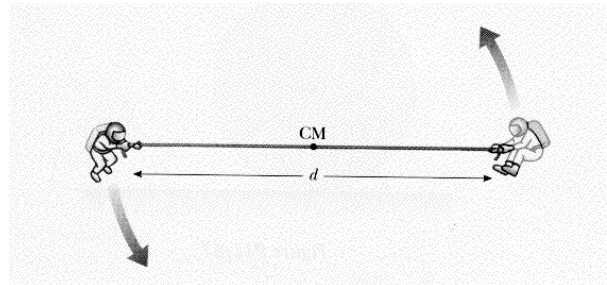


1. A baseball catcher sits on a rotating stool. He reaches out 85.0cm to catch a 40.0m/s fastball. After catching the ball he spins at a rate of 60.0rpm. His mass is 80.0kg and the mass of the ball is 150g. Find the rotational inertia of the catcher and the stool.



2. Two astronauts each have a mass of 75.0kg are initially connected by a 10.0m long rope of negligible mass. They are isolated in space and orbit their center of mass with a speed of 5.00m/s. They then begin to pull in on the rope until they are only 5.00m apart. Find (a) their initial angular momentum, (b) their initial kinetic energy, (c) their final angular momentum, (d) their final speed, (e) their final kinetic energy and (f) the work they have done.



3. The Antarctic ice sheet is the largest single mass of ice on Earth. If it melted completely, sea levels would rise by 61.1m and the radius of Earth will also increase by just about the same amount. (a) Use the current mass, M , radius, R , and time for one rotation, T , of Earth to find an expression for the angular momentum of Earth in terms of M , R , and T . (b) Solve this expression for the period as a function of the radius, R . (c) Differentiate T with respect to R to show that,

$$\frac{dT}{dR} = 2\frac{T}{R}.$$

Explain why some quantities are constants. (d) Let $\frac{dT}{dR} \approx \frac{\Delta T}{\Delta R}$ to

find a value for the change in the period of Earth's rotation due to the melting of Antarctica. (e) Explain your result by comparing Earth to a spinning ice skater that moves her hands outward.



A satellite image of Antarctica



4. Your friend tells you that it is easier to keep your balance on a moving bicycle than on a bicycle at rest. Do you agree or disagree? Explain to your friend the answer using the ideas of physics.