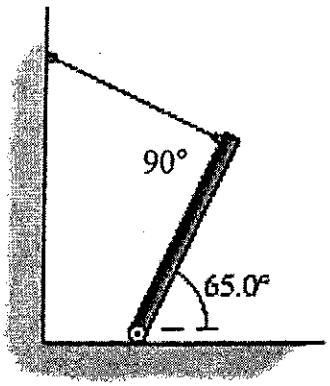
807 AP Physics C
Name: _____ Block: ____

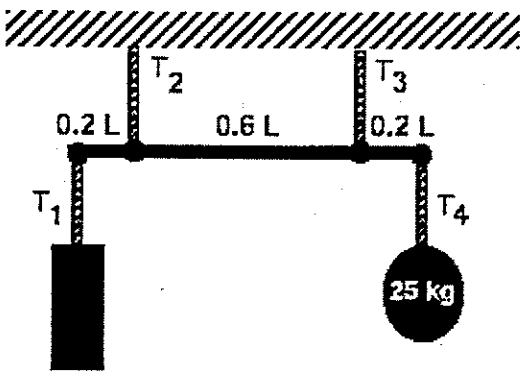
U6H5

Rotational Equilibrium

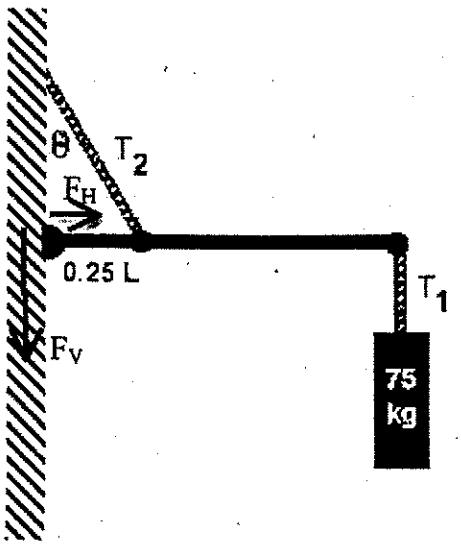
1. A trap door, of length and width 1.65 m, is held open at an angle of 65.0°with respect to the floor. A rope is attached to the raised edge of the door and fastened to the wall behind the door in such a position that the rope pulls perpendicularly to the trap door. If the mass of the trap door is 16.8 kg, what is the torque exerted on the trap door by the rope? (First find the tension in the rope) *(58.6 Nm)*



2. Two ropes having tensions T_2 and T_3, support a uniform 100 N beam and two weights. If the right weight has a mass of 25 kg and T_2 has a tension of 500 N, calculate the tension in T_3 as well as the mass of the unknown weight. (F_{NET}=0 in each direction and τ_{NET} is zero about ANY point) *(T3= 250N, m= 40kg)*



3. A 75-kg block is suspended from the end of a uniform 100-N beam. If θ = 30°, what are the values of T_2 as well as the horizontal and vertical forces on the hinge? *(T2=3695N, FH=1847N, FV=2399N)*



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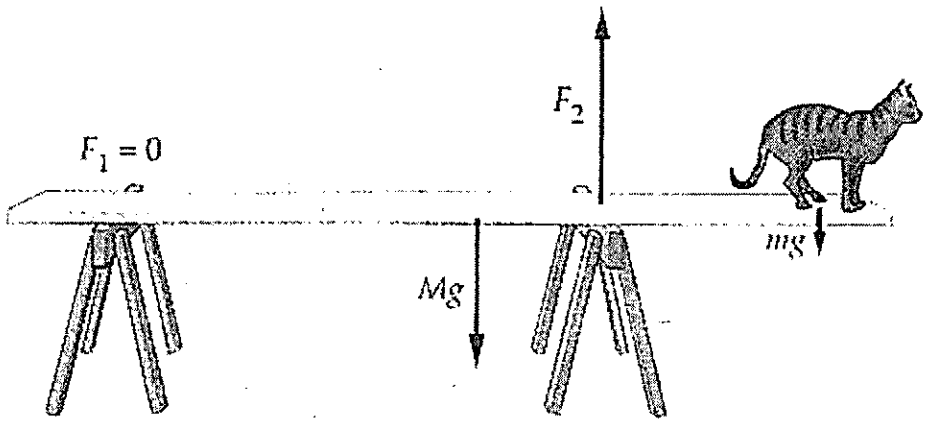
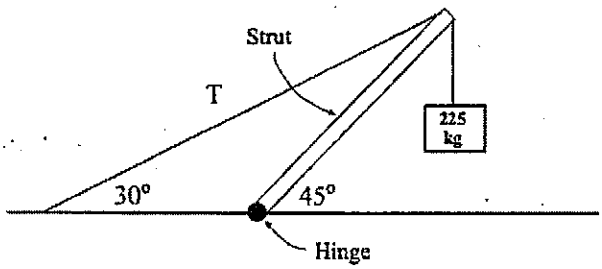
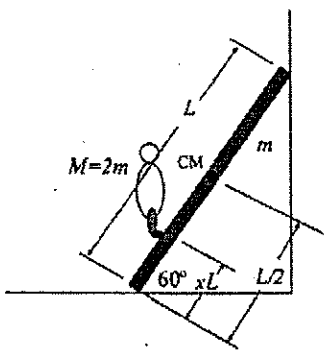
4. A cat walks along a uniform plank that is 4.00 m long and has a mass of 7.00 kg. The plank is supported by two sawhorses, one 0.44 m from the left end of the board and the other 1.58 m from its right end. When the cat nears the right end, the plank just begins to tip. If the cat has a mass of 5.4 kg, how close to the right end of the two-by-four can it walk before the board begins to tip? *(1.04m)*



5. The system in the Fig below is in equilibrium. A mass of 225 kg hangs from the end of the uniform strut whose mass is 45.0 kg. Find (a) the tension T in the cable and the (b) horizontal and (c) vertical force components exerted on the strut by the hinge. *(about 6730 N, 6500 N and 4441 N)*

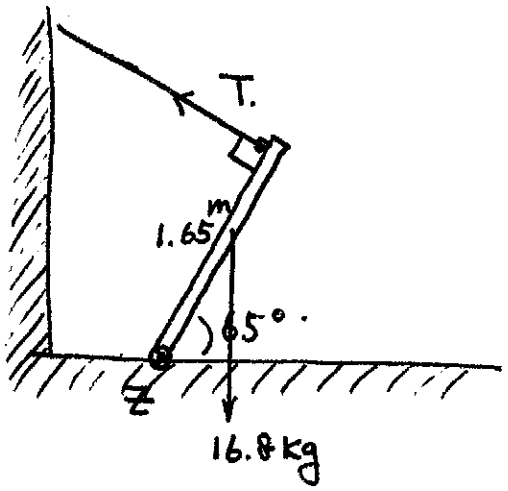


6. A ladder having a uniform density and a mass m rests against a frictionless vertical wall at an angle of 60 degrees. The lower end rests on a flat surface where the coefficient of static friction is μs = 0.40. A student with a mass M = 2m attempts to climb the ladder. What fraction of the length L of the ladder will the student have reached when the ladder begins to slip? *(0.79L)*



U6H5

1.



$\Sigma M_z + \circlearrowleft = 0$

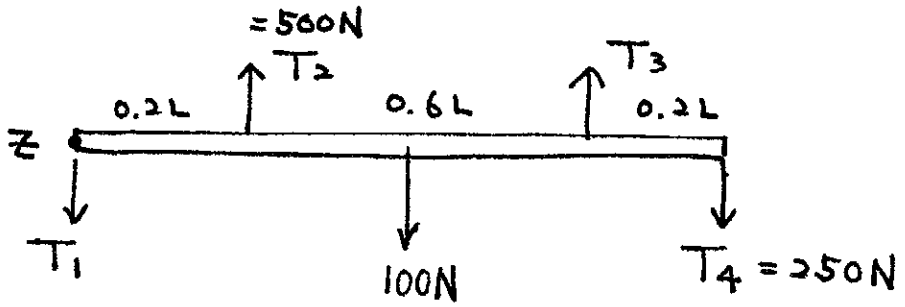
$-16.8 \times 10 \times \frac{1.65}{2} \times \cos 65° + T \cdot 1.65 = 0.$

$-58.58 + 1.65\,T = 0.$

$T = 35.5\,N.$

or. just $\tau = 58.58\,N \cdot m.$

2.



$\Sigma M_z + \circlearrowleft = 0 = 500\,(0.2L) - 100\,(0.5L) + T_3\,(0.8L) - 250\,(L)$

$0 = 100 - 50 + 0.8\,T_3 - 250.$

$0.8\,T_3 = 250 - 100 + 50$

$T_3 = 250\,N.$

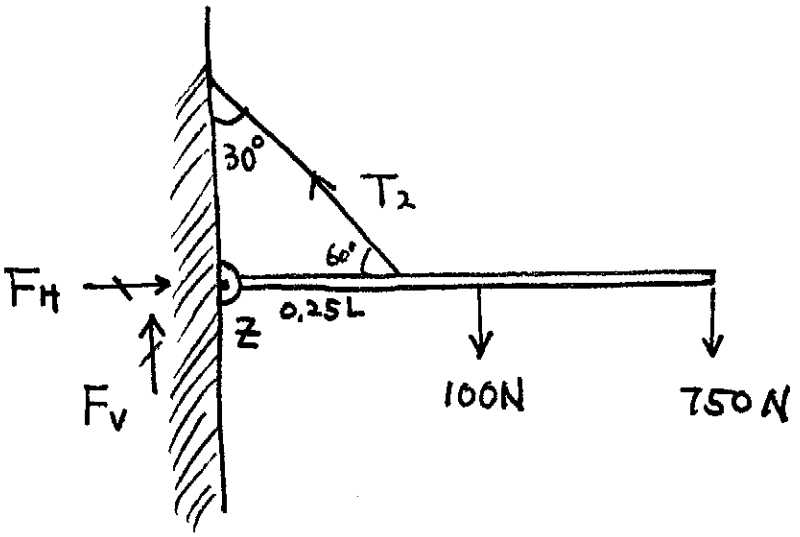
$\Sigma F_y + \uparrow = 0 = 500 + 250 - 100 - 250 - T_1$

$\therefore T_1 = 400\,N$

$\therefore m = 40\,kg$

U6H5

3.



$$\Sigma M_z +\circlearrowleft = 0 = T_2 \cdot \sin 60^\circ \cdot 0.25L - 100 \cdot (0.5L) - 750(L)$$

$$800 = 0.2165\, T_2$$

$$\therefore T_2 = 3695\ N$$

$$\Sigma F_x +\rightarrow = 0 = F_H - (3695) \cdot \cos 60^\circ$$

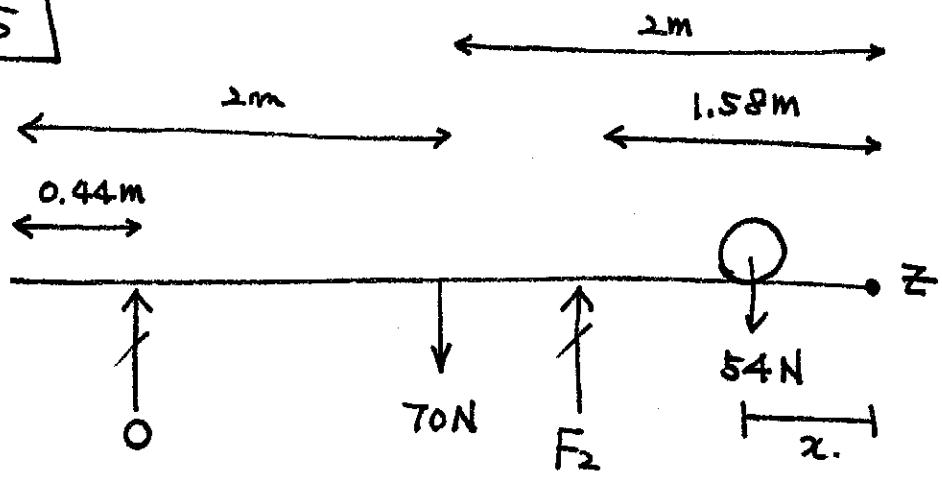
$$\therefore F_H = 1847\ N$$

$$\Sigma F_y +\uparrow = 0 = F_V + (3695)\sin 60^\circ - 100 - 750$$

$$F_V = -2350\ N$$

U6H5

4.



$$\Sigma M_z + \circlearrowleft = 0 = 70(2) - F_2(1.58) + 54x.$$

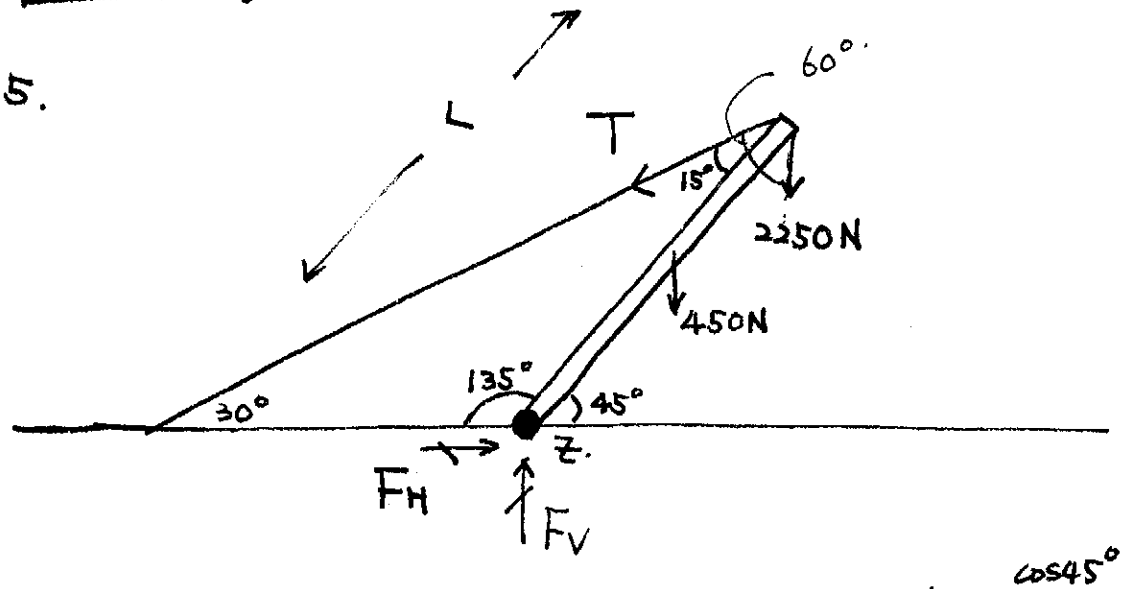
$$x = \frac{-140 + 1.58F_2}{54} = 1.036\ m.$$

$$\Sigma F_y + \uparrow = 0 = -70 + F_2 - 54$$

$$\therefore F_2 = 124N$$

U6H5

5.



$$\Sigma M_z + \circlearrowleft = 0 = T \cdot \sin 15° L - 450\left(\frac{L}{2}\right)\cdot\cos 45° - 2250 \cdot (L) \cdot \cos 45°$$

$$0.259\,T = 1750.1$$

$$T = 6757\ N$$

$$\Sigma F_y + \uparrow = 0 = F_V - 450 - 2250 - T \cdot \cos 60°$$

$$\therefore F_V = 6078.5\ N$$

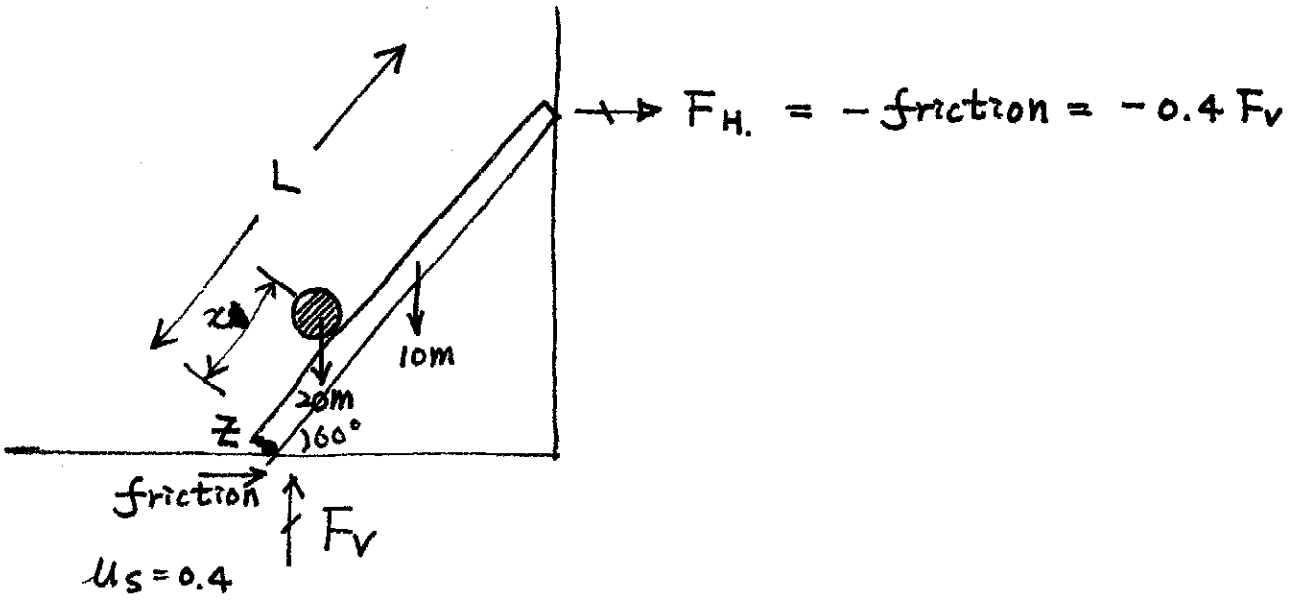
$$\Sigma F_z + \rightarrow = 0 = F_H - T \cdot \sin 60°$$

$$F_H = 6757 \cdot \sin 60°$$

$$= 5852\ N$$

HW5

6.



$$\text{friction} = \mu \cdot F_V = 0.4\, F_V$$

$$\Sigma M_{Z+\circlearrowleft} = 0 = -20m \cdot x \cdot \cos 60^\circ - 10m \cdot \frac{L}{2} \cos 60^\circ + 0.4 F_V \cdot L \sin 60^\circ$$

$$10m\, x = -2.5m\, L + 0.35\, F_V \cdot L$$

$$x = \frac{1}{10}\left(-2.5 + 0.35 \frac{F_V}{m}\right) L$$

$$\Sigma F_{y+\uparrow} = 0 = F_V - 20m - 10m$$

$$F_V = 30m.$$

$$\therefore \quad x = \frac{1}{10}\left(-2.5 + 0.35 \times \frac{30\,m}{m}\right) L$$

$$= \frac{8}{10} L = 0.8\, L$$