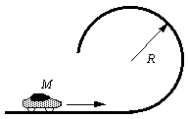
1. A small car of mass *M* travels along a straight, horizontal track. As suggested in the figure, the track then bends into a vertical circle of radius *R*.



What is the minimum acceleration that the car must have at the top of the track if it is to remain in contact with the track?
a. 4.91 m/s^2, downward
b. 4.91 m/s^2, upward
c. 9.81 m/s^2, upward
d. 9.81 m/s^2, downward
e. 19.6 m/s^2, upward

2. A certain string just breaks when it is under 400 N of tension. A boy uses this string to whirl a 10-kg stone in a horizontal circle of radius 10 m. The boy continuously increases the speed of the stone. At approximately what speed will the string break? Assume the tension force is directed horizontally.
a. 10 m/s
b. 20 m/s
c. 80 m/s
d. 100 m/s
e. 400 m/s

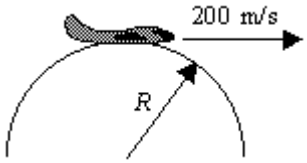
3. A satellite is placed in equatorial orbit above Mars, which has a radius of 3397 km and a mass M_M =6.40X10^{23} kg. The mission of the satellite is to observe the Martian climate from an altitude of 488 km. What is the orbital period of the satellite in seconds?

4. Determine the minimum angle at which a roadbed should be banked so that a car traveling at 20.0 m/s can safely negotiate the curve without the aid of friction. The radius of the curve is 2.00 x 10^2 m.

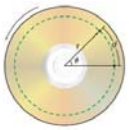
5. A 0.25-kg ball attached to a string is rotating in a horizontal circle of radius 0.5 m. Assume the tension force is directed horizontally. If the ball revolves twice every second, what is the tension in the string?

6. Consider a hypothetical planet in our solar system whose average distance from the Sun is about four times that of Earth. Determine the orbital period for this hypothetical planet (in years).

7. A plane is traveling at 200 m/s following the arc of a vertical circle of radius *R*. At the top of its path, the passengers experience "weightlessness." To one significant figure, what is the value of *R*?



8. If the radius of the CD below is 6.0 cm and the angular velocity is 5.0 rad/s, what is its angular displacement in 2.0 s?
A) 60 rad
B)1.7 rad
C) 0.60 rad
D)10 rad



9. If the radius of the CD above is 6.0 cm and the angular velocity is 5.0 rad/s, what is the linear displacement of a point on the edge in 2.0 s?
A) 60 m
B) 0.30 m
C) 0.60 m
D) 3.8 m

10. If the door is 0.90 m wide and you exert a force of 2.0 N, what is the magnitude of the resulting torque?

A) 1.8 N•m
B) 0.40 N•m
C) 2.9 N•m
D) 0.45 N•m

11. A 5,000-kg motorboat sits still on a frictionless lake. There is no wind to push against the boat. The captain starts the motor and runs it steadily for 10.00 seconds in a direction straight forward and then shuts the motor down. The boat has attained a speed of 5.000 meters per second straight forward. What is the impulse supplied by the motor?

(a) 2.500×10^{5} kg · m/s

(b) 2.500×10^{4} kg · m/s

(c) 2,500 kg · m/s

(d) 6.250×10^{4} kg · m/s

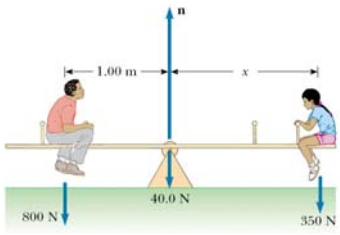
12. A 2 kg mass is located 1.0 m directly above a 1.0 kg mass. A third 3 kg mass is located 2 m directly to the right of the 1.0 kg mass. Find the location of the center of mass.

13. A 0.5 kg bullet hits a 25 kg ballistic pendulum and it gets embedded in it and causes it to rise by 0.5 m. Find the initial velocity of the bullet.

14. At an intersection, a car of mass = 2m and velocity v plows into a car of mass = 3m going through the intersection from a perpendicular direction at the same speed. The cars stick together. Find the magnitude of the final velocity.

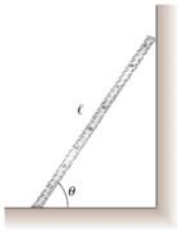
15. Bob crashes into a tree when he is traveling at 30 m/s. His truck has a mass of 1500 kg. Find the impulse during the collision.

16. A uniform 40.0-N board supports a father and daughter weighing 800 N and 350 N, respectively, as shown. If the support (the fulcrum) is under the center of gravity of the board and if the father is 1.00 m from the center,
a) determine the magnitude of the upward force n exerted on the board by the support.
b) Determine where the child should sit to balance the system.



17. A uniform horizontal beam with a length of 8.00 m and a weight of 200 N is attached to a wall by a pin connection. Its far end is supported by a cable that makes an angle of 53.0° with the horizontal. If a 600-N person stands 2.00 m from the wall, find the tension in the cable, as well as the magnitude and direction of the force exerted by the wall on the beam.

18. A uniform ladder of length L and weight mg = 50 N rests against a smooth, vertical wall. If the coefficient of static friction between the ladder and the ground is $\mu_s = 0.40$, find the minimum angle θ_{min} at which the ladder does not slip.



19. A 1.50 kg ball moving at 8.00 m/s south, strikes a 2.00 kg ball moving at 3.00 m/s south. If the velocity of the 2.00 kg ball after the collision is 4.50 m/s south, what is the velocity of the 1.50 kg ball?

20. A 3.0×10^5 kg freight car moving at 2.5 m/s east, strikes a stationary 1.5×10^5 kg car. If the two cars end up connected to each other, what is their resulting velocity?

21. A 39.4 kg child is sitting in the middle of a 177.7 kg merry-go-round of radius 2.59 m while it is spinning at a rate of 1.3 rpm. If the child moves out to the edge, how fast will it be spinning?

22. A ball is stuck 0.98 m from the center of a disk spinning at 1.78 rad/s. If its angular momentum is 0.624 J*s, what is its mass?

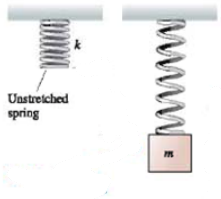
23. A 47.9 kg child is sitting on the edge of a merry-go-round of radius 2.09 m while it is spinning at a rate of 1.603 rpm. If the child moves to the center the merry-go-round will rotate at 3.1 rpm. What is the mass of the merry-go-round?

24. A thin rod has a length of 0.25 m and rotates in a circle on a frictionless tabletop. The axis is perpendicular to the length of the rod at one of its ends. The rod has an angular velocity of 0.27 rad/s and a moment of inertia of $1.20X10^{-3}$ kg · m2. A bug standing on the axis decides to crawl out to the other end of the rod. When the bug (mass = $4.2X10^{-3}$ kg) gets where it's going, what is the angular velocity of the rod?

25. A ball is swung on a string at a velocity of 14 m/s and with a radius of 1.5 m. If the radius is decreased to a value of 0.3 m, what is the new speed of the ball provided the sum of the net external torques is zero?

26. A 75 g, 34cm long rod hangs vertically on a frictionless, horizontal axle passing through its center. A 15 g ball of clay traveling horizontally at 2.2 m/s hits and sticks to the very bottom tip of the rod. To what maximum angle, measured from vertical, does the rod (with the attached ball of clay) rotate?

27. A 200g block hangs from a spring with spring constant of 10N/m. The block is pulled down to a point where the spring is 30cm longer than its **un-stretched** length, then released at t=0.
a. Where is the block with respect to spring's un-stretched position at t=3.0 s?
b. What is its velocity (magnitude and direction) at t=3.0 s ?

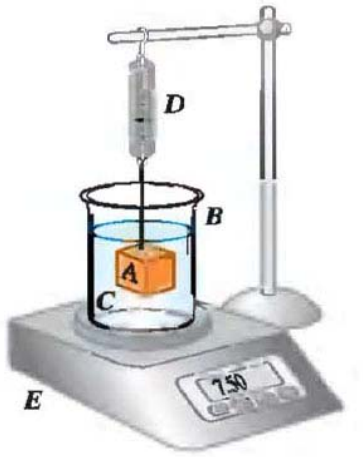


28. A cubical block of wood 0.100m on a side and with a density of $550kg/m^3$ floats in a jar of water. Oil with a density of 750 kg/m^3 is poured on the water until the top of the oil layer is 0.035m below the top of the block.
a. How deep is the oil layer?
b. What is the gauge pressure at the block's lower face?

29. Block A hangs by a cord from spring balance D and is submerged in a liquid C contained in the beaker B. The mass of the beaker is 1.00kg; the mass of the liquid is 1.80kg. Balance D reads 3.50kg and balance E reads 7.50kg. The volume of the block A is $3.80X10^{-3}$ m^3.

a. What is the density of the liquid?

b. What will each balance read if block A is pulled up of the liquid?



30. A 950kg cylindrical can buoy floats vertically in salt water (density $1030kg/m^3$). The diameter of the buoy is 90cm. Calculate the additional distance the buoy will sink when a 70kg man stands on top of it.

31. A slab of ice floats on a freshwater lake. What minimum volume must the slab have for a 45kg woman to be able to stand on it without getting her feet wet?

32. An ore sample weighs 17.5N in air. When the sample is suspended by a light cord and totally immersed in water, the tension in the cord is 11.20N. Find the total volume and the density of the sample.

33. An object is undergoing SHM with a period of 1.200s and an amplitude of 0.600m. At t=0 the object is at x=0 and is moving in the negative x-direction. How far is the object from the equilibrium position when t=0.480s?

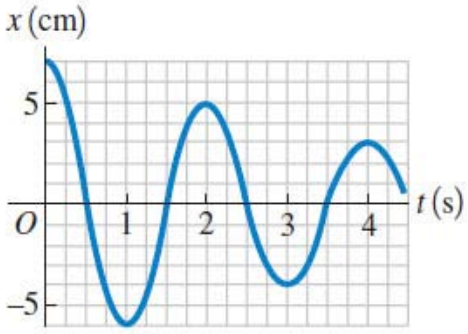
34. An object is undergoing SHM with a period of 0.300s and amplitude 6.00cm. At t=0 the object is instantaneously at rest at x=6.00cm. Calculate the time it takes the object to go from x=6.00cm to x=-1.50cm.

35. A mass is vibrating at the end of a spring of force constant 225N/m. The graph is showing its position x as a function of time t.

a. At what time is the mass not moving?

b. How much energy did the system lose between t=1.00s and t=4.00s?

c. Where did this energy go?



36. A 2.50-kg rock is attached at the end of a thin, very light rope 1.45 m long. You start it swinging by releasing it when the rope makes an 11° angle with the vertical. You record the observation that it rises only to an angle of 4.5° with the vertical after swings.
a) How much energy has this system lost during that time?
b) What happened to the “lost” energy?

37. A 1.50-kg, horizontal, uniform tray is attached to a vertical ideal spring of force constant 185N/m and a 275-g metal ball is in the tray. The spring is below the tray, so it can oscillate up and down. The tray is then pushed down to point A, which is 15.0 cm below the equilibrium point, and released from rest.
a) How high above point A will the tray be when the metal ball leaves the tray?
b) How much time elapses between releasing the system at point A and the ball leaving the tray?
c) How fast is the ball moving just as it leaves the tray?