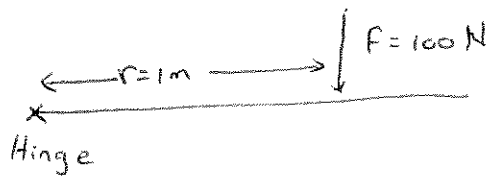
Name: KEY UFID:

PHY2053 Health, Summer C 2016

Quiz 4

Date: Wednesday, June 30, 2016

Problem 1: A person opens a door by applying a contant force of 100 N perpendicular to it, at a distance of 1 m from the hinge. After rotating by 60°, the door has an angular velocity of 0.8 rad/s. Find the moment of inertia of the door.



$$\Delta\theta = 60^\circ = \frac{60}{360} \times 2\pi \text{ rad} = \frac{\pi}{3} \text{ rad}$$

Work done $= \tau \, \Delta\theta$

Also Work done $= \frac{1}{2} I (\omega_f^2 - \cancel{\omega_i^2})$ $\quad [KE_f - KE_i]$

So, $\tau \, \Delta\theta = \frac{1}{2} I \, \omega_f^2$

$\tau = 100 \text{ N} \times 1 \text{ m} = 100 \text{ Nm}$

Plugging in all the values, we get

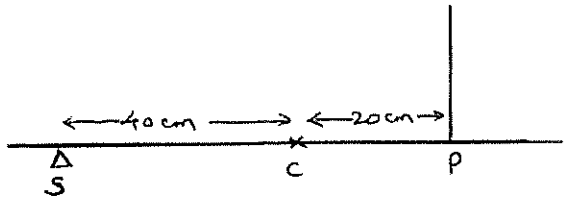
$$I = \frac{2 \tau \Delta\theta}{\omega_f^2} = 327.2 \text{ kg m}^2$$

$$\boxed{I = 327.2 \text{ kg m}^2}$$

(Problem 2 on the next page)

Problem 2: A stick of mass 3 kg is suspending by a rope as shown. To prevent the toppling of the stick, a support is placed under the stick to the left of the point of suspension. Calculate the force of tension exerted on the stick by the rope.

On the diagram: P = point of suspension, S = support, C = center of mass of the stick.

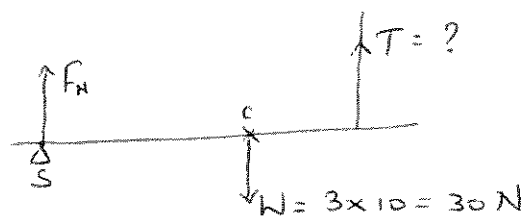


The weight of the stick effectively acts through C.

The two other forces are tension at P and normal force at S. We can find both these forces using the equations for equilibrium $\Sigma F = 0$; $\Sigma \tau = 0$.

If we only need the tension, by picking S to be the pivot, we can ~~first~~ avoid having to use $\Sigma F = 0$.

Pivot at S :



$$\tau_W = -(30\ N \times 0.4\ m) = -12\ N.m$$

$$\tau_T = +[T \times (0.4 + 0.2)m] = T\ 0.6\ m$$

$$\tau_{F_N} = \emptyset$$

$\Sigma \tau = 0$ gives $-12\ Nm + T\ 0.6\ m = 0$

or $T = \dfrac{12\ N}{0.6} = 20\ N$

$\boxed{T = 20\ N}$

Using $\Sigma F = 0$, we can also find that $\boxed{F_N = 10\ N}$