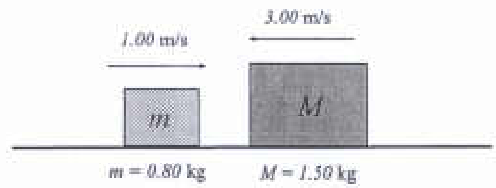
Name Units? Units?

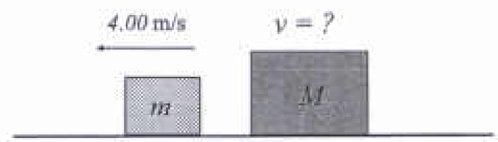
Oct. 29, 2003

Phys 2010, Section 2
Quiz #4 — Fall 2003

1. A 0.800 kg block slides to the right and a 1.50 kg block slides to the left on a frictionless track, with speeds as shown in the figure; they collide. After the collision, the 0.800 kg block moves to the left with speed $4.00 \frac{\text{m}}{\text{s}}$.



a) Find the *velocity* of the 1.50 kg block after the collision. Note, you have to give the magnitude and the direction!!



Linear momentum is conserved! Total momentum before the collision equals total momentum after. This gives:

$$(0.800\,\text{kg})(1.00\,\tfrac{\text{m}}{\text{s}}) + (1.50\,\text{kg})(-3.00\,\tfrac{\text{m}}{\text{s}}) = (0.800\,\text{kg})(-4.00\,\tfrac{\text{m}}{\text{s}}) + (1.50\,\text{kg})\,v$$

Solve for v; collecting terms to one side we get

$$(1.50\,\text{kg})\,v = -0.500\,\text{kg}\,\tfrac{\text{m}}{\text{s}}$$

and then we have:

$$\boxed{v = -0.333\,\tfrac{\text{m}}{\text{s}}}$$

that is, it is moving to the left with speed $0.333\,\frac{\text{m}}{\text{s}}$

b) How much kinetic energy was lost in this collision?

Calculate the total KE before & after the collision:

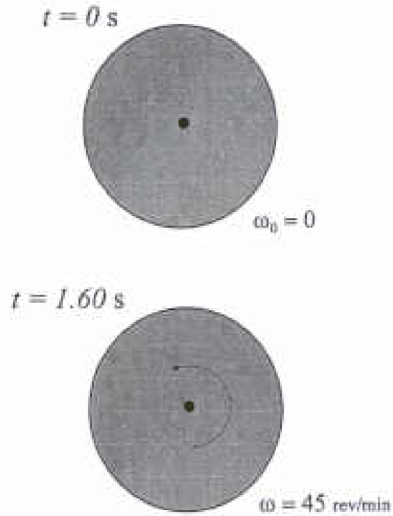
$$KE_{\text{init.}} = \tfrac{1}{2}(0.800\,\text{kg})(1.00\,\tfrac{\text{m}}{\text{s}})^2 + \tfrac{1}{2}(1.50\,\text{kg})(3.00\,\tfrac{\text{m}}{\text{s}})^2 = 7.15\ \text{J}$$

$$KE_{\text{final}} = \tfrac{1}{2}(0.800\,\text{kg})(4.00\,\tfrac{\text{m}}{\text{s}})^2 + \tfrac{1}{2}(1.50\,\text{kg})(0.333\,\tfrac{\text{m}}{\text{s}})^2 = 6.48\ \text{J}$$

The loss in KE is

$$|\Delta KE| = 7.15\,\text{J} - 6.48\,\text{J} = \boxed{0.667\ \text{J}}$$

2. A turntable starts from rest and accelerates uniformly in 1.60 s to a final angular velocity of 45.0 $\frac{\text{rev}}{\text{min}}$.



a) Find the final angular velocity in units of $\frac{\text{rad}}{\text{s}}$

$$45.0 \frac{\text{rev}}{\text{min}} = \left(45.0 \frac{\text{rev}}{\text{min}}\right)\left(\frac{2\pi \text{ rad}}{1 \text{ rev}}\right)\left(\frac{1 \text{ min}}{60 \text{ s}}\right)$$

$$= \boxed{4.71 \text{ rad/s}}$$

b) Find the angular acceleration of the turntable.

Use $\alpha = \frac{\omega - \omega_0}{t}$. Then:

$$\alpha = \frac{(4.71 \text{ rad/s} - 0)}{(1.60 \text{ s})} = \boxed{2.95 \frac{\text{rad}}{\text{s}^2}}$$

c) Find the angle through which the turntable turned in the 1.60 s.

We can use $\theta = \omega_0 t + \frac{1}{2}\alpha t^2$. Get:

$$\theta = \omega_0 t + \tfrac{1}{2}\alpha t^2 = 0 + \tfrac{1}{2}\left(2.95 \frac{\text{rad}}{\text{s}^2}\right)(1.60 \text{ s})^2$$

$$= \boxed{3.77 \text{ rad}}$$

d) Find the number of revolutions though which the turntable turned in this time.

Express θ in revolutions:

$$\theta = (3.77 \text{ rad})\left(\frac{1 \text{ rev}}{2\pi \text{ rad}}\right) = \boxed{0.60 \text{ rev}}$$

You must show all your work and include the right units with your answers!

$\mathbf{F}_{\text{net}} = m\mathbf{a}$ $g = 9.80 \frac{\text{m}}{\text{s}^2}$ *sohcahtoa...sohcahtoa...*mmm-hmm-mm, *sohcahtoa*

$\text{KE} = \frac{1}{2}mv^2$ $\mathbf{p} = m\mathbf{v}$ For isolated system $\mathbf{P}$ is conserved

$2\pi \text{ rad} = 360° = 1 \text{ rev}$ $\omega = \omega_0 + \alpha t$ $\theta = \omega_0 t + \frac{1}{2}\alpha t^2$ $\omega^2 = \omega_0^2 + 2\alpha\theta$ $|\tau| = Fr\sin\phi$

$v = \omega r$ $a_T = \alpha r$ $a_c = \frac{v^2}{r} = \omega^2 r$