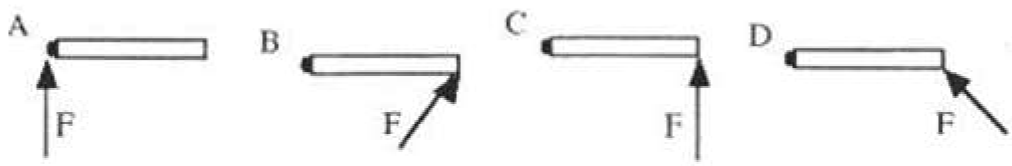
1) A football is kicked off the ground a distance of 50 yards downfield. Neglecting air resistance, which of the following statements would be INCORRECT when the football reaches the highest point?
(A) all of the balls original kinetic energy has been changed into potential energy
(B) the ball's horizontal velocity is the same as when it left the kickers foot
(C) the ball will have been in the air one-half of its total flight time
(D) the vertical component of the velocity is equal to zero

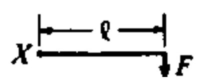
2) A uniform meterstick of mass 0.20 kg is pivoted at the 40 cm mark. Where should one hang a mass of 0.50 kg to balance the stick?
(A) 16 cm (B) 36 cm (C) 44 cm (D) 46 cm

3) A door (seen from above in the figures below) has hinges on the left hand side. Which force produces the largest torque? The magnitudes of all forces are equal.

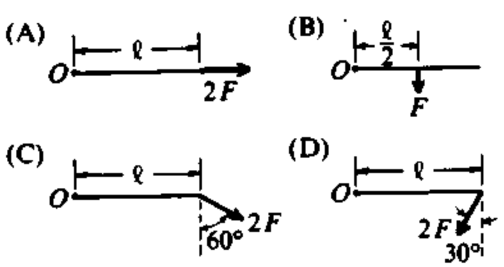


4) A system of two wheels fixed to each other is free to rotate about a frictionless axis through the common center of the wheels and perpendicular to the page. Four forces are exerted tangentially to the rims of the wheels, as shown. The magnitude of the net torque on the system about the axis is

(A) zero (B) 2FR (C) 5FR (D) 14FR



5) In which of the following diagrams is the torque about point O equal in magnitude to the torque about point X in the diagram above? (All forces lie in the plane of the paper.)



Use the following information to answer #'s 6 and 7

A wheel with rotational inertia *I* is mounted on a fixed, frictionless axle. The angular speed ω of the wheel is increased from zero to ω_f in a time interval T.

6) What is the average net torque on the wheel during this time interval?

(A) $\frac{\omega_f}{T}$ (B) $\frac{I\omega_f^2}{T}$ (C) $\frac{I\omega_f}{T^2}$ (D) $\frac{I\omega_f}{T}$

7) What is the average power input to the wheel during this time interval?

(A) $\frac{I\omega_f}{2T}$ (B) $\frac{I\omega_f^2}{2T}$ (C) $\frac{I\omega_f^2}{2T^2}$ (D) $\frac{I^2\omega_f}{2T^2}$

8) A 70 kg man runs at a constant velocity of 4 m/s. What is his kinetic energy?

a. 140 J b. 210 J c. 280 J d. 560 J

9) In which of the following situations is the kinetic energy decreasing?

a. A sphere is dropped from a building

b. A satellite is moving in a circular orbit around Earth

c. A baseball is heading upward after being thrown at an angle

d. An elevator is moving upward at a constant speed

10) A ball is dropped from rest and falls to the floor. The potential energy of the ball-Earth-floor system is 10 J. The ball then bounces back up to a height where the potential energy is 7 J. What is the mechanical energy of the ball-Earth-floor system the instant the ball left the floor?

a. 0 J b. 3 J c. 7 J d. 10 J

11) A crate is on a horizontal frictionless surface. A force of magnitude F is applied on the crate at an angle θ. As the crate slides a distance d, it gains a kinetic energy of ΔK. While F is kept constant, the angle θ is now doubled but less than 90 degress. As the crate slides a distance d, how does the new change in kinetic energy compare to ΔK?

a. The new gain is greater than ΔK

b. The new gain is less than ΔK

c. The new gain is equal to ΔK

d. The new gain is greater or less than ΔK depending on the value of θ

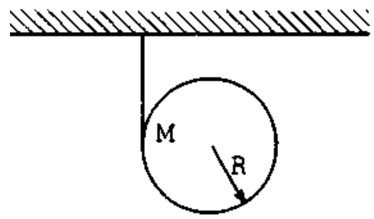
Short answer problems below on next page

1) [Short answer] A compressed vertical spring stores 40 J of potential energy. The spring has a 0.1 kg stone acting on it. The spring is released, throwing the stone straight up in the air.

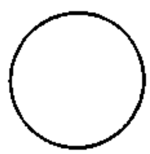
a. How much kinetic energy will the stone have when it first leaves the spring?

b. How much gravitational potential energy, relative to the spot where the stone was released, will the stone have when it reaches the peak of its flight?

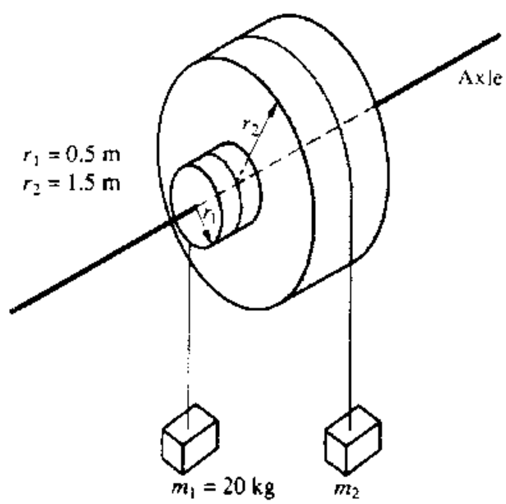
c. Calculate the height above the release point to which the stone travels.



2) A cloth tape is wound around the outside of a uniform solid cylinder (mass M, radius R) and fastened to the ceiling as shown in the diagram above. The cylinder is held with the tape vertical and then released from rest. As the cylinder descends, it unwinds from the tape without slipping. The moment of inertia of a uniform solid cylinder about its center is $\frac{1}{2}MR^2$.



a. On the circle above draw vectors showing all the forces acting on the cylinder after it is released. Label each force clearly.
b. In terms of g, find the downward acceleration of the center of the cylinder as it unrolls from the tape.
c. While descending, does the center of the cylinder move toward the left, toward the right, or straight down? Explain.



3) Two masses. m_1 and m_2, are connected by light cables to the perimeters of two cylinders of radii r_1 and r_2, respectively, as shown in the diagram above with r_1 = 0.5 meter, r_2 = 1.5 meters, and m_1 = 20 kilograms.
a. Determine m_2 such that the system will remain in equilibrium.