Ch8 Q14. We claim that momentum and angular momentum are conserved. Yet most moving or rotating objects eventually slow down and stop. Explain.

Friction, an external, nonconservative force. Mention that objects in the absense of friction, continue to rotate/move, like the earth on its axis.

Ch8 P60. What is the angular momentum of a 0.270-Kg ball revolveing on the end of a thin string in a circle of radius 1.35 at an angular speed of 10.4 rad/s?

We have that

$$L = I\omega.$$

In this case, $I = mr^2$, so

$$\begin{aligned} I &= (0.270\,\mathrm{Kg})\,(1.35\,\mathrm{m})^2 \\ &= (0.270\,\mathrm{Kg})\,(1.35\,\mathrm{m})^2 \\ &= .4921\mathrm{Kgm}^2 \end{aligned}$$

So,

$$\begin{aligned} L &= .4921\mathrm{Kgm}^2 \cdot 10.4\,\mathrm{rad/s} \\ &= 5.12\,\mathrm{Kgm}^2/\mathrm{s} \end{aligned}$$

Ch8 Q19. In what direction is the Earth's angular velocity vector as it rotates daily about its axis?

It rotates to the east, so it points up from the north pole using the right hand rule.

Ch8 P66. What is the angular momentum of a figure skater spinning at 3.0 rev/s with arms in close to her body, assuming her to be a uniform cylinder with a height of 1.5 m, a radius of 15 cm, and a mass of 48 Kg? (b) How much torque is required to slow her to a stop in 4.0 s, assuming she does not move her arms?

(a) To get her angular momentum, we need her moment of inertia first, which is that of a cylinder, $I = \frac{1}{2}Mr^2$

$$\begin{aligned} I &= \frac{1}{2}(48\mathrm{Kg})(.15\mathrm{m})^2 \\ &= (24 \cdot 0.0225)\mathrm{Kgm}^2 \\ &= 0.54\mathrm{Kgm}^2. \end{aligned}$$

To have L in canonical units, we have that

$$\begin{aligned} 3.0\,\frac{\mathrm{rev}}{\mathrm{s}}\frac{2\pi\,\mathrm{rad}}{1\,\mathrm{rev}} &= 18.9\mathrm{rad/s}. \\ \Rightarrow L &= 10.\,\mathrm{Kgm}^2/\mathrm{s}. \end{aligned}$$

(b) To have her stop in 4.0 s, we can assume a constant torque, so

$$\begin{aligned} \tau &= -\frac{\Delta L}{\Delta t} \\ &= -\frac{10\ \mathrm{Kgm}^2/\mathrm{s}}{4.0\mathrm{s}} \\ &= -2.5\ \mathrm{Kgm}^2/\mathrm{s}^2. \end{aligned}$$

Ch9 Q2. A bungee jumper momentarily comes to rest at the bottom of the dive before he springs back upward. At that moment, is the bungee jumper in equilibrium? Explain.

No, because his speed changes, so there is a non-zero net force on him.

Ch9 P13. Find the tension in the two wires supporting the traffic light shown in the figure 9-53:

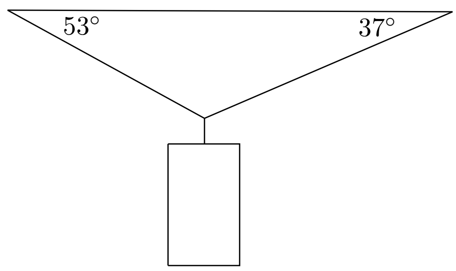

Figure 1.

We have that the forces must cancel, that is

$$\begin{aligned} m\vec{a} &= \vec{T}_{53} + \vec{T}_{37} - mg\hat{y} \\ &= 0 \\ \Rightarrow mg\hat{y} &= \vec{T}_{53} + \vec{T}_{37} \end{aligned}$$

This equation has two components, the y component,

$$mg = T_{53y} + T_{37y}$$

and the x component

$$0 = -T_{53x} + T_{37x}.$$

The negative is to take into account the direction of the left tension. The y component of each is the $\sin\theta$ of the respective tensions from investigation of the triangles, so

$$mg = T_{53}\sin(53) + T_{37}\sin(37),$$

While from the x component equation, we have that

$$\begin{aligned} T_{53}\cos(53) &= T_{37}\cos(37) \\ \Rightarrow T_{53} &= T_{37}\frac{\cos(37)}{\cos(53)} \\ \Rightarrow mg &= T_{37}\cos(37)\frac{\sin(53)}{\cos(53)} + T_{37}\sin(37) \\ &\Rightarrow T_{37}(\sin(37) + \cos(37)\tan(53)) \\ \Rightarrow T_{37} &= \frac{mg}{\sin(37) + \cos(37)\tan(53)} = 190\,\mathrm{N} \\ \Rightarrow T_{53} &= \frac{\cos(37)}{\cos(53)}\frac{mg}{\sin(37) + \cos(37)\tan(53)} \\ &= \frac{\cos(37)}{\cos(53)}190\mathrm{N} \\ &= 260\,\mathrm{N}. \end{aligned}$$

Ch9 P18. A shope sign weighing 215 N hangs from the end of a uniform 155 N beam as shown in Fig 9–58. Find the tension in the supporting wire at 35 degrees and the horizontal and vertical forces exerted by the hinge on the beam at the wall[HINT: First draw a free-body diagram.]

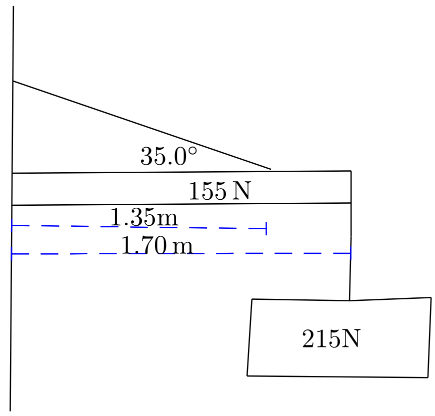

Figure 2.

We use that the sum of the torques are zero first. Choosing the fulcrum at the wall joint,

$$\begin{aligned} 0 &= T\sin 35 \times 1.35\text{m} - 215\text{N}\times 1.70\,\text{m} - 155\text{N}\times 0.85\text{m} \\ \Rightarrow T &= \frac{215\text{N}\times 1.70\,\text{m} + 155\text{N}\times 0.85\text{m}}{\sin 35\cdot 1.35\text{m}} \\ &= 642\text{N}. \end{aligned}$$

Now that we have the force of tension, consider the forces on the beam. There are three, the force from the sign, from the line (which we just found) and the force from the hinge. For the vertical dimension, we have

$$\begin{aligned} 0 &= F_{\text{hinge}\,y} + 642\text{N}\sin(35) - 215\text{N} - 155\,\text{N} \\ \Rightarrow F_{\text{hinge}\,y} &= 215\text{N} + 155\,\text{N} - 642\text{N}\sin(35) \\ &= 2\,\text{N}. \end{aligned}$$

For the horizontal dimension, only the wire exerts a force in this direction, towards the wall, so

$$\begin{aligned} F_{\text{hinge}\,x} &= 642\cos(35) \\ &= 526\,\text{N}. \end{aligned}$$

Ch9 Q6. Can the sum of torques on an object be zero while the net force on the object is nonzero? Explain.

Yes, we answered this... You can easily push something without rotating it. Basically, the line of action for a force that enters the calculation of a force making the net sum of forces different from that of the net sum of torques.

Ch9 P25. A man doing push-ups pauses in the position shown in figure 9-26. His mass is $m = 68\,\text{Kg}$. Determine the normal force exerted by the floor (a) on each hand; (b) on each foot.

Choosing the fulcrum at his foot first, we have that no net torque yields,

$$\begin{aligned} 0 &= 9.8\text{m/s}^2 \times 68\text{Kg} \times .95\text{m} - 1.37\text{m} F_{\text{hands}} \\ \Rightarrow F_{\text{hands}} &= \frac{9.8\text{m/s}^2 \times 68\text{Kg} \times .95\text{m}}{1.37\,\text{m}} \\ &= 462\text{N}. \end{aligned}$$

For each hand then, it feels a force of $462\text{N}/2 = 231\text{N} \approx 230\text{N}$. For the feet, choose the fulcrum at the hands, then,

$$\begin{aligned} 0 &= 1.37\text{m} F_{\text{feet}} - 9.8\text{m/s}^2 \times 68\text{Kg} \times .42\text{m} \\ \Rightarrow F_{\text{feet}} &= \frac{9.8\text{m/s}^2 \times 68\text{Kg} \times .42\text{m}}{1.37\,\text{m}} \\ &= 204\,\text{N} \end{aligned}$$

so the force on each foot is 100N.