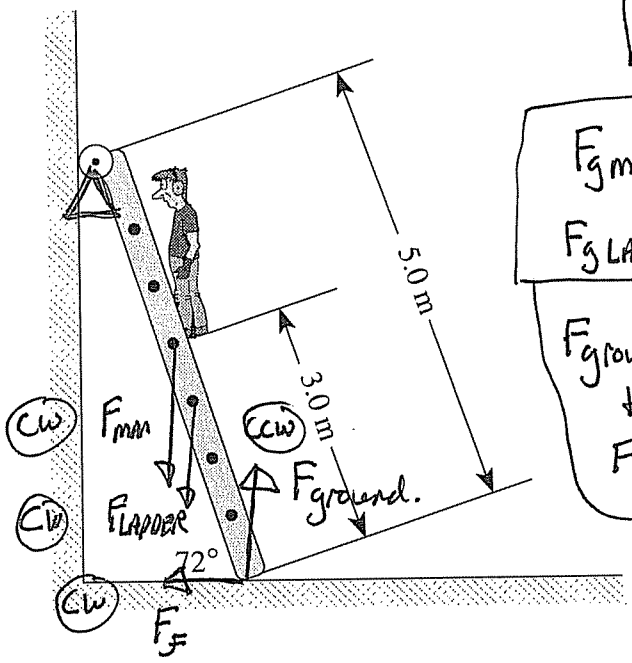
$$F_f = F_w = \frac{711.66}{4.755}$$

$$\therefore F_f = 150 \text{ N} \qquad \leftarrow \textbf{1 mark}$$

This solution is a bit longer.

3. Torque Problem, Hard

A 65 kg man is 3.0 m up a 5.0 m, 16 kg ladder leaning against a smooth wall at an angle of 72° as shown below.



Pivot @ T.O.P.

$F_{g\,man} = 637\,N$

$F_{g\,LADDER} = 156.8\,N$

$F_{ground} = F_{man} + F_{LADDER} = 793.8\,N$

$F_{up} = F_{down}$

What minimum force of friction between the ladder and the floor is required to keep the ladder from sliding? **(5 marks)**

$$\tau_{cw} = \tau_{ccw}$$

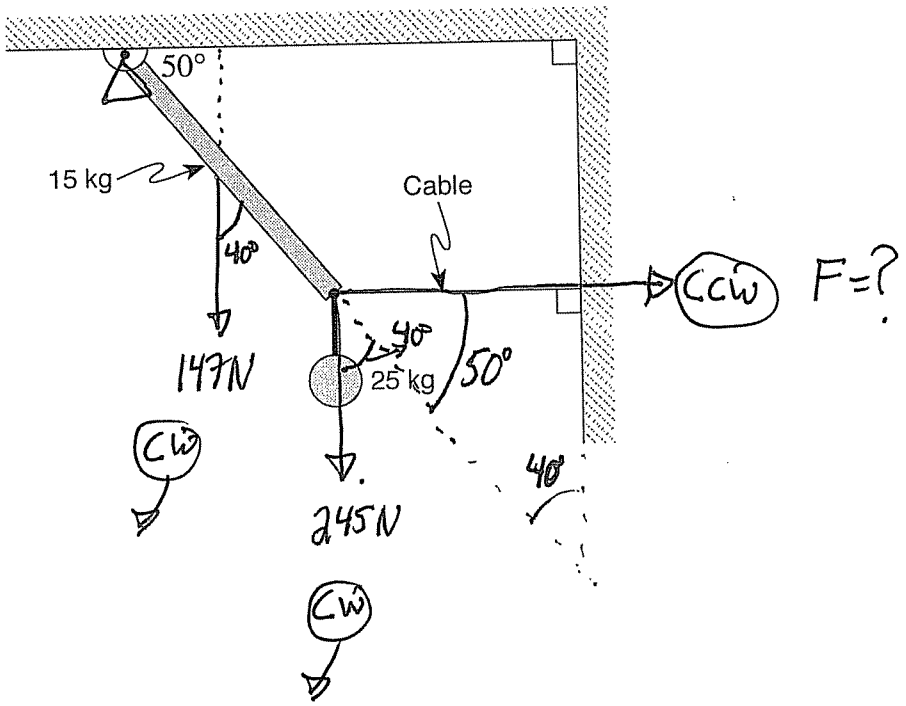
$$(F_f)(5)(\sin 72^\circ) + (156.8)(2.5)(\sin 18) + (637)(2)(\sin 18) = (793.8)(5)(\sin 18)$$

$$(4.75528)F_f + 514.82 = 1226.488$$

$$F_f = 149.6 \approx 150\,N$$

4. Hanging Mass Problem, Med Hard

A 4.0 m long uniform pole with a mass of 15 kg is pivoted at one end and held in position by a horizontal cable at the other end. If a 25 kg mass is suspended from the end of the pole, what is the tension in the horizontal cable? **(7 marks)**



$$T_{cw} = T_{ccw}$$

$$(147)(2)(\sin 40) + (245)(4)(\sin 40) = F(\sin 50^\circ)(4)$$

$$818.91 = F\ 3.06417$$

$$F = 267\ N$$