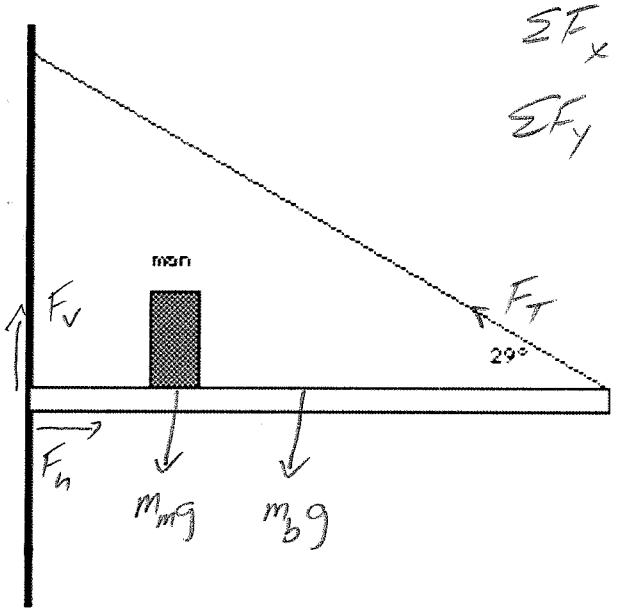
Physics 10154 - Exam #8B

Answer the following two questions. Be sure to clearly indicate your answer with a circle or box. Show all work. If I cannot see how you arrived at an answer, I will deduct points!

1. A uniform, 450-N horizontal beam is cemented to a brick wall and partially supported by a wire at the end furthest from the wall. A 750-N man walks one-fourth (0.25) of the way out from the wall to the end of the beam.

What is the tension in the wire and what are the horizontal and vertical components of the reaction force exerted by the wall on the beam?



$$\Sigma F_x = F_h - F_T \cos 29^\circ = 0$$

$$\Sigma F_y = F_V + F_T \sin 29^\circ - m_m g - m_b g = 0$$

$$\Sigma \tau = \tau_{man} + \tau_{beam} + \tau_T = 0$$

$$\tau_{man} = -\frac{L}{4}(750)\sin 90^\circ$$

$$\tau_{beam} = -\frac{L}{2}(450)\sin 90^\circ$$

$$\tau_T = +L F_T \sin 151^\circ$$

$$\Sigma \tau = -188L - 225L + 0.48 F_T L = 0$$

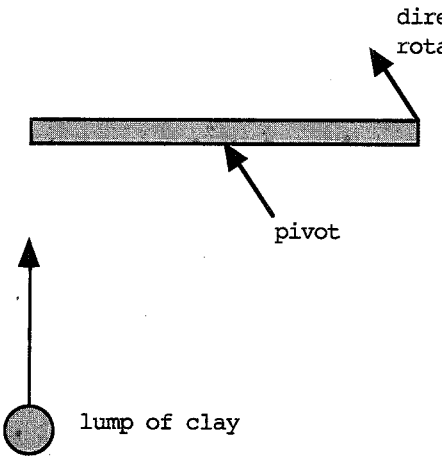
$$0.48 F_T = 188 + 225$$

$$\boxed{F_T = 860\ N}$$

$$F_h = 860 \cos 29^\circ = \boxed{750\ N}$$

$$F_V = 750 + 450 - 860 \sin 29^\circ = \boxed{780\ N}$$

2. A 12-meter long, 520-kg iron beam is hanging by its center of mass from a crane and rotating at a rate of 4.5 rev/min in a plane horizontal to the ground. Its moment of inertia about its axis of rotation is 6200 kg-m^2. In an attempt to slow the beam's rotation, a 45-kg lump of sticky clay is thrown at a speed of 3.8 m/s at one end of the rod, tangent to the motion in the opposite direction, also in the plane of the rod (top view shown below). The lump sticks to the rod and they rotate together ... at what angular speed (in rad/sec)?



$I_{beam} = 6200 \text{ kg}\cdot\text{m}^2$

$I_{clay} = MR^2 = 1620 \text{ kg}\cdot\text{m}^2$

$\omega_{i,beam} = 4.5 \frac{\text{rev}}{\text{min}} = 0.47 \text{ rad/s}$

$\omega_{i,clay} = \frac{v}{R} = \frac{3.8}{6\text{m}} = -0.63 \text{ rad/s}$

$I_{beam}\,\omega_{i,beam} + I_{clay}\,\omega_{i,clay} = (I_{beam} + I_{clay})\,\omega_f$

$(6200)(.47) - (1620)(0.63) = (7820)\,\omega_f$

2914 1020.6

$1893.4 = 7820\,\omega_f$

$\boxed{\omega_f = 0.24 \text{ rad/s}}$