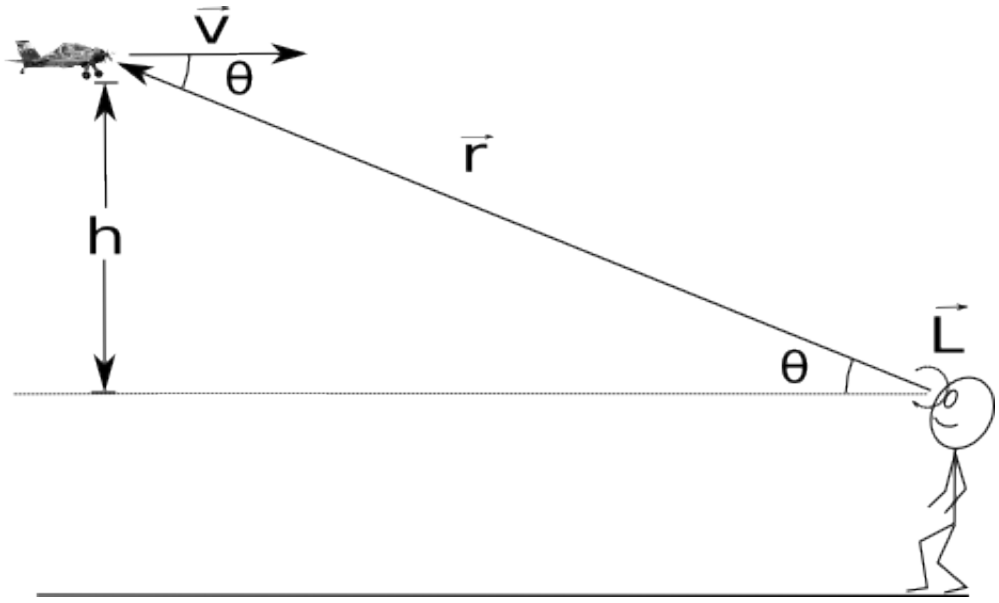
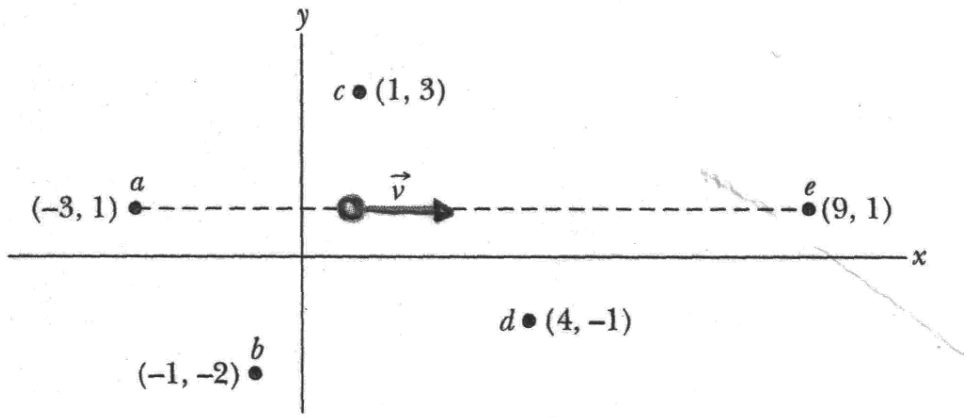
Name: _____ Problems Solved __/ 8

An airplane flying at a constant velocity conserves momentum. Show that the quantity $\vec{r}\times\vec{p}$ is also conserved, where $\vec{r}$ is the displacement between an observer and the plane and $\vec{p}$ is the momentum of the plane.

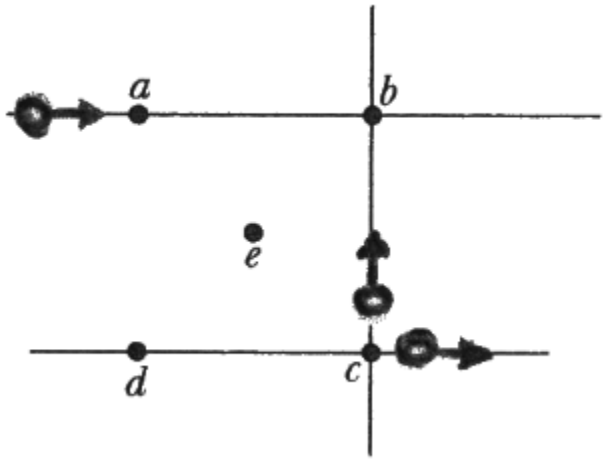
Calculate $\vec{r}\times\vec{p}$ from the prospective of an observer on the ground. Write the answer in terms of *m*, *v*, and *h*.



The figure below shows a particle moving at a constant velocity and five points along the trajectory. Rank the points according of the magnitude of the angular momentum of the particle measured about them, greatest first.



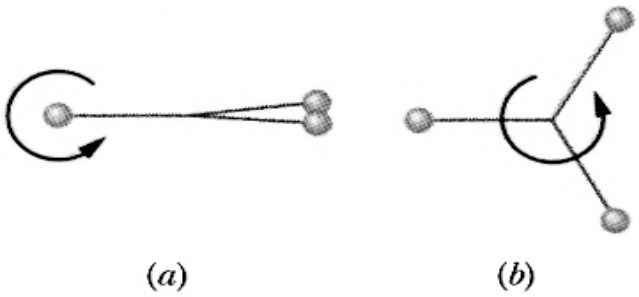
The figure shows three particles of the same mass and speed moving as indicated by the velocity vectors. Points a, b, c, and d form a square and e is at the center of the square. Rank the points according to the magnitude of the net angular momentum of the system.



The diameter of the Sun is approximately 100 Earth diameters and has a rotational period of about 25 days. If it ran out of nuclear fuel and suddenly collapsed to the diameter of the Earth, what would it's new rotational period be?

$$I_{sphere} = \frac{2}{5}MR^2$$

A Bola consists of three heavy balls connected to a common point by identical lengths of sturdy string. It is launched by holding one of the balls overhead and rotating the wrist, causing the other two balls to rotate in a horizontal circle. When it is released, its configuration changes from that shown in figure a to that shown in figure b.



Does its angular momentum about it's axis of rotation increase, decrease, or stay the same?
Does it's angular velocity about it's axis of rotation increase, decrease, or stay the same?
Discuss.

A beetle rides the rim of a horizontal disk rotating like a merry-go-round. If the beetle walks along the rim in the direction of the rotation, will the magnitudes of the following quantities increase decrease or remain the same?

Angular momentum of the system measured about the rotation axis.
a) increase b) decrease c) remain the same d) not enough information

Angular velocity of the beetle measured about the rotation axis.
a) increase b) decrease c) remain the same d) not enough information

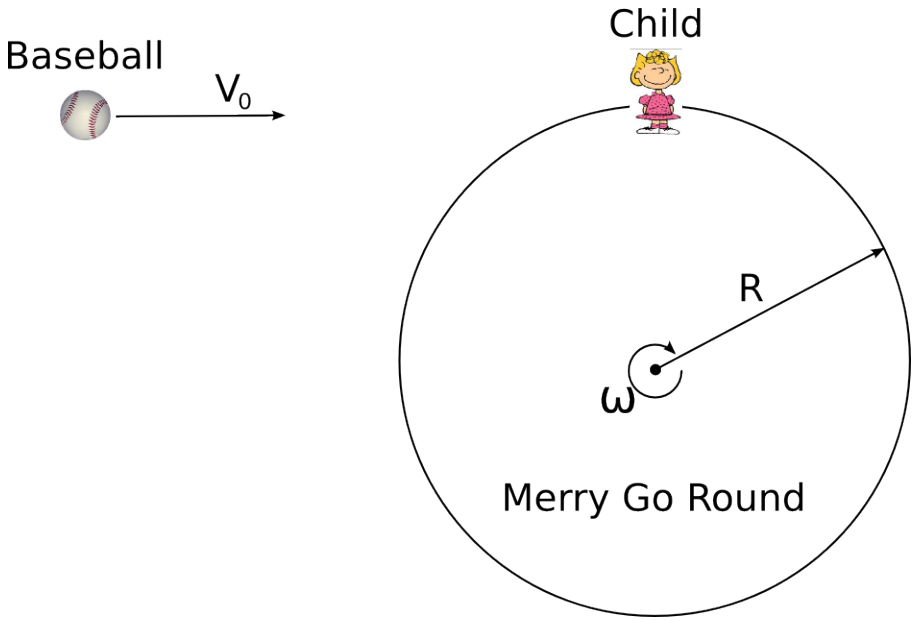
Angular momentum of the beetle measured about the rotation axis.
a) increase b) decrease c) remain the same d) not enough information

Angular velocity of the disk measured about the rotation axis.
b) increase b) decrease c) remain the same d) not enough information

Angular momentum of the disk measured about the rotation axis.
a) increase b) decrease c) remain the same d) not enough information

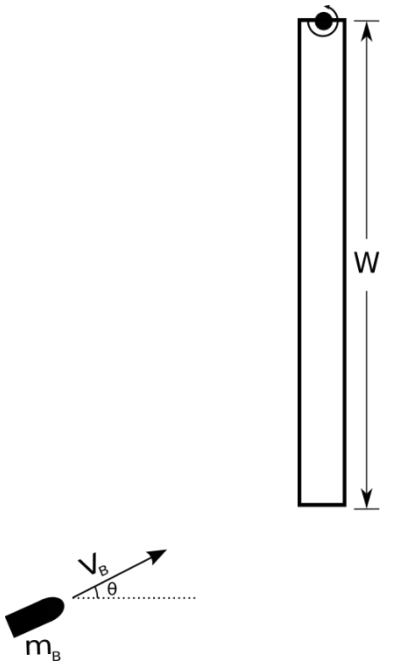
A child of mass *M* is on the outer edge of a merry-go-round that has a radius *R* and a moment of inertia I_M. Her friend throws a baseball with a mass *m* and velocity *v* in a direction tangent to the edge of the merry-go-round that is caught by the girl.

Find an expression for the angular velocity of the child, merry-go-round, baseball combination after the impact.



A bullet of mass m is fired with a velocity v_b at an angle θ with respect to the horizontal towards a door of width W and mass M. The moment of inertia of the door about its center is $I_{cm} = 1/12\ MW^2$. The bullet impacts the door on the edge opposite the hinge as shown in the picture below. Find an expression for the angular velocity of the bullet door combination after the impact.

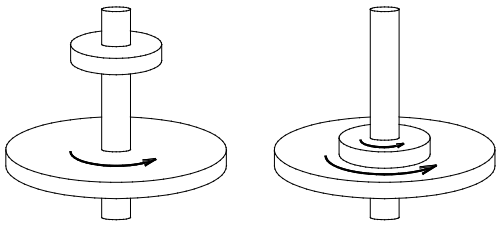
NOTE: The view is looking down at the door from above such that gravity is into the page and provides no Torque.



A disk with moment of inertia of I_1 rotates about a vertical, frictionless axle with an angular speed ω_o. A second disk, initially at rest, has a moment of inertia I_2 and is dropped onto the first disk. Because of friction between the two surfaces, the two disks eventually reach the same speed ω_f.

(a) Calculate ω_f.

(b) Show that the kinetic energy of the system decreases in this interaction and calculate the ratio of the final rotational energy to the initial rotational energy.



A chunk of clay of mass m_{clay} = m = 0.500 kg moving at a velocity of 3.00 m/s hits and sticks to a long thin rod that spins freely about a point ¼ of the way down from the top. The rod has a mass of m_{rod} = 2m = 1.00 kg and a length of 1.00 m.

Note: The moment of inertia a long thin rod about its *center of mass* is $I_{cm} = \frac{1}{12}mL^2$.

(a) What is the moment of inertia of the rod–clay combination?

(b) What is ω right after the collision?

(c) What is θ_{max}?