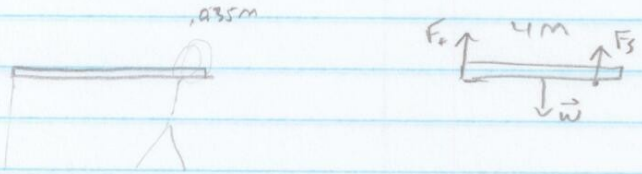
Ch 8 #5

Torque

Carrying a 4m, 21kg pole & rest the end on a fence. You hold the other end of the pole on your shoulder 0.35m from the tip. Find the force on your shoulder



AOR: Left end

$$\Sigma\tau = F_F \cdot 0m - w\,2m + F_S\,3.65m = 0$$

$$F_S\,3.65m = w\,2m$$

$$F_S = \frac{w\,2m}{3.65} = \frac{21kg\ 9.8\frac{m}{s^2}\,2m}{3.65m} = 113N$$

AOR: Shoulder

$$\Sigma\tau = -F_F\,3.65 + w\,1.65m + F_S\,0m = 0$$

$$\Sigma F = F_F - w + F_S = 0$$

$$F_F = \frac{w\,1.65m}{3.65} = \frac{21 \cdot 9.8 \cdot 1.65}{3.65} = 93N$$

$$93N - 21kg\,9.8 = -F_S = -113N$$

AOR: Right End

$$\Sigma\tau = -F_F\,4m + w\,2m - F_S\,0.35m = 0$$

$$\Sigma F = F_F - w + F_S = 0$$

$$F_F = w - F_S$$

$$-(w - F_S)\,4m + w\,2m - F_S\,0.35m = 0$$

$$-w\,2m + F_S\,3.65m = 0 \qquad \frac{21kg\ 9.8\ 2m}{3.65} = F_S = 113N$$

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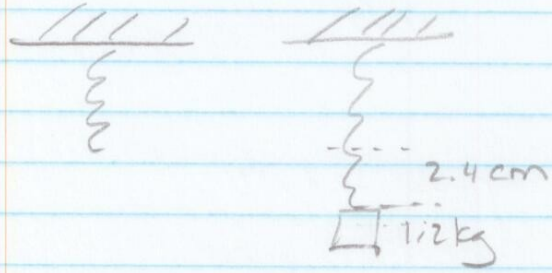
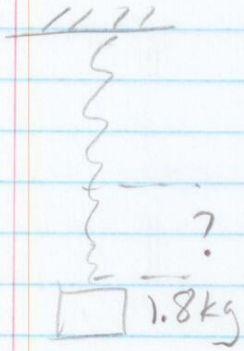
22. A 1.2kg block is hung from a vertical spring, causing the spring to stretch by 2.4cm. How much farther will it stretch if a 0.60kg block is added to the 1.2kg block?



$F = -kx$

$F/x = k = -\frac{1.2kg \cdot 9.8 m/s^2}{(-.024m)} = 490 N/m$



$F = -kx$

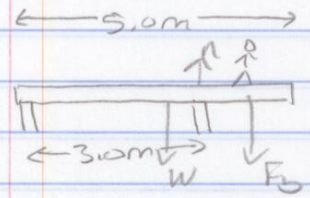
$x = -F/k$

$= \frac{1.8kg \cdot 9.8 m/s^2}{490 N/m} = -0.036m$

$-0.036m - -0.024m = \boxed{-0.012m \text{ further}}$

CK8 43

A 40kg, 5.0 m-long beam is supported by, but not attached to, the two posts as shown. A 20 kg boy starts walking along the beam. How close can he get to the right end of the beam without tipping?



You are interested in the time when the force (normal force) on the left end has just become zero. That's when it's just about to tip.

I'm going to pick the middle support as my axis of rotation because I do not know the normal force at that point.

$$\Sigma\tau = W\,0.5m - F_b x = 0$$

$$\frac{W\,0.5m}{F_b} = x$$

$$\frac{40kg\ 9.8m/s^2\ 0.5m}{20kg\ 9.8m/s^2} = 1.0m$$

This distance is from the middle support because I said that was my axis of rotation.

To get the distance from the right end of the beam I take 2.0m − 1.0m $\boxed{1.0m}$

Method 2 You could also find the location of the boy so that the center of gravity of the beam-boy system is over the support at 2.0m.