

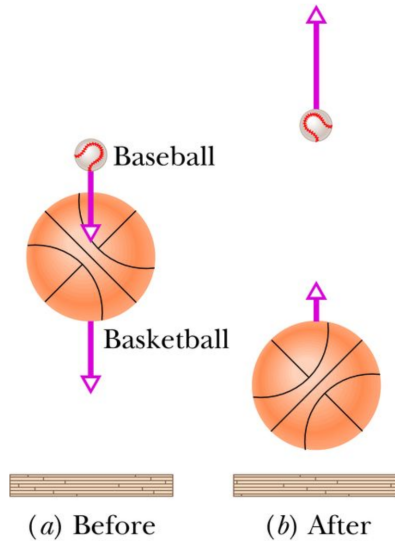
General Physics B1 - Midterm Exam 2 (12/06, 8:00AM~9:50AM)

There are 6 problem sets on two sides. Total:100 points

You may answer in English or Chinese. Please use SI units and take significant figure to the second decimal place for the answers. The gravitational acceleration $g=9.8m/s^2$.

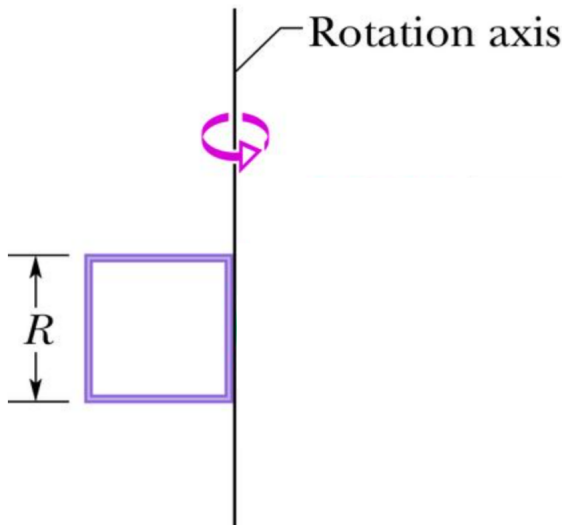
1.Elastic Collision

A small ball of mass m is aligned above a larger ball of mass $M = 0.9 \text{ kg}$ (with a slight separation, as with the baseball and basketball of Fig.(a), and the two are dropped simultaneously from a height of $h = 1.5 \text{ m}$. (Assume the radius of each ball is negligible relative to h .) (1) If the larger ball rebounds elastically from the floor and then the small ball rebounds elastically from the larger ball, what value of m results in the larger ball stopping when it collides with the small ball?(10points) (2) What height does the small ball then reach in Fig.(b)?(10points)



2. Rotational Energy and Angular Momentum

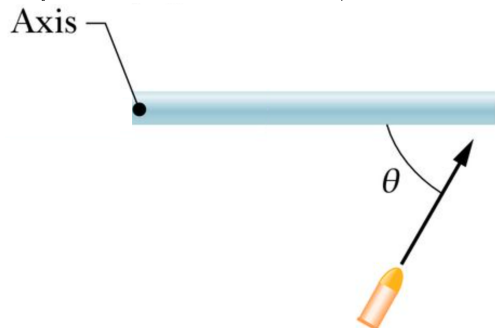
As shown in the following figure, a rigid structure consisting of a square made of four thin bars, each of length $R=0.5\text{m}$ and mass $m = 2.0 \text{ kg}$. The rigid structure rotates at a constant speed about a vertical axis, with a period of rotation of 2.5 s . calculate (1) the structure's rotational energy (10points) and (2) its angular momentum about that axis.(10points)



3. Rotational Inertia and Conservation of Angular Momentum

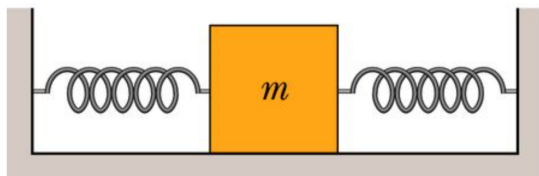
In the following figure (an overhead view), a uniform thin rod of length 0.500 m and mass 4.00 kg can rotate in a horizontal plane about a vertical axis through its END. The rod is at rest when a 3.00 g bullet traveling in the rotation plane is fired into the other end of the rod. In the view from above, the bullet's path makes angle $\theta = 60.0^\circ$ with the rod. The bullet lodges in the rod and the angular velocity of the rod is 10 rad/s immediately after the collision. (1) What is the rotational inertia of the rod with the bullet after the collision? (10 points) (2) What is the bullet's speed just before impact? (10 points)

maybe useful: $\sin 60^\circ = 0.8660$, $\cos 60^\circ = 0.5000$



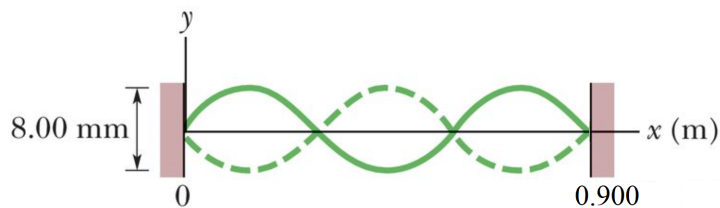
4. Oscillation with two springs

In the following figure, two springs are attached to a block that can oscillate over a frictionless floor. If the left spring is removed, the block oscillates at a frequency of 40 Hz. (1) If the mass is $m = 0.10 \text{ kg}$, what is the spring constant of the right spring. (5 points) (2) If, instead, the spring on the right is removed, the block oscillates at a frequency of 50 Hz. At what frequency does the block oscillate with both springs attached? (10 points)



5. Standing Wave

In the following figure shows resonant oscillation of a string of mass $m = 2.500 \text{ g}$ and length $L = 0.900 \text{ m}$ and that is under tension $\tau = 325.0 \text{ N}$. (1) What is the wavelength λ of the transverse waves producing the standing wave pattern? (5 points) and (2) what is the harmonic number n ? (5 points) (3) What is the frequency f of the transverse waves? (5 points) (4) What is the maximum magnitude of the transverse velocity u_m of the element oscillating at coordinate $x = 0.20 \text{ m}$? (5 points)



6. Draining a Tank

A large, open tank is filled to a height $h = 0.5 \text{ m}$ with liquid of density $\rho = 1000 \text{ kg/m}^3$. Find the speed of the liquid emerging from a small hole at the base of the tank? (10 points)