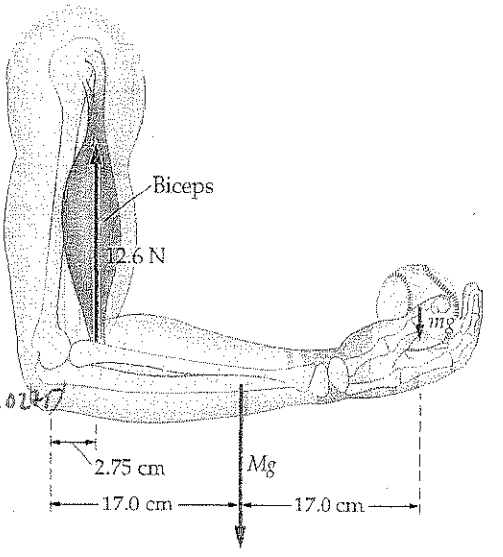
14 pts

AP Physics

Torque Practice B

Name: KEY

11.5 A person holds a 1.42 N baseball in his hand, a distance of 34.0 cm from the elbow joint, as shown in the figure to the right. The biceps, attached at a distance of 2.75 cm from the elbow, exerts an upward force of 12.6 N on the forearm. Consider the forearm and hand to be a uniform rod of mass 1.20 kg.



a. Calculate the net torque acting on the forearm and hand. Use the elbow joint as the axis of rotation.

(+) (-)

$\Sigma\vec{\tau} = \vec{\tau}_{ccw} + \vec{\tau}_{cw}$ $= 12(0.17) + 1.42(0.34) + 12.6(0.0275)$

$= \boxed{-2.18\ N\cdot m}$ CW (2)

b. If the net torque obtained in (a) above is nonzero, in which direction will the hand and forearm rotate? ~~CCW~~ CW (1)

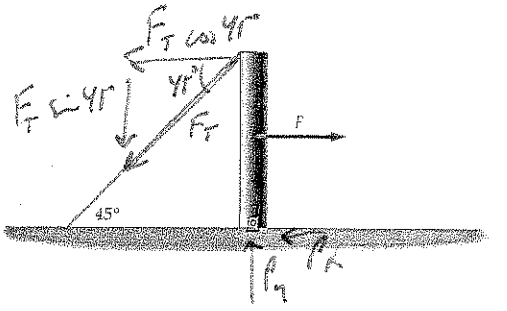
c. Would the net torque exerted on the forearm and hand increase or decrease if the biceps were attached farther from the elbow joint? ~~↑~~ ↓ (1)

d. Assume that the bicep now exerts enough force for the system to be in static equilibrium. Calculate the force exerted by the bicep.

$12(0.17) + 1.42(0.34) - F_{Bicep}(0.0275) = 0$

$F_{Bicep} = 91.7\ N$ (2)

11.30 A rigid, vertical rod of negligible mass is connected to the floor by an axle through its lower end, as shown to the right. The rod also has a wire connected between its top end and the floor. If a horizontal force F is applied at the midpoint of the rod, find



a. the tension in the wire

$F_T \cos 45°(L) = F(L/2)$ (2)

$\boxed{F_T = 0.71F}$

b. the horizontal and vertical components of force exerted by the bolt on the rod

$F_T \sin 45° = P_y = 0.71F(\sin 45°) = \boxed{0.5F = P_y}$ (2)

$P_x + F_T \cos 45° = F$

$P_x = F - F_T \cos 45° = F - 0.71F(\cos 45°) = \boxed{F(0.5) = P_x}$ (2)

11.79 When you arrive at Duke's Dude Ranch, you are greeted by the large wooden sign shown below. The left end of the sign is held in place by a bolt. The right end is tied to a rope that makes an angle of 20.0° with the horizontal. If the sign is uniform, 3.20 m long, and has a mass of 16 kg, what is (are) the

a. tension in the rope

$mg\left(\frac{L}{2}\right) - T\sin 20°(L) = 0$

$T\sin 20° = \frac{mg}{2}$

$T = \frac{mg}{2\sin 20°} = \frac{16(10)}{2\sin 20°} = 234\,N$

(3)

b. horizontal and vertical components of the force, **F**, exerted by the bolt?

$F_x = T\cos 20°$

$F_y + T\sin 20° - mg = 0$

(4)

$F_x = 220\,N$

$F_y = mg - T\sin 20° = 160 - 80$

$F_y = 80\,N$