

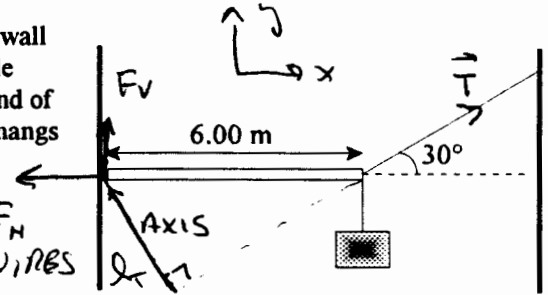
EXAM 4

Name: _____

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A 6.00 m uniform beam extends horizontally from a hinge fixed on a wall on the left. A cable is attached to the right end of the beam. The cable makes an angle of 30.0° with respect to the horizontal and the right end of the cable is fixed to a wall on the right. At the right end of the cable hangs a 140.0 kg mass. The mass of the beam is 240.0 kg. See figure.



A. [15 pts.] Find the tension in the cable. THIS IS AN F_H EQUILIBRIUM PROBLEM. T REQUIRES TORQUE EQ.

$$\sum \tau_i = 0 = \tau_{FH} + \tau_{Fv} + \tau_{WB} + \tau_{WLOAD} + \tau_D$$

$$0 = -W_B l_B - W_{LOAD} l_{LOAD} + T l_T$$

$$= -(240 \text{ kg})(9.8 \text{ m/s}^2)(3 \text{ m}) - (140 \text{ kg})(9.8 \text{ m/s}^2)(6 \text{ m}) + T(3.00 \text{ m})$$

$l_B = 3.00 \text{ m}$
 $l_{LOAD} = 6.00 \text{ m}$
 $l_T = (6 \text{ m}) \sin 30^\circ = 3.00 \text{ m}$

$T = 5100 \text{ N}$

B. [20 pts.] Find the vertical and horizontal forces the hinge exerts on the left end of the beam.

$$\sum F_x = 0 = T \cos 30^\circ - F_H \quad F_H = T \cos 30^\circ$$

$$F_H = (5100 \text{ N})(\cos 30^\circ)$$

$F_H = 4410 \text{ N}$

(10 PTS)

$$\sum F_y = 0 = F_v + T \sin 30^\circ - W_B - W_L$$

$$F_v = (380 \text{ kg})(9.80 \text{ m/s}^2) - (5100 \text{ N})(1.5)$$

$F_v = 1180 \text{ N}$

(10 PTS)