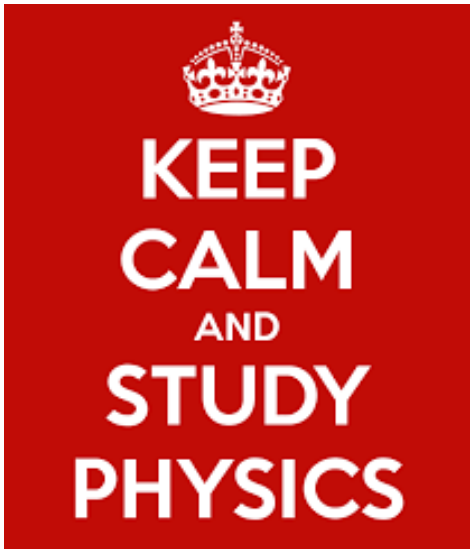
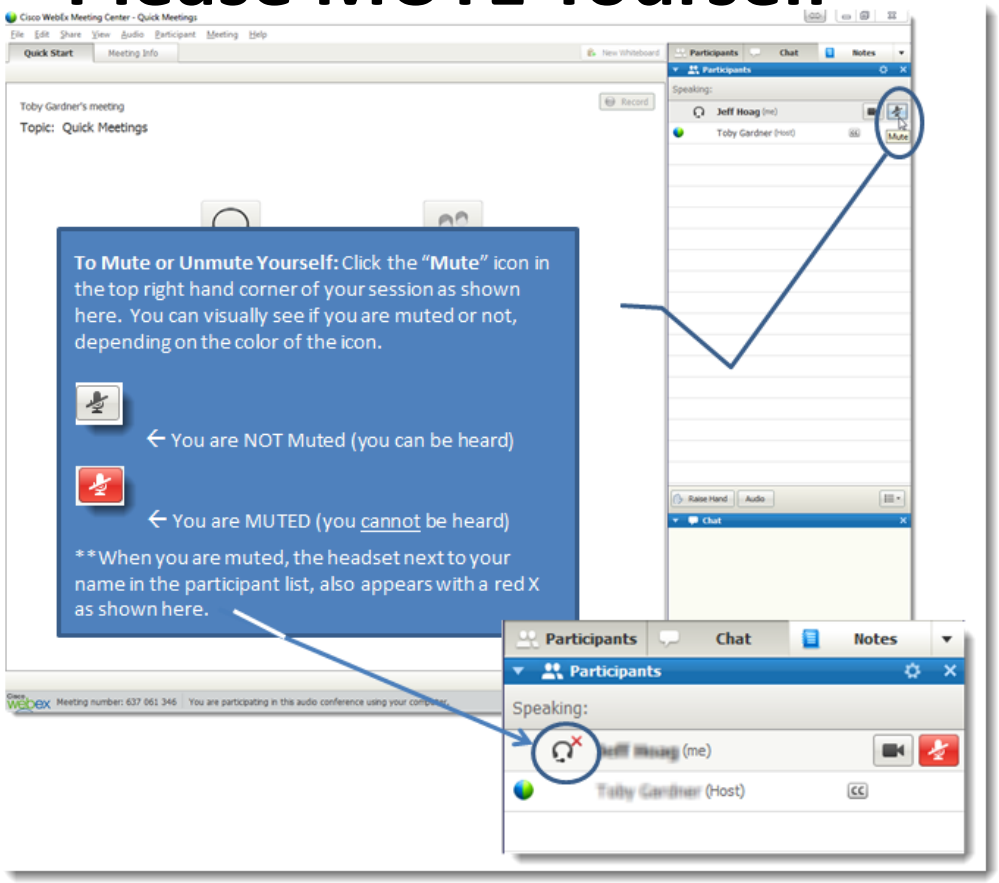
Physics 1041 Review Session



Physics Ninja is still resting

Your session will begin momentarily

Please MUTE Yourself



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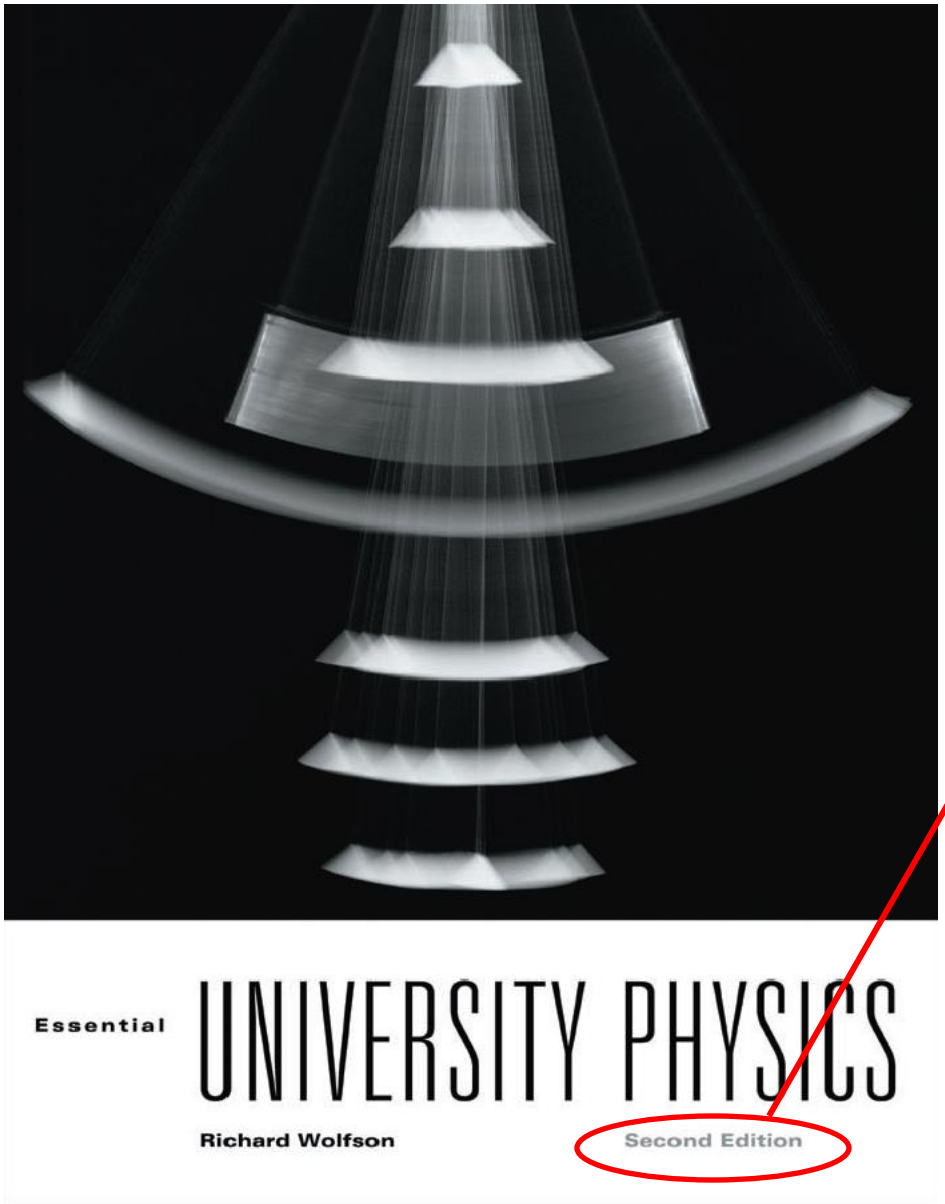


Same problems as 3rd edition but may have different numbers

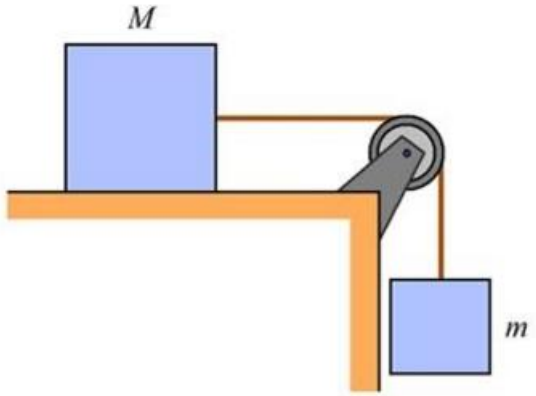
Submitted Questions

Problem 9.77

A car moving at speed *v* undergoes a one-dimensional collision with an identical car initially at rest. The collision is neither elastic nor fully inelastic; 5/18 of the initial kinetic energy is lost. Find the velocities of the two cars after the collision.

Problem: Acceleration of blocks with mass of the pulley

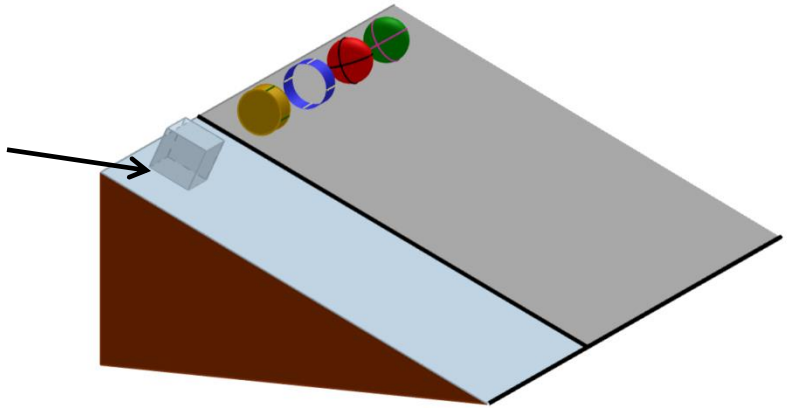
Find the acceleration of the system composed of two blocks of mass m and M and a disk shaped pulley with radius R and mass M_p ? The block M slides on a frictionless surface.

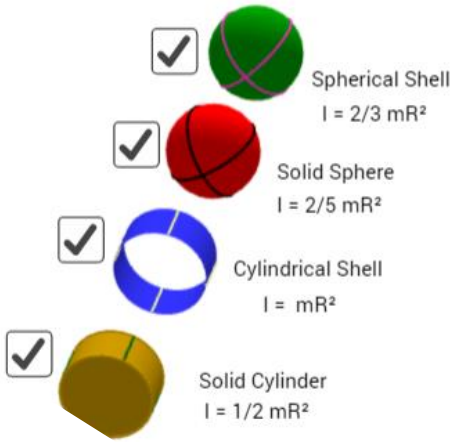


Problem: Race of Rigid Bodies

Which object makes it to the bottom of the incline first?

Block of mass M sliding down frictionless ramp

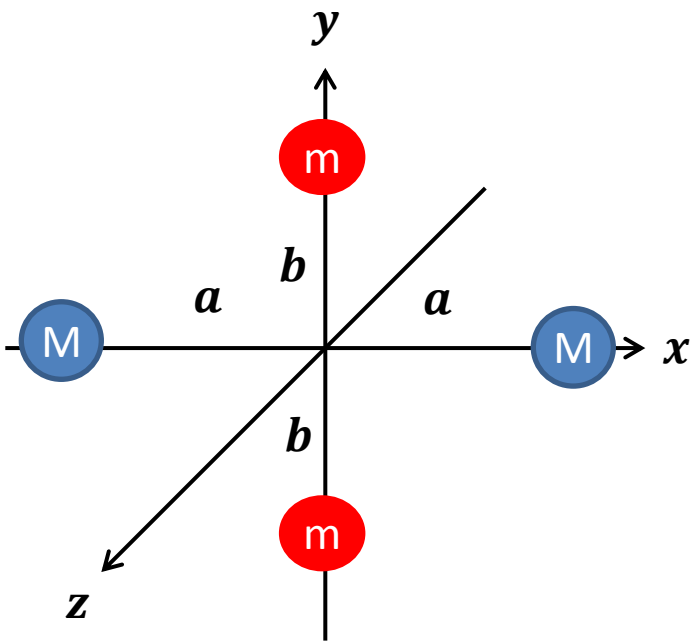




Problem: Moment of Inertia

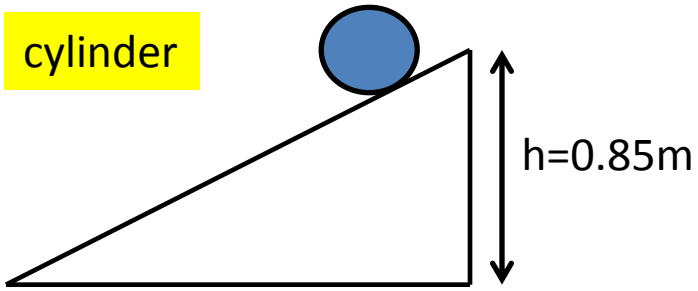
The figure shows a system of 4 particles joined by light rigid metal rods. Assume that the distances a=b and masse M > m. About which coordinate axis is the moment of inertia the smallest.

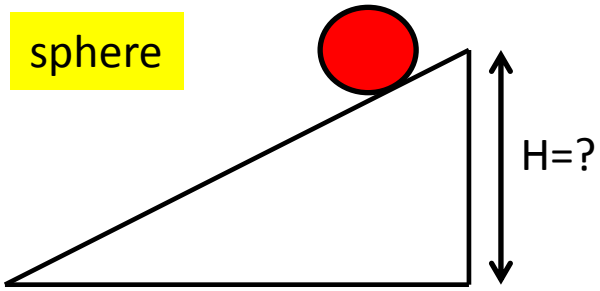
a) x-axis
b) y-axis
c) z-axis
d) The moment of inertia is the same for axis of rotation



Problem: Rotational dynamics 1

A solid cylinder is released from the top of an inclined plane of height 0.85m. From what height on the incline should a solid sphere of the same mass and radius be released to have the same speed as the cylinder at the bottom of the hill?





Problem: Rotational dynamics 2

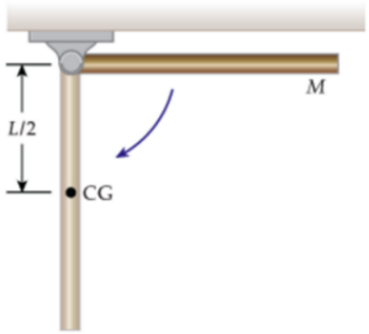
What is the final velocity of a hoop that rolls without slipping down a 5.5m high hill, starting from rest? What would be the final velocity if a disk of the same mass and radius as the hoop rolled down the hill?

Problem: Rotational dynamics 3

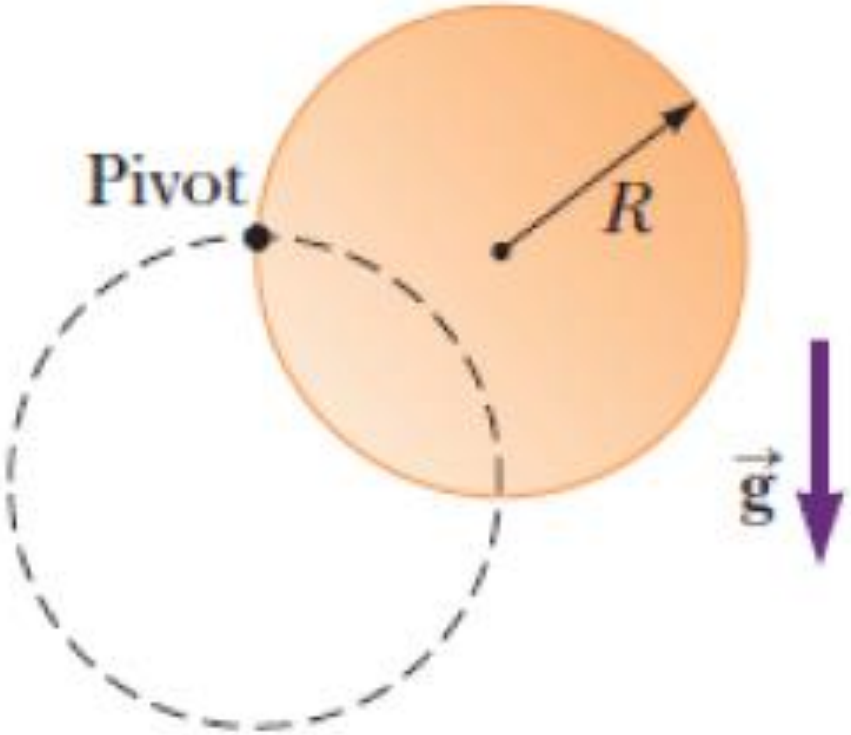
The diagram show a thin rod of uniform mass distribution pivoted about one end by a pin passing through that point. The mass of the rod is 0.37kg and its length is 2.8m. The center of gravity is located at half of its length. When the rod is released from its horizontal position, it swings down to the vertical position as shown.

a) Determine the speed of the center of gravity at its lowest position.

b) When the rod reaches the vertical position, calculate the tangential speed of the free end of the rod?

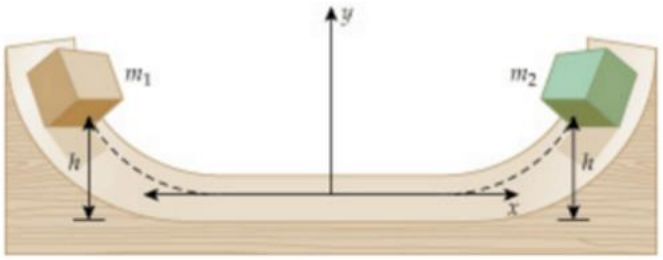


Problem: Another variation of preview problem



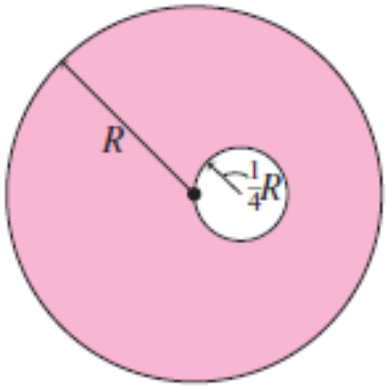
Problem: Elastic Collision

Two blocks are each released from rest at a height of h=3.28m on a frictionless track. When they meet at the bottom they undergo an elastic collision. Let m_1=2.5kg and m_2=4.25kg, determine the maximum heights (y_{1f} and y_{2f}) to which they rise after the collision



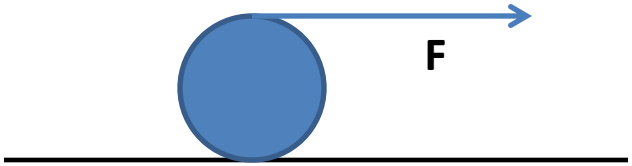
Problem 10.65: Disk with hole

A disk of radius *R* has an initial mass *M*. Then a hole of radius R/4 is drilled, with its edge at the disk center (Fig. 10.29). Find the new rotational inertia about the central axis.



Problem: Rotational Dynamics

A force **F** is applied to a cylindrical roll of paper of radius R and mass M by pulling on the paper as shown. The acceleration of the center of mass of the roll of paper (when is rolls without slipping is?



a) $\frac{F}{2M}$

b) $\frac{F}{M}$

c) $\frac{3F}{2M}$

d) $\frac{4F}{3M}$

Problem: Fan speeding up

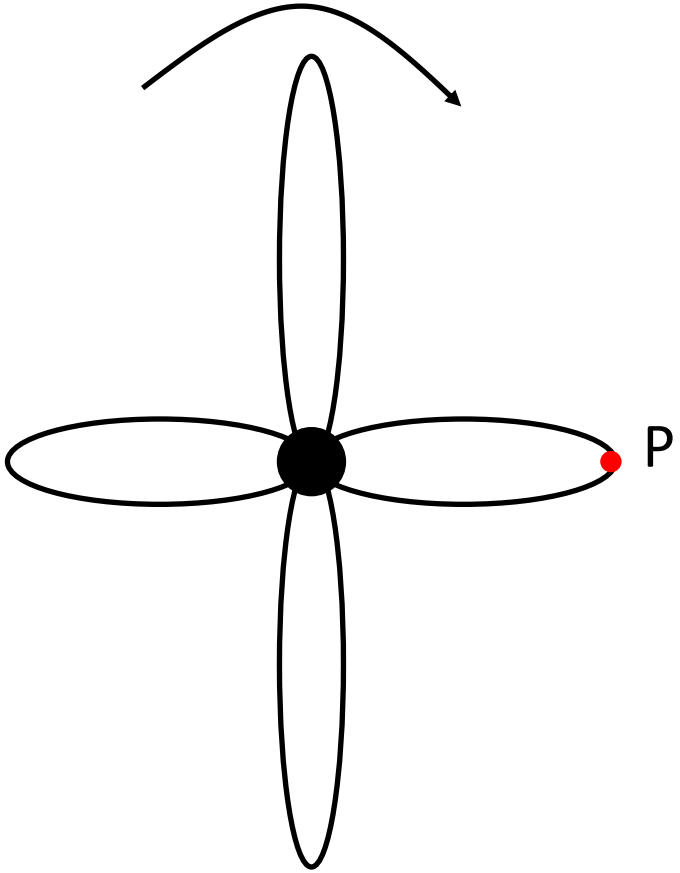
What is the direction of the acceleration at point P when the fan is slowing down?

a)

b)

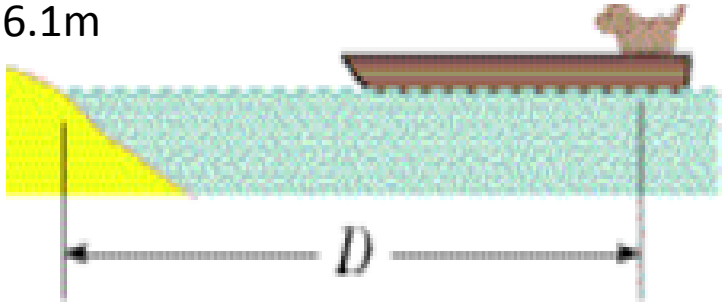
c)

d)



Problem: Dog on a boat

A 4.5Kg dog stands on an 18kg flatboat and is D=6.1m from the shore. He walks 2.4m along the boat toward the shore and then stops. If there is no friction between the boat and water, find how far the dog is then from the shore.



Problem: Buoyancy Problem

On land, the most massive concrete block you can carry is 25 kg. Given concrete's density of 2200 kg/m^3, how massive a block could you carry underwater?

VS

Problem

An object with Kinetic Energy K explodes into two pieces, each of which moves with twice the speed of the original object. What's the ratio of internal kinetic energy to the centre-of-mass kinetic energy after the explosion.

Problem

On a smooth, horizontal floor, an object slides into a spring which is attached to another mass that is initially stationary. When the spring is most compressed, both objects are moving at the same speed. Ignoring friction, what is conserved during this interaction?

a) kinetic energy
b) momentum
c) momentum and potential energy
d) momentum and kinetic energy
e) momentum and mechanical energy

Problem

A boat of mass 250 kg is coasting, with its engine in neutral, through the water at speed 1.00m/s when it starts to rain with incredible intensity. The rain is falling vertically, and it accumulates in the boat at the rate of 100 kg/hr.

a) What is the speed of the boat after time 0.500**hr** has passed? Assume that the water resistance is negligible.

b) Now assume that the boat is subject to a drag force $\boldsymbol{F}_d$ due to water resistance. Is the component of the total momentum of the system parallel to the direction of motion still conserved?

c) The drag is proportional to the square of the speed of the boat, in the form $F_d=bv^2$ where $b=0.5N{\cdot}s\ 2/m2$. What is the acceleration of the boat just after the rain starts? Take the positive x-axis along the direction of motion.

Problem 33 and 37:

33) At the MIT Magnet Laboratory, energy is stored in huge solid flywheels of mass $7.7 * 10^4$ kg and radius 2.4 m. The flywheels ride on shafts 41 cm in diameter. If a frictional force of 34 kN acts tangentially on the shaft, how long will it take the flywheel to come to a stop from its usual 360-rpm rotation rate?

37) (a) Find the energy stored in the flywheel of Exercise 33 when it's rotating at 360 rpm. (b) The wheel is attached to an electric generator and the rotation rate drops from 360 rpm to 300 rpm in 3.0 s. What's the average power output?

Problem 10.27

The chamber of a rock-tumbling machine is a hollow cylinder with mass 65 g and radius 7.1 cm. The chamber is closed by end caps in the form of uniform circular disks, each of mass 22 g. Find (a) the rotational inertia of the chamber about its central axis and (b) the torque needed to give the chamber an angular acceleration of 3.4 rad/s^2

Problem 11.13 (3rd edition)

A bug, initially at rest on a stationary, frictionless turntable, walks halfway around the turntable's circumference. Describe the motion of the turntable while the bug is walking and after the bug has stopped.

Problem 11.15

A wheel is spinning at 45 rpm with its axis vertical. After 15 s, it's spinning at 60 rpm with its axis horizontal. Find (a) the magnitude of its average angular acceleration and (b) the angle the average angular acceleration vector makes with the horizontal.

Problem 11.30

30. Vector $\vec{A}$ points 30° counterclockwise from the x-axis. Vector $\vec{B}$ has twice the magnitude of $\vec{A}$. Their product $\vec{A} \times \vec{B}$ has magnitude A^2 and points in the negative z-direction. What's the direction of vector $\vec{B}$?

Problem 15.26

A vertical tube open at the top contains 5.0 cm of oil with density 0.82g/cm^3 floating on 5.0 cm of water. Find the gauge pressure at the bottom of the tube.

Problem 15.46

Archimedes purportedly used his principle to verify that the king's crown was pure gold by weighing the crown submerged in water. Suppose the crown's actual weight was 25.0 N. What would be its apparent weight if it were made of (a) pure gold and (b) 75% gold and 25% silver, by volume? The densities of gold, silver, and water are 19.3 g/cm^3, 10.5 g/cm^3 and 1 g/cm^3 respectively.

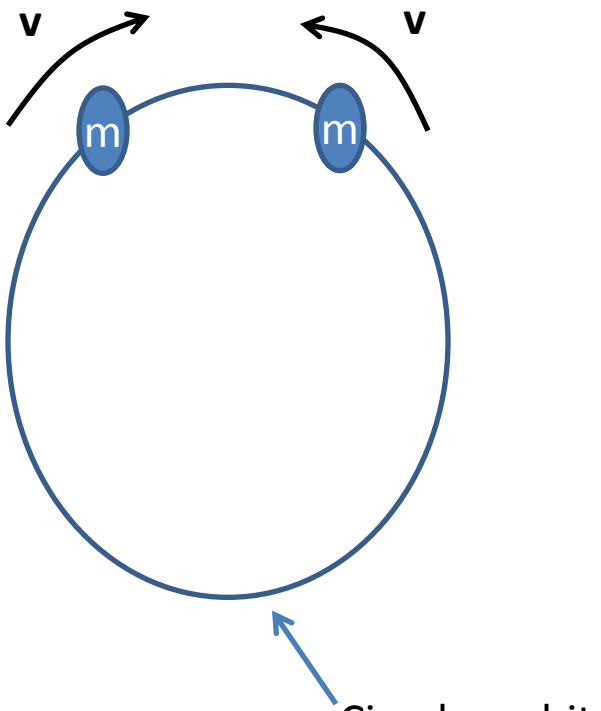
Problem 15.51

(a) How much helium (density) is needed to lift a balloon carrying two people, if the total mass of people, basket, and balloon (but not gas) is 280 kg? (b) Repeat for a hot-air balloon whose air density is 10% less than that of the surrounding atmosphere.

Chapter 9: Systems of Particles

Problem 9.11

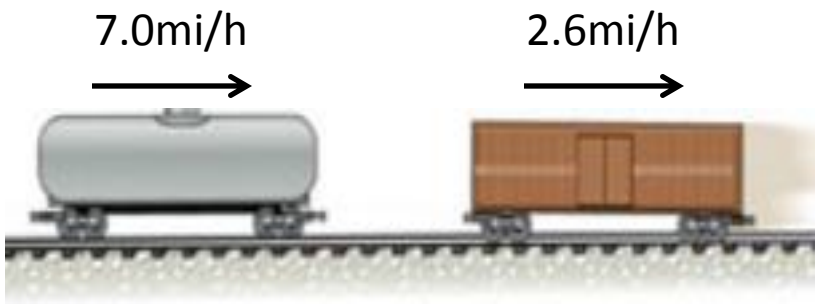
Two identical satellites are going in opposite directions in the same circular orbit when they collide head-on. Describe their subsequent motion if the collision is (a) elastic or (b) inelastic.



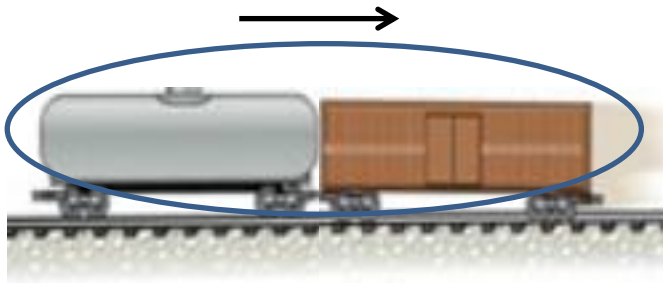
Problem 9.26

In a railroad switchyard, a 56-ton freight car is sent at 7.0 mi/h toward a 31-ton car moving in the same direction at 2.6 mi/h. (a) What's the speed of the cars after they couple? (b) What fraction of the initial kinetic energy was lost in the collision?

Before Collision

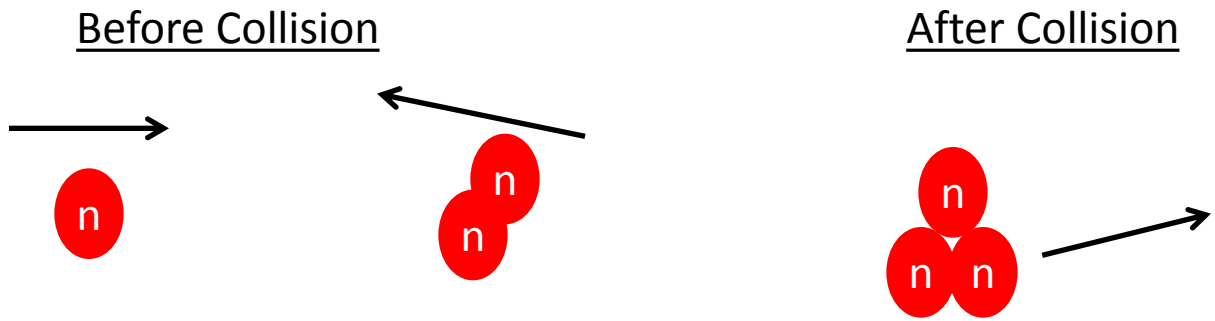


After Collision



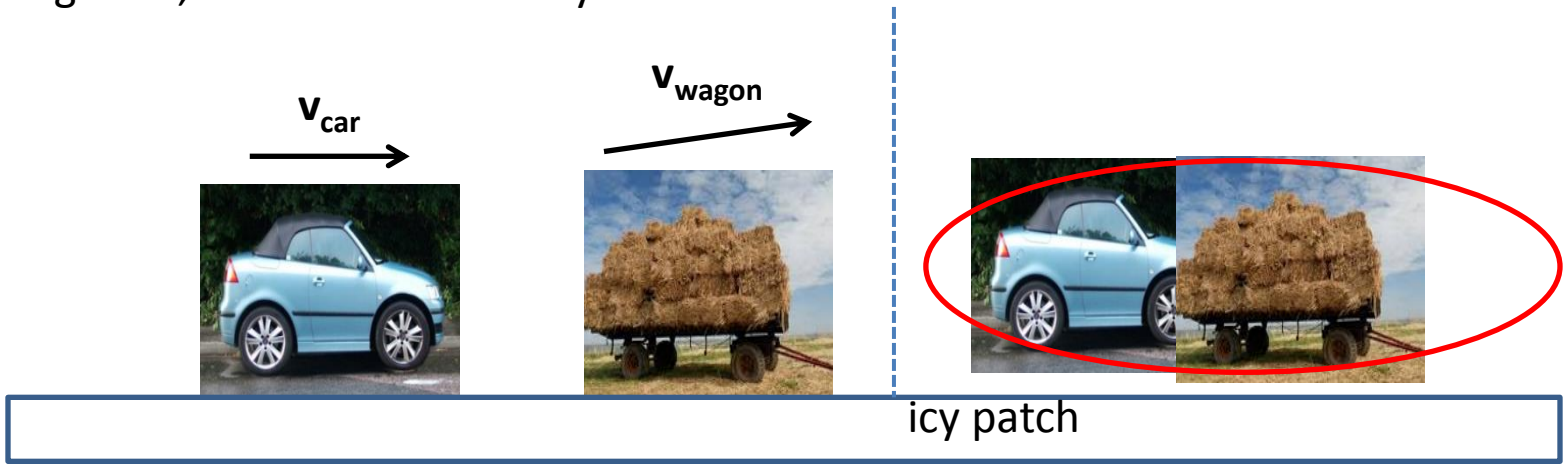
Problem 9.28

A neutron (mass 1 u) strikes a deuteron (mass 2 u), and they combine to form a tritium nucleus. If the neutron's initial velocity was $28\vec{\imath} + 17\vec{j}$ Mm/s and if the tritium leaves the reaction with velocity $12\vec{\imath} + 20\vec{j}$ Mm/s, what was the deuteron's velocity?



Problem 9.46

A 950-kg compact car is moving with velocity $32\vec{\imath} + 17\vec{j}\ m/s$. It skids on a frictionless icy patch and collides with a 450-kg hay wagon with velocity $12\vec{\imath} + 14\vec{j}\ m/s$. If the two stay together, what's their velocity?



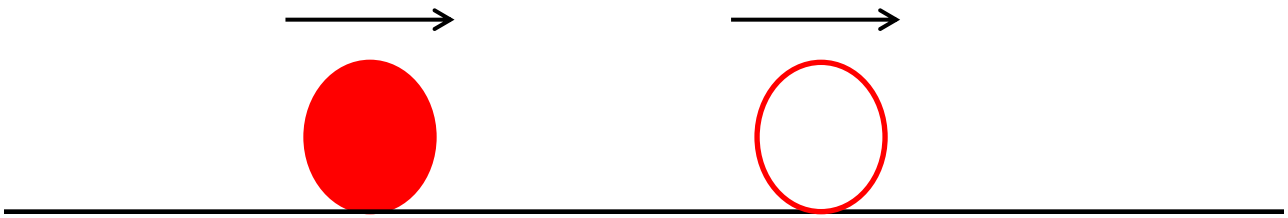
Chapter 10: Rotational Motion

Problem 10.1

Do all points on a rigid, rotating object have the same angular velocity? Linear speed? Radial acceleration?

Problem 10.6

A solid sphere and a hollow sphere of the same mass and radius are rolling along level ground. If they have the same total kinetic energy, which is moving faster?



Problem 10.34

A 25-cm-diameter circular saw blade has mass 0.85 kg, distributed uniformly in a disk. (a) What's its rotational kinetic energy at 3500 rpm? (b) What average power must be applied to bring the blade from rest to 3500 rpm in 3.2 s?

Problem 10.38

A solid 2.4-kg sphere is rolling at 5.0 m/s. Find (a) its translational kinetic energy and (b) its rotational kinetic energy.

Problem 10.41

A wheel turns through 2.0 revolutions while accelerating from rest at 18 rpm/s. (a) What's its final angular speed? (b) How long does it take?

Problem 10.59

A potter's wheel is a stone disk 90 cm in diameter with mass 120 kg. If the potter's foot pushes at the outer edge of the initially stationary wheel with a 75-N force for one-eighth of a revolution, what will be the final speed?

Chapter 11: Rotational Vectors and Angular Momentum

Problem 11.32

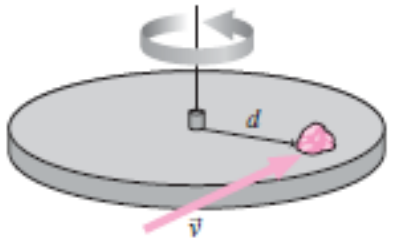
Show that $\vec{A} \cdot \left(\vec{A} \times \vec{B}\right)$ for any vectors 3 vectors.

Problem 11.43

A circular bird feeder 19 cm in radius has rotational inertia $0.12\ kg \cdot m^2$. It's suspended by a thin wire and is spinning slowly at 5.6 rpm. A 140-g bird lands on the feeder's rim, coming in tangent to the rim at 1.1 m/s in a direction opposite the feeder's rotation. What's the rotation rate after the bird lands?

Problem 11.45

A turntable has rotational inertia **I** and is rotating with angular speed about a frictionless vertical axis. A wad of clay with mass *m* is tossed onto the turntable and sticks a distance *d* from the rotation axis. The clay hits horizontally with its velocity at right angles to the turntable's radius, and in the same direction as the turntable's rotation (Fig. 11.14). Find an expression for *v* that will result in (a) the turntable's angular speed dropping to half its initial value, (b) no change in the turntable's angular speed, and (c) the angular speed doubling.



Chapter 15: Fluids

Problem 15.21

A 4300-kg circus elephant balances on one foot. If the foot is a circle 30 cm in diameter, what pressure does it exert on the ground?

Problem 15.27

A child attempts to drink water through a 100-cm-long straw but finds that the water rises only 75 cm. By how much has the child reduced the pressure in her mouth below atmospheric pressure?

Problem 15.32

A steel drum has volume $0.23\ m^3$ and mass 16 kg. Will it float in water when filled with (a) water or (b) gasoline (density $860\ kg/m^3$)?

Problem 15.52

A 55-kg swimmer climbs onto a Styrofoam block of density $860\ kg/m^3$. If the water level comes right to the top of the Styrofoam, what's the block's volume?

Thank You!

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