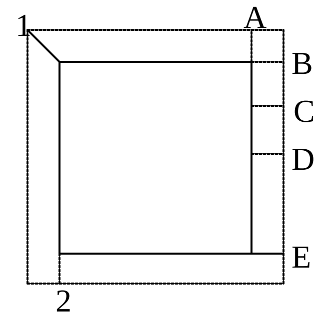
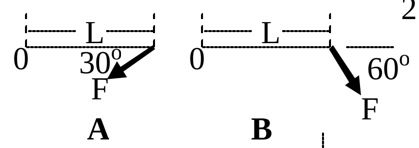


8-1A) A rigid square object of negligible weight is acted upon by the forces 1 and 2 shown at the right, which pull on its corners. The forces are drawn to scale in terms of the dotted lines. Which one of the labelled forces and locations will produce equilibrium?

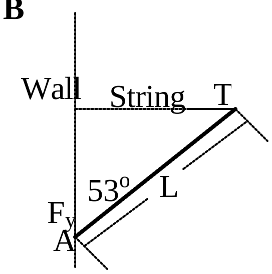
(a) A (b) B (c) C (d) D (e) E

8-2A). A force F = 4 N is pulling on one end of a stick of length L = 2 m. About what are the magnitudes of the torques about the other end of the stick (point 0) when the force is applied in the two different cases, A and B shown at the right.



(a) A: 4 N-m; B: 4 N-m (b) A: 8 N-m; B: 4 N-m (c) A: 7 N-m; B: 4 N-m
(d) A: 4 N-m; B: 7 N-m (e) A: 7 N-m, B: 7 N-m

A uniform rod of mass 6.0 kg and length L = 2.0 m is attached to a wall at one end by a pivot A and at the other end by a horizontal string. The rod is in static equilibrium at an angle of 53° with the wall.



8-3A) About what is the magnitude of the tension T in the string?

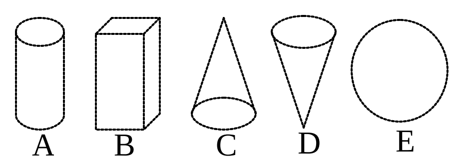
(a) 80 N (b) 23 N (c) 30 N (d) 60 N (e) 40 N

8-4A) About what is the magnitude of the vertical force F_v on the rod at the pivot A?

(a) 60 N (b) 30 N (c) 23 N (d) 40 N (e) 90 N

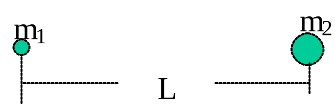
8-5A) The five figures shown at the right all have the same height and are all of uniform density. Which one has its center of gravity closest to the ground?

(a) A (b) B (c) C (d) D (e) E



8-6A) Two particles of mass m_1 = 2.0 kg and m_2 = 6.0 kg, respectively, are separated by a distance L = 80 cm as shown at the right. How far from the smaller mass is the center of gravity of these two masses?

(a) 40 cm (b) 20 cm (c) 60 cm (d) 50 cm (e) 80 cm

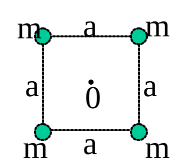


8-7A) A uniform solid cylinder made of lead has the same mass and the same length as a uniform solid cylinder of wood. The rotational inertia of the lead cylinder (about its cylindrical axis) compared to the wood one is: (Note: lead is much denser than wood.)

(a) larger. (b) smaller. (c) the same. (d) you need to know the radii to tell. (e) you need to know both the masses and the radii to tell.

8-8A) What is the moment of inertia I of the four equal masses m shown at the right about the axis 0 (sticking out of the page) at the center of the four masses?

(a) $2\ ma^2$ (b) $6\ ma^2$ (c) ma^2 (d) $4\ ma^2$ (e) None of these is right



8-9A) A disk of rotational inertia I, initially rotating with angular speed ω stops in a time t due to a retarding torque τ. If the torque is doubled, and the initial angular speed is halved, about how long should it take for the disk to stop?

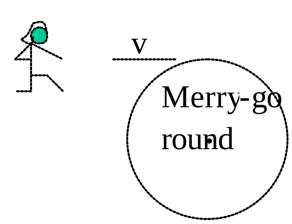
(a) t /4 (b) t /2 (c) t (d) 2t (e) 4t

8-10A) A disk of rotational inertia I, initially rotating with angular speed ω moves through an angle ϑ(rad) as it stops due to a retarding torque τ. If the torque is doubled, and the initial angular speed is halved, through about what angle does it rotate as it stops?

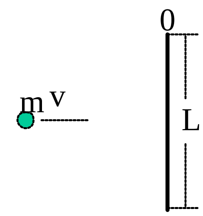
(a) $\vartheta/16$ (b) $\vartheta/2$ (c) $\vartheta/4$ (d) $\vartheta/8$ (e) ϑ

8-11A) A girl initially running with constant velocity **v** jumps onto the outer edge of a merry-go-round as shown at the right, and thereafter rotates with the merry-go-round. To solve for the angular velocity of the merry-go-round plus girl, which of the following laws should be used?

(a) conservation of angular momentum only.
(b) conservation of linear momentum only.
(c) conservation of kinetic energy only.
(d) conservation of angular momentum and kinetic energy.
(e) conservation of linear momentum and kinetic energy.



8-12A) A piece of clay of mass m = 2 kg is initially sliding on a horizontal frictionless table top with constant speed v = 6 m/s toward the middle of a uniform rod of length L = 1 m and mass M = 3 kg that is pivoted about one end (point 0) and is initially at rest. The clay sticks to the rod where it hits. About what is the resulting angular velocity ω of the rod plus clay? I(rod) = $(1/3)ML^2$.



(a) 1 rad/s (b) 6 rad/s (c) 2 rad/s (d) 4 rad/s (e) 3 rad/s

8-13A) A student is holding two equal dumbbells at arms length and is standing on a circular table that is rotating without friction with a constant angular speed ω. If, without moving anything else, the student simply drops the dumbbells, which one of the following statements is WRONG? Neglect air resistance, and consider the problem immediately after the dumbbells are released.
(a) The angular momentum of each dumbbell is conserved. (b) The student continues to rotate with ω.
(c) The dumbells initially move radially outward. (d) The student's angular momentum is conserved.
(e) The student's kinetic energy is conserved.

8-14A) Which one of the following statements is WRONG?
(a) For calculating the moment of inertia, the mass of a body cannot simply be considered as concentrated at its center of mass.
(b) If a uniform cylinder and a hoop, having the same outer radius and the same total mass, roll side by side down an inclined plane, both starting from rest, then the cylinder should reach the bottom of the plane first.
(c) If a girl sitting on a horse on a merry-go-round throws a ball radially outward, then the angular momentum of the girl plus merry-go--round stays constant.
(d) If a particle moves in a straight line with constant velocity, its angular momentum about any fixed point stays constant as it moves.
(e) A solid cylinder rolls without slipping down two different inclined planes of the same height but different angles of inclination. Its speed at the bottom is faster for the plane with the larger angle of inclination.

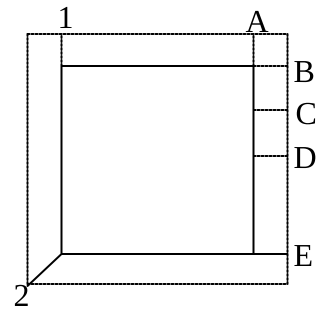
8-15A) Which one of the following statements is WRONG?
(a) A cockroach is initially at rest on the perimeter of a static turntable that has an almost frictionless bearing but a rough top surface. If the cockroach now walks clockwise around the perimeter, the turntable should rotate counterclockwise.
(b) Ruth and Roger are cycling together at the same linear speed. The wheels of Ruth's bike have a little larger diameter than those of Roger's. The angular speed of Ruth's wheels is a little slower than the angular speed of Roger's wheels.
(c) If a car's speedometer reads a speed proportional to the rotation speed of its rear wheels, then one must correct the reading when using tires of a different diameter (e.g., snow tires).
(d) If global warming melted the ice caps, and the resulting water was distributed closer to the equator, the length of the day on Earth should decrease.
(e) A high diver rotating in the 'layout position' (large moment of inertia about her center of gravity) can rotate faster by drawing her legs up against her chest ('tuck position' = smaller moment of inertia about her center of gravity).

8-16A) A demonstrator is rotating at constant ω on a chair with frictionless bearings. She initially has her arms out, holding weights so that her total moment of inertia is I. When she brings the weights in to her chest, her moment of inertia decreases to I/2. What is the ratio of her final kinetic energy to her initial kinetic energy?
(a) 1 (b) 2 (c) ½ (d) ¼ (e) 4.

8-17A) Which one of the following statements is WRONG?
(a) The moment of inertia of a body will generally change as the axis of rotation is changed.
(b) The moment of inertia of a thin rod is larger about its end than about its center.
(c) The moment of inertia of a uniform cylinder of a given mass and radius is smaller than that of a hoop of the same mass and radius.
(d) The center of gravity of a body can be outside the physical part of the body (i.e., it can be in empty space).
(e) If the center of gravity of a body is at rest, then no part of the body can be moving in any way.

8-18A) A wheel of radius r = 2.0 m rolls without slipping on flat ground. If the linear speed of its center of mass is 6.0 m/sec relative to the ground, what is its angular speed of rotation ω about its center of mass?
(a) 12 rad/s (b) 3.0 rad/s (c) 6π rad/s (d) 24π rad/s (e) 12π rad/s

8-19A) A disk of mass m, radius R, and moment of inertia I, starts from rest and rolls without slipping down a hill of height h. Its linear kinetic energy at the bottom of the hill is:
(a) mgh (b) $mgh(1 + I/mR^2)$ (c) $mgh/(1 + I/mR^2)$ (d) $mgh/(I/mR^2)$ (e) None of these is correct.

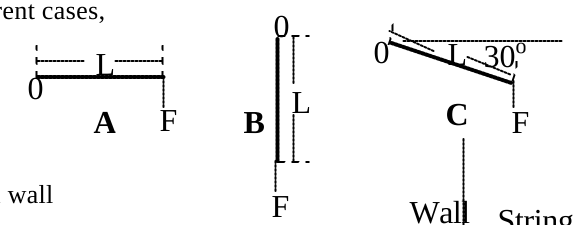


8-1B) A rigid square object of negligible weight is acted upon by the forces 1 and 2 shown at the right, which pull on its corners. The forces are drawn to scale in terms of the dotted lines. Which one of the labelled forces and locations will produce equilibrium?

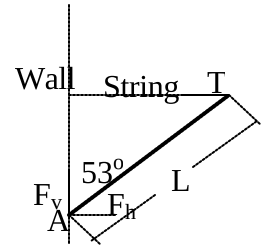
(a) A (b) B (c) C (d) D (e) E

8-2B) A force F = 10 N is pulling on one end of a stick of length L = 4.0 m. About what are the magnitudes of the torques (in N-m) about the other end of the stick (point 0) when the force is applied in the three different cases, A, B, and C shown at the right.

(a) A = 40, B = 0, C = 20. (b) A = 0, B = 40, C = 20.
(c) A = 40, B = 0, C = 35. (d) A = 35, B = 0, C = 40.
(e) A = 20, B = 35, C = 40



A uniform rod of mass 9.0 kg and length L = 2.0 m is attached to a wall at one end by a pivot A and at the other end by a horizontal string. The rod is in static equilibrium at an angle of 53^o with the wall.

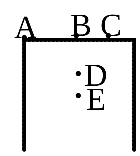


8-3B) About what is the magnitude of the horizontal force F_h on the rod at the pivot A?

(a) 80 N (b) 23 N (c) 30 N (d) 60 N (e) 40 N

8-4B) About what is the magnitude of the vertical force F_v on the rod at the pivot A?

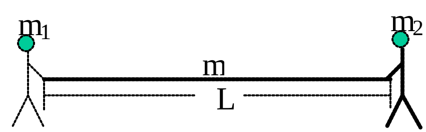
(a) 90 N (b) 45 N (c) 30 N (d) 72 N (e) 54 N



8-5B) The center of gravity of the thick wire object shown at the right is closest to point:

(a) A (b) B (c) C (d) D (e) E

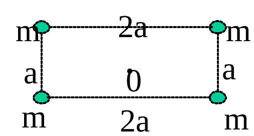
8-6B). Two strong children on ice skates, one of mass m_1 = 20 kg and one of mass m_2 = 60 kg, are holding the ends of a uniform rod of mass 20 kg and length 2 m as shown at the right. The children gradually pull themselves together to the middle of the rod. If you can neglect friction with the ice, about how far should they be from the starting position of the smaller (20 kg) child, when they reach the middle of the rod?



(a) 1.4 m (b) 1.0 m (c) 1.1 m (d) 1.8 m (e) You don't have enough information to tell.

8-7B) One uniform solid cylinder of wood has mass M, length L and radius R. A second uniform solid cylinder made of the same wood also has mass M, but has length 2L and whatever radius r is need to make the total mass stay equal to M. The moment of inertia of the second cylinder (around its cylindrical axis) compared to the first one is:

(a) larger. (b) smaller. (c) the same. (d) you need to know the radii to tell. (e) you need to know both the masses and the radii to tell.



8-8B) What is the moment of inertia about the axis 0 (sticking out of the page) of the four equal masses m shown at the right?

(a) 4 ma^2 (b) 10 ma^2 (c) 6 ma^2 (d) 8 ma^2 (e) 5 ma^2

8-9B) A cylinder with an initial angular speed ω_1 = 2 rad/s about its center of mass is stopped by a torque τ = -10 Nm. The total time it takes to stop is t_1 = 2 s. How long would it take the same cylinder to stop if it is acted upon by the same torque, but starts with an initial angular speed ω_2 = 4 rad/s?

(a) 4π s (b) 8π s (c) 4 s (d) 1 s (e) 2 s

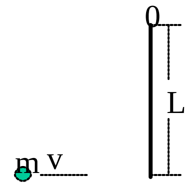
8-10B) A disk of rotational inertia I, initially rotating with angular speed ω, moves through an angle ϑ(rad) as it stops due to a retarding torque τ. If the torque and the initial angular speed are both doubled, through about what angle does it rotate as it stops?

(a) $\vartheta/8$ (b) $\vartheta/4$ (c) $\vartheta/2$ (d) ϑ (e) 2ϑ

8-11B) A person is rotating on a frictionless base with her arms extended outward holding two 1 kg weights. When she pulls her arms straight in, which one of the following statements is CORRECT?

(a) Her angular momentum and kinetic energy both increase.
(b) Her angular momentum is constant, but her kinetic energy increases.
(c) Her angular momentum and kinetic energy are both constant.
(d) Her angular momentum and kinetic energy both decrease.
(e) Her angular momentum is constant, but her kinetic energy decreases.

8-12B) A piece of clay of mass m = 2 kg is initially sliding on a horizontal frictionless table top with constant speed v = 6 m/s toward the end of a uniform rod of length L = 1 m and mass M = 3 kg that is pivoted about one end (point 0) and is initially at rest. The clay sticks to the rod where it hits. About what is the resulting angular velocity ω of the rod plus clay? I(rod) = $(1/3)ML^2$.



(a) 1 rad/s (b) 6 rad/s (c) 2 rad/s (d) 4 rad/s (e) 3 rad/s

8-13B) A student is holding two equal dumbbells at arms length and is standing on a circular table that is rotating without friction with a constant angular speed ω. If, without moving anything else, the student simply drops the dumbbells, which one of the following statements is WRONG? Neglect air resistance, and consider the problem immediately after the dumbbells are released.
(a) The angular momentum of each dumbbell is conserved.
(b) The student starts to rotate with angular speed faster than ω.
(c) The dumbells initially move tangentially.
(d) The student's angular momentum is conserved.
(e) The student's kinetic energy is conserved.

8-14B) Which one of the following statements is WRONG?
(a) For calculating the moment of inertia, the mass of a body cannot simply be considered as concentrated at its center of mass.
(b) If a uniform cylinder and a hoop, having the same outer radius and the same total mass, roll side by side down an inclined plane, both starting from rest, then the hoop should reach the bottom of the plane first.
(c) If a girl sitting on a horse on a merry-go-round throws a ball radially outward, then the angular momentum of the girl plus merry-go--round stays constant.
(d) If a particle moves in a straight line with constant velocity, its angular momentum about any fixed point stays constant as it moves.
(e) A solid cylinder rolls without slipping down two different inclined planes of the same height but different angles of inclination. Its speed at the bottom is the same for both planes.

8-15B) Which one of the following statements is WRONG?
(a) A cockroach is initially at rest on the perimeter of a static turntable that has an almost frictionless bearing but a rough top surface. If the cockroach now walks clockwise around the perimeter, the turntable should also rotate clockwise.
(b) Ruth and Roger are cycling together at the same linear speed. The wheels of Ruth's bike have a little larger diameter than those of Roger's. The angular speed of Ruth's wheels is a little slower than the angular speed of Roger's wheels.
(c) If a car's speedometer reads a speed proportional to the rotation speed of its rear wheels, then one must correct the reading when using tires of a different diameter (e.g., snow tires).
(d) If global warming melted the ice caps, and the resulting water was distributed closer to the equator, the length of the day on Earth should increase.
(e) A high diver rotating in the 'layout position' (large moment of inertia about her center of gravity) can rotate faster by drawing her legs up against her chest ('tuck position' = smaller moment of inertia about her center of gravity).

8-16B) A demonstrator is rotating at constant ω on a chair with frictionless bearings. He initially has his arms in, holding weights so that his total moment of inertia is I. When he extends his arms outward, his moment of inertia increases to 3I. About what is the ratio of his final kinetic energy to his initial kinetic energy?
(a) 1 (b) 1/3 (c) 1/9 (d) 3 (e) 9.

8-17A) Which one of the following statements is WRONG?
(a) The moment of inertia of a body will generally change as the axis of rotation is changed.
(b) The moment of inertia of a thin rod is larger about its end than about its center.
(c) The moment of inertia of a uniform cylinder of a given mass and radius is smaller than that of a hoop of the same mass and radius.
(d) The center of gravity of a body cannot be outside the physical part of the body (i.e., it can't be in empty space).
(e) If the center of gravity of a body is at rest, the body can still be rotating about its center of gravity.

8-18B) A wheel of radius r = 2.0 m is rolling without slipping on flat ground. If the wheel's angular speed of rotation about its center of mass is ω = 4.0 rad/sec, what is the linear speed of its center of mass?
(a) 2π m/s (b) 16π m/s (c) 2.0 m/s (d) 4π m/s (e) 8.0 m/s

8-19B) A disk of mass m, radius R, and moment of inertia I, starts from rest and rolls without slipping down a hill of height h. Its rotational kinetic energy at the bottom of the hill is:
(a) mgh (b) $mgh/(1 + I/mR^2)$ (c) $mgh/(1 + mR^2/I)$ (d) $mgh(1 + mR^2/I)$ (e) None of these is correct.

8-1A) b 2A) d 3A) e 4A) a 5A) c 6A) c 7A) b 8A) a 9A) a 10A) d 11A) a 12A) d 13A) c 14a) e 15A) d 16A) b 17A) e 18A) b 19A) c

8-1B) e 2B) c 3B) d 4B) a 5B) d 6B) a 7B) b 8B) e 9B) c 10B) e 11B) b 12B) d 13B) b 14B) b 15B) a 16B) b 17B) d 18B) e 19B) c