Physics 2010
Fall 2004
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EXAM 3

3

Name:____________________________ Student ID #:________________________

TA (circle one): Ali Ben Brigham Dan Elspeth Eric Geoff

A. The blades of a "Cuisinart" blender when run at the "mix" level, start from rest and reach 2.00×10^3 rpm (revolutions per minute) in 1.60 s. The edges of the blades are 3.10 cm from the center of the circle about which they rotate.

$$\omega = 2\times10^3 \frac{REV}{MIN} \times \frac{2\pi\ rad}{REV} \times \frac{MIN}{60 s} = 209\ rad/s$$

1. *[5 pts.]* What is the angular acceleration of the blades in rad/s^2 while they are accelerating?

$$\alpha = \frac{\Delta\omega}{\Delta t} = \frac{209\ rad/s}{1.60 s} = \boxed{131\ rad/s^2}$$

2. *[5 pts.]* Through how many rotations did the blades travel in that 1.60 s?

$$\Delta\theta = \omega_{AV} t = \frac{209\ rad/s}{2} \times 1.6 s = 167\ rad$$

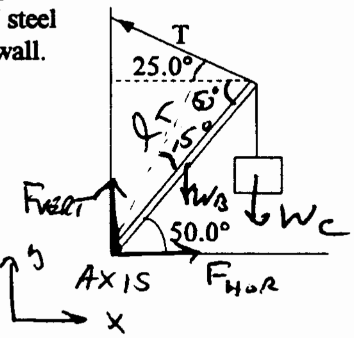
$$\#ROT = 167\ rad \times \frac{1\ ROT}{2\pi\ rad} = \boxed{26.2\ ROT}$$

3. *[5 pts.]* If the blades have a moment of inertia of 5.00×10^{-5} kg m^2, what net torque did the blades feel while accelerating?

$$\tau_{NET} = I\alpha = (5\times10^{-5} kg\,m^2)(131\ rad/s^2)$$

$$\boxed{\tau_{NET} = 6.55\times10^{-3} N\cdot m}$$

B. A 7.50×10^4 N shipping crate is hanging by a cable attached to a uniform 1.20×10^4 N steel beam that can pivot at its base. A second cable supports the beam and is attached to a wall. See figure.



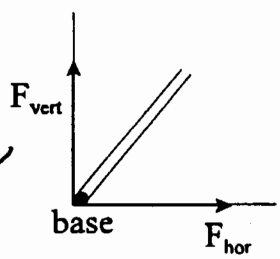
1. *[10 pts.]* Determine the tension T in the upper cable.

$$\Sigma\tau_i = 0 = -W_B\left(\frac{L}{2}\cos 50^\circ\right) - W_c(L\cos 50^\circ) + T\cos 15^\circ$$

$$T = \frac{(6000 N \cos 50^\circ) + (7.5\times10^4 N \cos 50^\circ)}{\cos 15^\circ}$$

$$\boxed{T = 5.39\times10^4 N}$$

2. *[20 pts.]* Determine the <u>magnitude</u> of the force exerted on the beam at its base. See drawing.



$$\Sigma F_x = 0 = F_{HOR} - T\cos 25.0^\circ$$

$$F_{HOR} = (5.39\times10^4 N)\cos 25^\circ = 4.89\times10^4 N$$

$$\Sigma F_y = 0 = F_{VERT} + T\sin 25^\circ - 1.2\times10^4 N - 7.5\times10^4 N$$

$$F_{VERT} = 8.7\times10^4 N - (5.39\times10^4 N)\sin 25^\circ = 6.42\times10^4 N$$

$$F_{TOT} = \sqrt{F_x^2 + F_y^2} = \sqrt{(4.89\times10^4 N)^2 + (6.42\times10^4 N)^2}$$

$$\boxed{F_{TOT} = 8.07\times10^4 N}$$