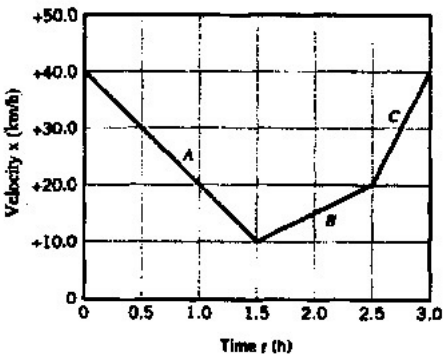
REVIEW FOR FINAL EXAM

1. A. A snowmobile moves according to the velocity-time graph shown. What is the snowmobile's average acceleration during each of the segments A, B, and C?



B. In reaching her destination, a backpacker walks with an average velocity of 1.34 m/s, due west. This average velocity results, because she hikes 6.44 km with an average velocity of 2.68 m/s, due west, turns around, and hikes with an average velocity of 0.477 m/s, due east. How far east did she walk?

2. A golfer standing on a fairway hits a shot to a green that is elevated 6.0 m above the point where she is standing. The ball leaves her club with a velocity of 43.0 m/s at an angle of 40.0° to the ground.

   A. Find the time for the ball to come down on the green.
   B. What is the speed of the ball just before impact?

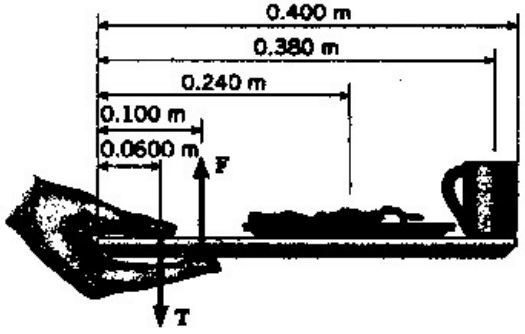
3. During a storm, a limb falls from a tree. It comes to rest across a barbed wire fence, one-fifth of the way between two fence posts, which are 4.00 m apart. Thus, the wire between the posts is divided into a shorter section and a longer section. The limb exerts a downward force of 151.0 N on the wire, depressing it 0.200 m below the horizontal.

   A. Find the tension in the section of wire that is shorter.
   B. Find the tension in the section of wire that is longer.

4. The coefficient of static friction between the tires of a motorcycle and the road is $\mu_s = 0.56$. At a speed of 19.0 m/s, what is the radius of the tightest ***unbanked*** turn that the driver can handle?

5. A. A 3.00 kg block of wood rests on the muzzle opening of a vertically oriented rifle, the stock of the rifle being firmly planted on the ground. When the rifle is fired, an 8.00 g bullet (velocity = 8.00×10^2 m/s, straight upward) becomes completely embedded in the block.
      (a) Using the conservation of linear momentum, find the velocity of the block/bullet system immediately after the collision.
      (b) Ignoring air resistance, determine how high the block/bullet system rises above the muzzle opening of the rifle.
   B. An electric circular saw is designed to reach its final angular speed, starting from rest, in 1.50 s. Its average angular acceleration is 328 rad/s^2. Obtain its final angular speed.

6. A lunch tray is being held in one hand, as shown in the drawing. The mass of the tray itself is 0.200 kg, and its center of gravity is located at its geometrical center. On the tray is a 1.00 kg plate of food and a 0.250 kg cup of coffee. Both forces act perpendicular to the tray, which is being held parallel to the ground.



   A. Find the force T exerted by the thumb.
   B. Find the force F exerted by the four fingers.

7. A. A main water line enters a house on the first floor. The line has a gauge pressure of 1.90×10^5 Pa. (Density of water is 1000 kg/m^3.)
   (a) A faucet on the second floor, 6.50 m above the first floor, is turned off. What is the gauge pressure at this faucet?
   (b) How high could a faucet be before no water would flow from it, even if the faucet were open?

   B. Only a small part of an iceberg protrudes above the water, while the bulk lies below the surface. The density of ice is 917 kg/m^3 and that of seawater is 1025 kg/m^3. Find the percentage of the iceberg's volume that lies below the surface.

8. A. The latent heat of vaporization of H_2O at body temperature (37°C) is 2.42×10^6 J/kg. To cool the body of a 75.0 kg jogger [average specific heat capacity = 3500.0 J/(kg.°C)] by 1.5°C, how many kilograms of water in the form of sweat has to be evaporated?

   B. At the start of a trip, a driver adjusts the absolute pressure in her tires to be 2.81×10^5 PA, when the outside temperature is 284 K. At the end of the trip, she measures the pressure to be 3.01×10^5 PA. Ignoring the expansion of the tires, find the air temperature inside the tires at the end of the trip.

9. After finishing Physics 2010 and feeling happy the course is over, some of the students go golfing. One student hits his fareway shot all the way to the green, which is elevated 6.0 m above the tee. The ball left the club with a velocity of 43.0 m/s at an angle of 40.0° to the ground.

   (a) Assuming the shot was successful, find the time it takes for the ball to hit the green?
   (b) What is the speed of the ball just before impact?

10. A 0.015 kg bullet is fired from a rifle. It takes 2.50×10^{-3} s for the bullet to travel the length of the barrel. The bullet exits the barrel with a speed of 300.0 m/s. Assuming that the acceleration of the bullet is constant, what is the average net force exerted on the bullet?

11. A motorcycle has a speed of 25.0 m/s as it passes over the top of a hill. The hill has a radius of curvature of 126.0 m. The weight of the motorcycle and driver combined is 3351.6 N.

   (a) What is the magnitude of the centripetal force?
   (b) What is the magnitude of the normal force?

12. A 0.5 kg block of wood rests on the muzzle opening of a vertical oriented rifle. (The rifle is planted firmly on the ground.) The rifle is fired and a bullet (8.0 grams) travels straight upward at a velocity of 3.5×10^2 m/s. It becomes embedded in the block. How high does the block/bullet system rise into the air?

13. A circular blade of a radial arm saw is turning at 262.0 rad/s at the instant the motor is turned off. In 18.0 s the speed of the blade is reduced to 85.0 rad/s. The blade is a uniform disk with a radius of 0.130 m and a mass of 0.400 kg. Find the net torque applied to the blade.

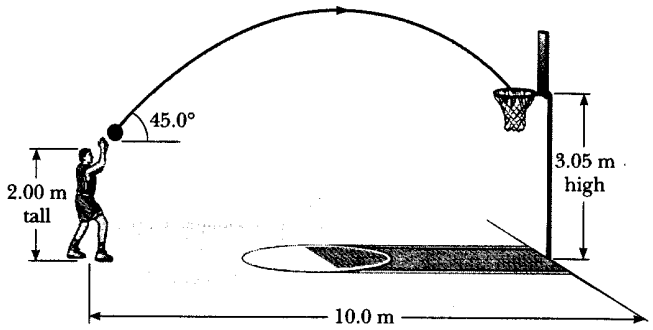
14. Water is flowing out of a horizontal pipe (radius = 1.9×10^{-2} m) on the ground. The speed of the water in the pipe is 0.62 m/s. A nozzle (radius 4.8×10^{-3} m) is attached to the end of the pipe. By how many pascals does the pressure of the water within the nozzle increase? The density of water is 1000 kg/m^3.

15. The temperature in an electric oven is 160.0°C and the temperature at the outer surface in the kitchen is 50°C. The oven (surface area 1.6 m^2) is insulated with material that has a thickness of 0.020 m and a thermal conductivity of 0.045 J·s/m·k.

   (a) How much energy is used to operate the oven for 6.0 hours?
   (b) At a price of $0.10 per kilowatt·hour for electrical energy, how much does it cost to operate the oven or 6.0 hours?

16. A 0.030 m^3 container is initially evacuated and the 4.0 g of water is placed in it. After a time, all the water evaporates and the temperature is 388 K. Find the pressure.
atomic mass of hydrogen 1.00794 u; atomic mass of oxygen 15.9994 u ;
Avogadro's number: 6.02×10^{23} atoms/gm·mole = 6.02×10^{26} atoms/kg·mole

17. A 2.00 m tall basketball player wants to make a goal from 10.0 m from the basket. The height of the basket is 3.05 m. If he shoots the ball at 45.0° angle, at what initial speed must he throw the basketball so that it goes through the hoop?

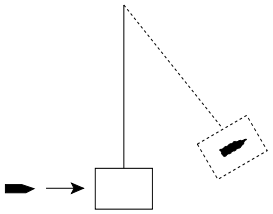


18. A toboggan slides down a hill with constant velocity. The angle of the hill is 11.3° with respect to the horizontal. What is the coefficient of kinetic friction between the toboggan and the hill?

19. While working in Mombasa, Kenya you are surprised to see many monkeys. One monkey (9.5 kg) swings down in a circle. You estimate the distance of the vine to be 85.0 cm. At the bottom of the circle the monkey has reached a speed of 2.8 m/s.

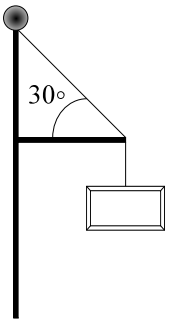
A. Find the centripetal force acting on the monkey.
B. Find the tension in the monkey's arm.

20. An 18.0 g rifle bullet traveling at a speed of 200.0 m/s buries itself in a 3.6 kg pendulum hanging on a 2.8 m long string. After is hits the pendulum they both swing upward in an arc. Determine how high vertically they swing.

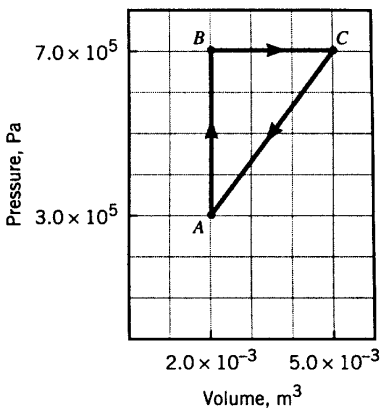


21. A. A student stood in front of the class and was rotated on a frictionless platform with an angular speed of 5 rad/s. His arms were outstretched and he was holding a dumbbell in each hand. His moment of inertia in this position was 5.4 kg·m^2. He pulled his arms in and then had a moment of inertia of 3.8 kg·m^2. What was his new angular speed?

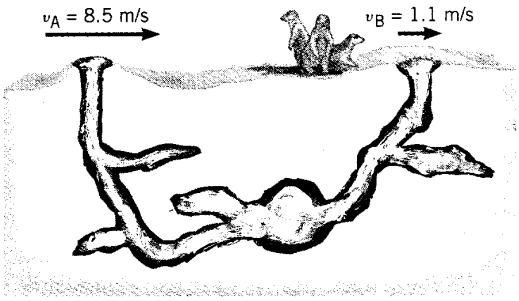
B. A 20 kg sign is supported at the end of horizontal beam (of negligible mass) that is hinged to a pole. A cable holds the beam at its end making an angle of 30°. Find the tension in the cable.



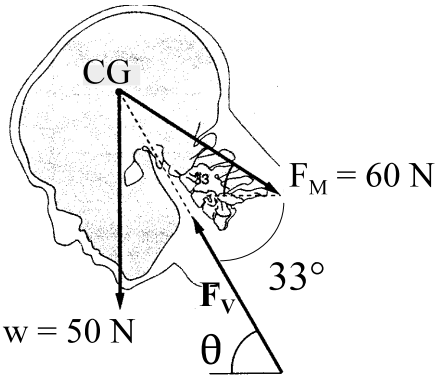
22. A. The pressure and volume of a gas are changed along the path ABCA. Determine the work done (including the algebraic sign) in each segment of the path A to B and B to C.



B. Prairie dogs are burrowing animals. They do not suffocate because they create two openings with different shapes thereby causing air to blow over each hole with a different velocity. This creates a different pressure at each opening causing circulation in the tunnel. (How did they know to do that!) Assuming that the openings are at the same vertical level, find the difference in the air pressure between the two openings.



23. A person working at a drafting board holds her head as shown in the figure, which requires muscle action to support the head. The three major forces acting are shown. Calculate the *direction* and *magnitude* of the force supplied by the upper vertebrae F_V to hold the head stationary, assuming that it acts along a line through the center of mass as do the weight and muscle force.



24. A 1.80 m radius playground merry-go-round has a mass of 120 kg and is rotating with an angular velocity of 0.500 rev/s.

(a) What is its angular velocity after a 22.0 kg child gets onto it by grabbing its outer edge? The child is initially at rest.
(b) How much energy is lost in the collision?

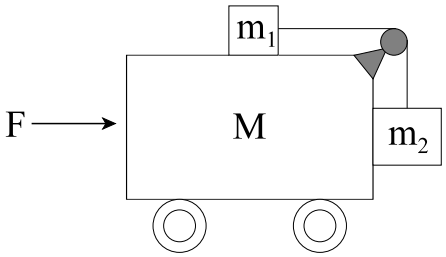
$I_{disk} = \frac{1}{2} mr^2$

25. A football player punts the ball at a 45° angle. Without an effect from the wind, the ball would travel 60.0 meters horizontally.

(a) What is the initial speed of the ball?
(b) When the ball is near its maximum height it experiences a brief gust of wind that reduces its horizontal velocity by 1.50 m/s. What distance does the ball travel horizontally?

26. A 0.0250 kg bullet is accelerated from rest to a speed of 550 m/s in a 3.00 kg rifle. The pain of the rifle's kick is much worse if you hold the gun loosely a few centimeters from your shoulder rather than holding it tightly against your shoulder.

(a) Calculate the recoil velocity of the rifle if it is held loosely away from the shoulder.
(b) How much kinetic energy does the rifle gain?
(c) What is the recoil velocity if the rifle is held tightly against the shoulder, making the effective mass 28.0 kg?
(d) How much kinetic energy is transferred to the rifle-shoulder combination? The pain is related to the amount of kinetic energy, which is significantly less in this latter situation.



27. What horizontal force must be applied to the cart shown in the figure in order that the blocks remain stationary relative to the cart? Assume all surfaces, wheels, and pulley are frictionless. [Hint: Note that the force exerted by the string accelerates m_1.]

m_1 = 10 kg; m_2 = 30 kg; M = 100 kg

28. A drinking straw which is 20.0 cm long and 3.0 mm in diameter stands vertically in a cup of juice (the cup is 8.0 cm in diameter). A section of the straw, 6.5 cm long, extends above the juice. A child sucks on the straw and the level of juice in the glass begins dropping at 0.20 cm/s.

(a) By how much does the pressure in the child's mouth differ from atmospheric pressure?
(b) What is the greatest height from which the child could drink, assuming this same mouth pressure.

29. Calculate the maximum force, in newtons, exerted by the blood on an aneurysm, or ballooning, in a major artery, given the maximum blood pressure for this person is 150 mm Hg and the effective area of the aneurysm is 20.0 $cm^{2.}$ Note that this force is great enough to cause the further enlargement and subsequently greater force on the ever-thinner vessel wall.

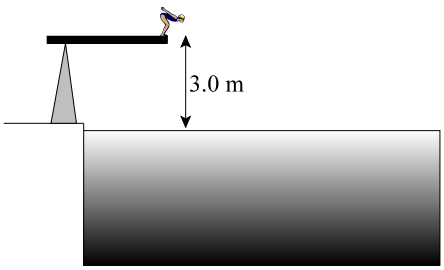
$1 \text{ atm} = 1.01 \times 10^5 \text{ Pa} = 760 \text{ mm Hg}$

30. Burns produced by steam at 100°C are much more severe than those produced by the same mass of 100°C water. To verify this:

(a) Calculate the heat that must be removed from 5.00 g of 100°C water to lower its temperature to 50.0°C.
(b) Calculate the heat that must be removed from 5.00 g of 100°C steam to condense it and lower its temperature to 50.0°C.
(c) Calculate the mass of human flesh that the heat produced in each case can raise from the normal to 37.0°C to 50.0°C. [Flesh is badly damaged at 50.0°C.]

$L_V = 22.6 \times 10^5 \text{ J/kg}; C_{Flesh} = 3500 \text{ J/kg·C°}; C_{Water} = 4186 \text{ J/kg·C°}$

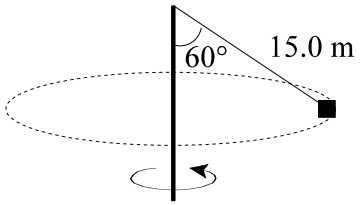
31. A diver springs upward from a board that is 3.0 m above the water. At the instant she contacts the water her speed is 8.90 m/s and her body makes an angel of 75.0° with respect to the horizontal surface of the water. Determine her initial velocity, both magnitude and direction.



32. Two objects of mass 45.0 kg and 21.0 kg, are connected by a massless string that passes over a massless, frictionless pulley. The pulley hangs from the ceiling.

(a) Find the acceleration of the objects.
(b) Calculate the tension in the string.

33. A swing ride a carnival consists of chairs that are swung in a circle by 15.0 m cables attached to a vertical rotating pole. Suppose the total mass of a chair and its occupant is 179.0 kg



(a) Determine the tension in the cable attached to the chair.
(b) Find the speed of the chair.

34. A 63.0 kg skier coasts up a snow-covered hill that makes an angle of 25° with the horizontal. The initial speed of the skier is 6.6 m/s. After coasting a distance of 1.9 m up the slope, the speed of the skier is 4.4 m/s. Find the work done by the kinetic frictional force that acts on the skis.

35. Kevin has a mass of 87.0 kg and is skating with in-line skates. He sees his 22.0 kg younger brother up ahead standing on the sidewalk, with his back turned. Coming up from behind, he grabs his brother and rolls off at a speed of 2.4 m/s. Ignoring friction, find Kevin's speed just before he grabbed his brother.

36. The shaft of a pump starts from rest and has an angular acceleration of 3.00 rad/s^2. The initial angular speed of the bit is 5.00 rad/s.

(a) After 4.00 s, what angle has the bit turned through?
(b) After 4.00 s, what is the angular speed of the bit?

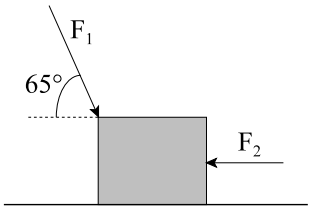
37. A person who weighs 670.0 N steps onto a spring scale in the bathroom and the spring compresses by 0.79 cm.

(a) What is the spring constant?
(b) What is the weight of another person who compresses the spring by 0.34 cm?

38. A thermos contains 150.0 cm^3 of coffee at 85°C. To cool the coffee, you drop two 11.0 g ice cubes into the thermos. The ice cubes are initially at 0°C and melt completely. What is the final temperature of the coffee? Treat the coffee as if were water.

Specific heat water = $C_w = 4.18$ J/g°C
Specific heat ice = $C_i = 2.03$ J/g°C
Latent hear for water = 3.35×10^5 J/kg

39. Two forces, F_1 and F_2, act on the 5.00 kg block shown in the drawing. The block sits on frictionless suface. The magnitudes of the forces are $F_1 = 50.0$ N and $F_2 = 35.6$ N.

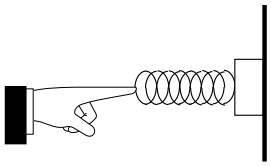


(a) What is the horizontal acceleration (magnitude and direction) of the block?
(b) The block is initially at rest and both forces act simultaneously for 5.00 s. How far does the block move during this time?
(c) What is the block's velocity after 5.00 s?

40. A hiker weighing 980 N strolls through the woods and crosses a small horizontal bridge. The bridge, which is uniform, weighs 3600 N and rests on two concrete supports, one at each end. The hiker stops to rest one-fourth of the way along the bridge.

(a) What is the magnitude of the force that the concrete support exerts on the bridge at the end nearest the hiker?
(b) What is the magnitude of the force that the concrete support exerts on the bridge at the farthest end from the hiker?

41. A spring of spring constant 480 N/m is attached to a block (mass = 2.0 kg). Someone pushes on the end of the spring in a direction perpendicular to the wall until the block does not slip downward.



(a) If the spring is compressed by 0.075 m, what is the coefficient of static friction?
(b) If the block is a copper cube measuring 0.10 m on each side, by how much does the block compress during the situation in part (a)?

Copper Y = 1.1×10^{11} N/m^2

42. A 0.300 kg of aluminum that has a temperature of -150°C is added to 1.50 kg of water that has a temperature of 2.50°C. At equilibrium the temperature is 0.00°C. Ignoring the container and assuming that the heat exchanged with the surroundings is negligible, determine

(a) the number of calories added to aluminum in order for it to reach its equilibrium temperature;
(b) the mass of the water that has been frozen into ice.

L_f water = 33.5×10^4 J/kg; specific heat of water = 4186 J/kg°C; specific heat of aluminum = 900 J/kg°C; 1 calorie = 4.186 J

43. A solid, square pinewood raft measures 3.0 m on each side and is 0.4 m thick.

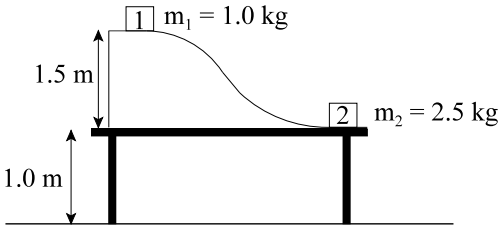
(a) Find the percentage of the raft *below* the surface of the water when nobody is on it?
(b) How many friends can Liz (mass 50.0 kg) have on the raft with her assuming each friend weighs 78.5 kg?
(c) What is the gauge pressure 2.0 m below the surface of the raft when it is fully loaded?

$\rho_{water} = 1000\ kg/m^3$
$\rho_{Liz} = 900\ kg/m^3$
$\rho_{pine} = 550\ kg/m^3$
$\rho_{air} = 1.29\ kg/m^3$
$1\ atmosphere = 1.013 \times 10^5\ Pa$

44. A trailer home is supported 0.5 m above the ground by sitting on stacks of cinder block at each of the four corners. A decorative trim is placed around the edges of the trailer such that it creates an open space underneath the trailer. The trim covers the bottom area in such a way that it is not air-tight, but reduces the wind so that even in strong winds the airspeed beneath the trailer is essentially zero. The trailer measures 6.0 m wide × 12.0 m long × 2.5 m high. The trailer starts to lift off the ground when a 100 mph wind blows across the top of the trailer. What is the mass of the trailer? [In your calculations do not neglect the difference in atmospheric pressure.]

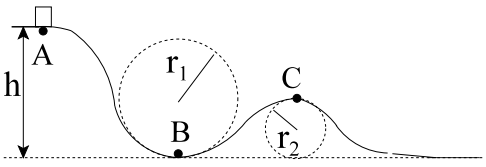
$\rho_{air} = 1.29\ kg/m^3$; 1 mile = 1609 m

45. A 1.0 kg mass (block 1) is released from rest at the top of frictionless track 1.50 m above the top of a table. The block 1 then collides elastically with a 2.5 kg mass (block 2) that is initially at rest on the table, as shown.



(a) Determine the velocity of each block immediately after the collision.
(b) How far away from the table does block 2 land given that the height of the table 1.00 m?
(c) What is the velocity (magnitude and direction) of block 2 right before it lands?

46. A block is released from rest at point A on the curved ramp as shown in the drawing. All answers should be expressed in terms of g, r_1 and r_2.



(a) What should the velocity of the block be at point C in order for it to feel weightlessness at point C?
(b) At what height should the block be released in order for it to feel weightlessness at point C?
(c) What is the centripetal acceleration of the block at point B when the block is released from the height h found in part (b)?

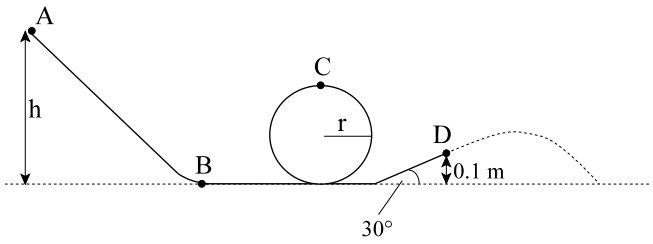
47. Driving along a country road you stop at a stop sign. There is another stop sign 1 km down the road. The speed limit is 40 mph. Your car's maximum acceleration is 3 m/s^2 and the maximum deceleration is 4 m/s^2.

(a) Without breaking any laws (not speeding), what is the shortest time you can make it to the stop sign?

(b) Draw a velocity vs. time graph that clearly shows your motion from one stop sign to the other.

1 mile = 1609 m

48. As demonstrated in lecture, a solid steel ball **rolls** down a ramp, around a loop (r = 0.5 m) and is then launched off into the air. Assume frictional losses and air resistance are negligible.



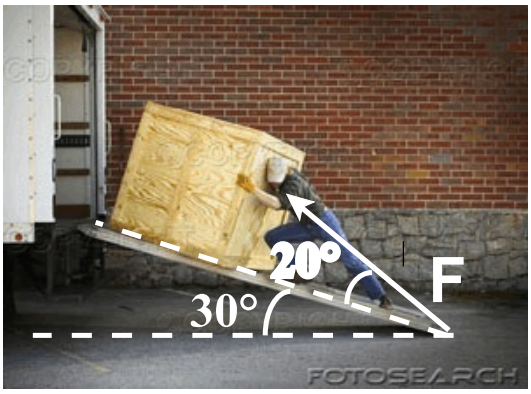
(a) In order for the ball to stay on the track, what minimum velocity does it need at point C?

(b) The ball is released at point A. Find the height of point A such that the ball barely stays on the track at point C.

(c) How far from the right end of the track does the ball land?

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

49. Rich pushes a 70 kg crate up a ramp for a distance of 5 m at a constant speed of 1.0 m/s. Due to friction, Rich must apply a constant force of 500 N as shown.



(a) Draw a free body diagram for the crate showing all forces it feels. Label all the forces.

(b) Name the force(s) doing positive work on the crate.

(c) Name the force(s) doing negative work on the crate.

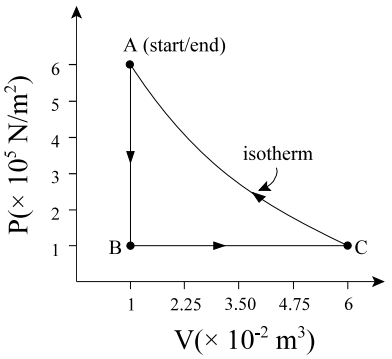
(d) Name the force(s) doing zero work on the crate.

(e) Name the nonconservative force(s) the crate feels.

(f) Find the magnitude of the work done by friction over the 5 m.

(g) What is the coefficient of kinetic friction between the crate and the ramp?

50. Two moles of a monatomic ideal gas are taken through the three-step cycle ABCA shown.



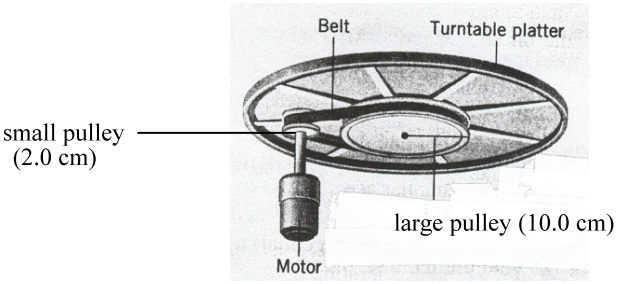
(a) What are the temperatures in Kelvins at A, B and C?

(b) With the data from the graph, fill in the 12 missing items in the table below.

$$R = 8.31\frac{J}{mol \cdot K}$$

	ΔU	W	Q
A → B			
B → C			
C → A			
Entire Cycle			

51. The drawing shows a view (from beneath) of a platter on a belt drive turntable. The platter has an angular speed of 200 rpm and a radius of 25 cm. The pulley on the platter has a radius of 10 cm. The pulley on this motor shaft has a radius of 2.0 cm. Assume the belt does not slip.



(a) Find the tangential speed of the outside edge of the platter in m/s.
(b) Calculate the angular speed of the large pulley on the platter in rad/s.
(c) Calculate the speed of the belt in m/s.
(d) What is the angular speed of the small pulley on the motor shaft in rpm?
(e) When the pulley on the motor shaft has made 500 revolutions, how many revolutions has the platter made?

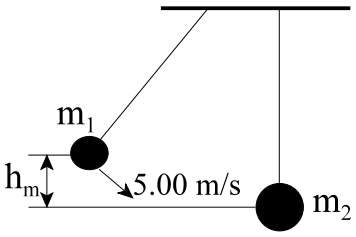
52. A. A0.200 kg piece of aluminum that has a temperature of -165°C is added to 1.50 kg of water that has a temperature of 3.00°C. At equilibrium the temperature is 0.00°C. Ignore the container and assume that the heat exchanged with the surroundings is negligible

(a) How many calories are added to the aluminum in order for it reach its equilibrium temperature?
(b) Find the mass of water that has been frozen into ice.

B. A 30 g ice cube at -15.0°C is dropped into a cup of water (500 g) at 20°C. The entire ice cube melts and the total amount of water reaches an equilibrium temperature. Find the equilibrium temperature.

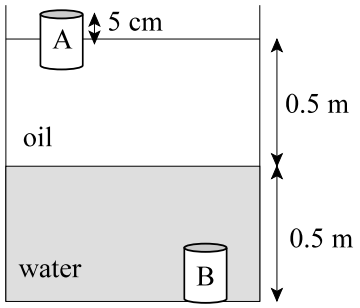
1 Calorie = 1000 calories = 1 kcal 1 kcal = 4186 J L_f(water) = 3.35×10^5 J/kg
C_{al} = 900 J/kg°C C_{water} = 4186 J/kg°C C_{ice} = 2000 J/kg°C

53. Ball m_1 (m_1 = 1.50 kg) starts with an initial speed of 5.00 m/s from a height of h_m = 0.345 m. It swings downward and strikes ball m_2 (m_2 = 4.65 kg) which is at rest (see drawing). The two balls collide perfectly inelastically.



(a) Using the principle of conservation of mechanical energy, find the speed of m_1 just before impact.
(b) Assuming that the collision is perfectly inelastic, find the speed of both balls just after the collision.
(c) Ignoring air resistance, how high do the balls swing after the collision?

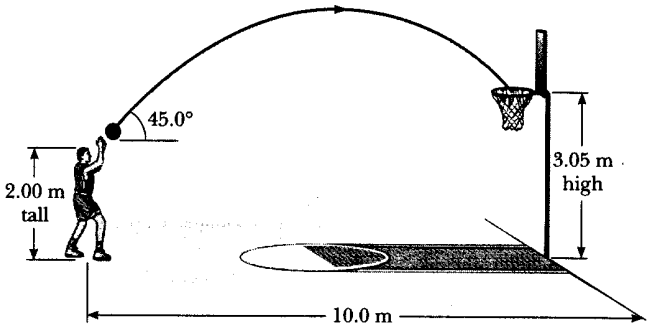
54. Two cylinders of uniform density are placed in a tank containing both oil and water. The tank is open to the air. Cylinder A is made of pine and is floating such that 5 cm of the cylinder floats above the surface of the oil (r_A = 3 cm, ρ_{pine} = 550 kg/m^3). Cylinder B is made of iron and rests on the bottom of the tank (r_B = 3 cm, h_B = 5 cm, ρ_{iron} = 7860 kg/m^3).



(a) What is the total height of cylinder A?
(b) Find the gauge pressure 10 cm directly below the bottom surface of cylinder A?
(c) What is the magnitude of the normal force acting on cylinder B?
(d) Determine the absolute pressure at the bottom of the tank.

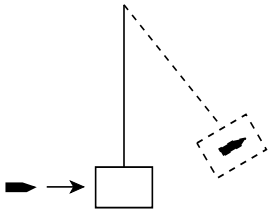
1 atm = 1.01×10^5 Pa; ρ_{oil} = 750 kg/m^3; ρ_{water} = 1000 kg/m^3

55. A. A 2.00 m tall basketball player wants to make a goal from 10.0 m from the basket. The height of the basket is 3.05 m. He shoots the ball at 45.0° angle.

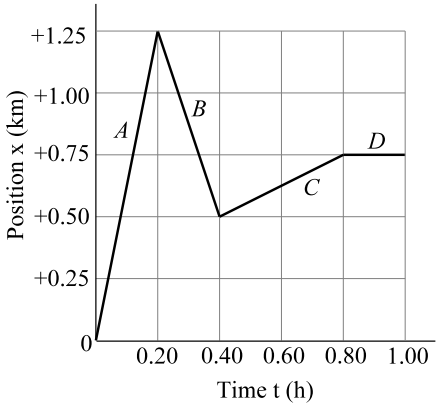


1. What must the initial speed be to throw the basketball so that it goes through the hoop?
2. How long does it take the basketball to get to reach the hoop?

B. An 18.0 g rifle bullet traveling at a speed of 250.0 m/s buries itself in a 3.6 kg pendulum hanging on a 2.8 m long string. After is hits the pendulum they both swing upward in an arc. Determine how high vertically they swing.

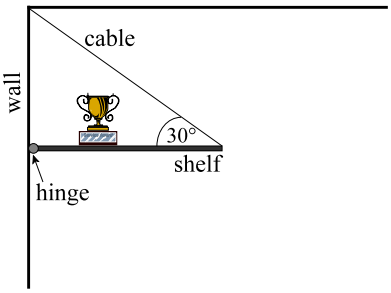


56. A person, walking for exercise along a straight road, is initially heading east and produces the position vs. time graph shown.



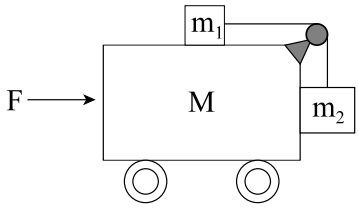
(a) Find the average velocity (magnitude and direction) of the walker for each section of the trip (A,B,C,D) in m/s. (Four answers are expected.)
(b) What is the average speed for the entire 1 hr trip in m/s ?
(c) What is the walker's displacement after 1.00 hour (magnitude and direction)?
(d) What is the average velocity (magnitude and direction) during the 1.00 hour trip? (Use units of m/s.)

57. A simple shelf is fastened to a wall by a hinge at one end and a cable on the free end (see drawing to the right). The shelf is a uniform board 3.0 m long with a weight of 50 N. A trophy (mass 20.0 kg) sits on the shelf. The cable can withstand a maximum tension of 200 N.



(a) What is the maximum distance from the wall that you can place the trophy without the cable breaking?
(b) What is the magnitude and direction of the net force the wall exerts on the hinge?

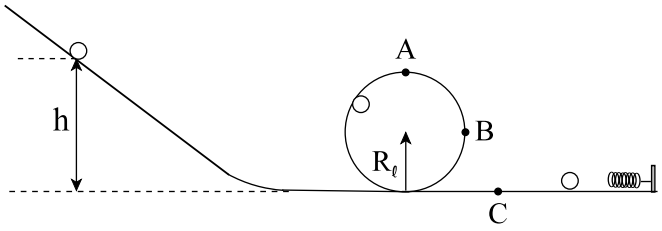
58. What horizontal force must be applied to the cart shown in the figure in order for the blocks to remain stationary relative to the cart? Assume all surfaces, wheels, and pulley are frictionless. [Hint: Note that the force exerted by the string accelerates m_1.]



m_1 = 2 kg; m_2 = 5 kg; M = 100 kg

59. A small sphere of mass m and radius r_s rolls along a looped track of radius R_ℓ, as shown. The sphere is released from a height h. The sphere barely remains on the track at the top of the circle and later encounters an unstrained spring with spring constant k. Your answers should be in terms of one or more of the following variables: h, g, m and k. Assume frictional losses and air resistance are negligible.

$$I_{solid\ sphere} = \frac{2}{5} m r_s^2$$



(a) What is the value of R_ℓ?
(b) What is the magnitude of the Normal force that the sphere feels at point B?
(c) What is the speed of the sphere at point C?
(d) By how much does the sphere compress the spring?

60. A. A drinking straw which is 20.0 cm long and 3.0 mm in diameter stands vertically in a cup of juice (the cup is 8.0 cm in diameter). A section of the straw, 6.5 cm long, extends above the juice. A child sucks on the straw and the level of juice in the glass begins dropping at 0.20 cm/s.

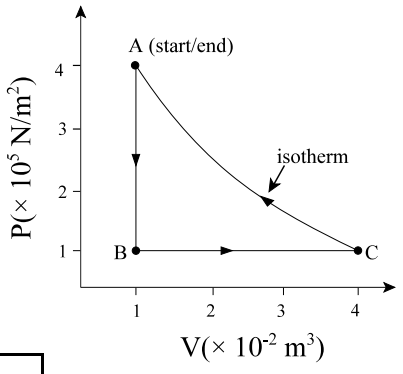
(a) Find the difference between in the pressure in the child's mouth and the atmospheric pressure?
(b) Calculate the greatest height from which the child can drink (from the surface of the juice to the mouth), assuming this same mouth pressure.

B. Burns produced by steam at 100°C are much more severe than those produced by the same mass of 100°C water. To verify this:

(a) Calculate the heat that must be removed from 15.00 g of 100°C water to lower its temperature to 50.0°C.
(b) Calculate the heat that must be removed from 15.00 g of 100°C steam to condense it and lower its temperature to 50.0°C.
(c) Find the mass of human flesh that the heat produced in each case can raise from the normal to 37.0°C to 50.0°C. [Flesh is badly damaged at 50.0°C.]

$L_V(\text{water}) = 22.6 \times 10^5$ J/kg; $C_{Flesh} = 3500$ J/kg·C°; $C_{Water} = 4186$ J/kg·C°

61. Two moles of a monatomic ideal gas are taken through the three-step cycle ABCA shown.

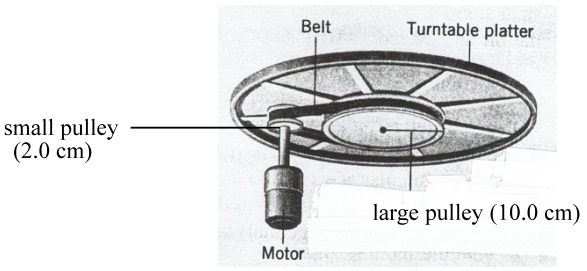


(a) What are the temperatures in Kelvins at A, B and C?
(b) With the data from the graph, fill in the 12 missing items in the table below.

$$R = 8.31 \frac{J}{mol \cdot K}$$

	ΔU	W	Q
A → B			
B → C			
C → A			
Entire Cycle			

62. A. The drawing shows a view (from beneath) of a platter on a belt drive turntable. The platter has an angular speed of 150 rpm and a radius of 30 cm. The pulley on the platter has a radius of 10 cm. The pulley on this motor shaft has a radius of 2.0 cm. Assume the belt does not slip.



(a) Find the tangential speed of the outside edge of the platter in m/s.

(b) Calculate the angular speed of the large pulley on the platter in rad/s.

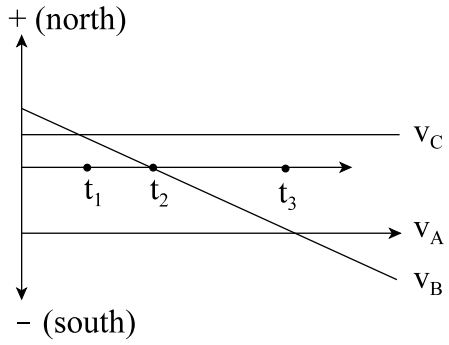
(c) Calculate the speed of the belt in m/s.

(d) What is the angular speed of the small pulley on the motor shaft in rpm?

(e) When the pulley on the motor shaft has made 500 revolutions, how many revolutions has the platter made?

B. A 81 kg person puts on a life jacket, jumps into the water, and floats. The jacket has a volume of 3.1×10^{-2} m^3 and is completely submerged under the water. The volume of the person's body that is underwater is 6.2×10^{-2} m^3. What is the density of the life jacket?

63. A Three cars, A, B and C, are traveling on 700 East. Take the intersection at 700 East and 2100 South to be the origin of your coordinate system. Assume that at $t_0 = 0$ all three vehicles are at 1700 South and 700 East. To the right are the velocity vs. time plots for the three vehicles. In the blanks below, enter A, B, and/or C, none or cannot tell to best answer the question posed. Take north as the positive direction.



1. _____ The car(s) initially moving in a northerly direction.
2. _____ The car(s) initially moving in a southerly direction.
3. _____ The car(s) moving with a constant positive acceleration.
4. _____ The car(s) moving with a constant negative acceleration.
5. _____ The car(s) that are not accelerating.
6. _____ The car(s) that momentarily stop at time t_2.
7. _____ The two cars that are farthest apart at t_3.
8. _____ The car(s) that have the same velocity at t_3.
9. _____ The car(s) with the greatest speed at t_1.
10. _____ The two cars that have identical speeds at some instant between t_2 and t_3, but not at t_2 or t_3.

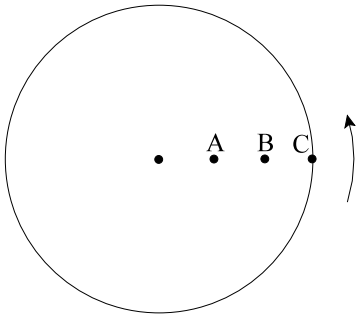
B. The planet Lepaute has 1/4 the mass of the earth and its radius is 1/4 that of the earth. On Earth Matt has a mass of 80 kg.

1. What is Matt's mass on Lepaute?
2. What is Matt's weight on earth?
3. What is Matt's weight on Lepaute?

64. A. Two objects, A and B, are hurled vertically upward from the same starting location with the same KE. The mass of A is twice the mass of B. In the spaces provided enter A, B, same, or neither that best satisfies the statement. Take the starting location to be the reference position for gravitational PE for both objects.

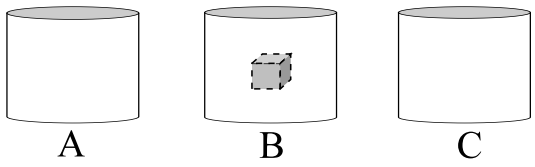
1. The object with the greater initial speed
2. The object with the larger GPE at the highest position reached for that object
3. The object that travels the larger vertical distance
4. The object with the larger mechanical energy at the starting location
5. The object with the larger initial momentum
6. The object conserving momentum during the entire trip

B. A disk (as shown) starting from rest rotates about a fixed axis with a constant angular acceleration. Three points, A, B and C are on the disk and rotate with the disk. In the spaces below enter A, B, C, or same to best fit the statement. Note: $r_A < r_B < r_C$.



1. The point(s) with the smallest angular speed
2. The point(s) with the largest tangential speed
3. The point(s) with the smallest angular acceleration
4. The point(s) with the smallest tangential acceleration
5. The point(s) with the smallest centripetal acceleration

C. The picture depicts three glass vessels, each filled with a liquid. The liquids each have different densities, and $\rho_A > \rho_B > \rho_C$. In vessel B sits an unknown block halfway to the bottom and completely submerged.



1. In which vessel would the block sit on the bottom?
2. In which vessel would the block float on the top?
3. In which vessel would the block feel the smallest buoyant force?
4. In which vessels are buoyant forces on the block the same?
5. Assume the coefficient of volume expansion for the liquid in B and the block are $\beta_B > \beta_{block}$. If the temperature of vessel B with the block is raised, would block B rise to the surface, sink to the bottom, or remain where it is?

65. A. A person eats a container of strawberry yogurt. The Nutritional Facts label states that it contains 240 Calories (1 Calorie = 4186 J). What mass of perspiration would one have to lose to get rid of this energy? At body temperature, the latent heat of vaporization of water is 2.43×10^6 J/kg.

B. In an aortic aneurysm, a bulge forms where the walls of the aorta are weakened. If blood flowing through the aorta (radius 1.0 cm) enters an aneurysm with a radius of 3.0 cm, how much higher on average is the blood pressure inside the aneurysm than the pressure in the unenlarged part of the aorta? The average speed of the blood through the aorta is 1.2 m/s. Assume the blood is non-viscous and the patient is lying down so there is no change in height. The density of blood is the same as water.

C. The amount of heat per second conducted from the blood capillaries beneath the skin to the surface is 240 j/s. The energy is transferred a distance of 2.0 mm through a body whose surface area is 1.6 m^2. Assuming that the thermal conductivity is that of body fat, determine the temperate difference between the capillaries and the surface of the skin. [k = 0.2 w/(m-k)]

D. A solid cylinder ($I = 0.5\ MR^2$ of mass 3.4 kg starts at rest on a ramp from a height of 10 m and rolls without slipping. If a block is released from the same height and has the same speed at the bottom of the ramp, how much work was done by friction on the block?

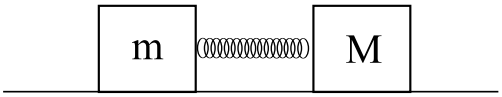
66. A. An experimental flywheel, used to store energy and replace an automobile engine, is a solid sphere of mass 200.0 kg and radius 0.40 m. Ignore losses of mechanical energy to means other than air resistance. For this problem, assume the engine shuts off when the flywheel is fully energized and doesn't turn back on. The flywheel is the only thing that provides additional energy to the car after this time.

(a) When driving at 80 km/hr, the fully energized flywheel is rotating at an angular speed of 30,176 rpm. What is the rotational kinetic energy of the flywheel?

(b) If the total mass of the car is 1000.0 kg, find the ratio of the initial rotational kinetic energy of the flywheel to the translational kinetic energy of the car when the engine first shuts off.

(c) If the force of the air resistance is 670.0 N, how far can the car travel before it comes to a stop after the engine shuts off?

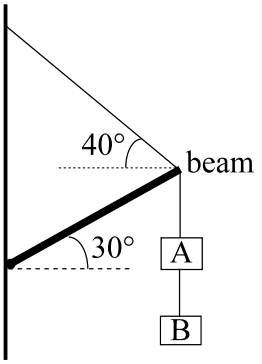
B. A14.6 kg block (m) and a 29.2 kg block (M) are resting on a horizontal frictionless surface. Between the two is squeezed a spring (spring constant =1170 N/m). The spring is compressed by 1.52 m from its unstrained length and is not attached permanently to either block. With what speed does each block move away after the mechanism keeping the spring squeezed is released and the spring falls straight down?



67. A 1240 N uniform beam is attached to a vertical wall at one end and is supported by a cable at the other end. A W = 1660 N crate (A) hangs from the far end of the beam. Another crate (B) of mass 50 kg is hanging on the end of the first crate. These crates are being pulled upward with an acceleration of 1.0 m/s^2.

A. Calculate the magnitude of the tension in the support cable.

B. Calculate the magnitude and direction of the force that the wall exerts on the left end of the beam.



68. A. An air puck of mass 0.25 kg is tied to a string and allowed to revolve in a circle of radius 1.0 m on a frictionless horizontal table. The other end of the string passes through a hole in the center of the table, and has a mass of 1.0 kg tied to it. The suspended mass remains in equilibrium while the puck on the tabletop revolves. What is the speed of the puck?

B. You are given 250 g of coffee (same specific heat as water) at 80.0^o C which is too hot to drink. In order to cool the entire drink to 40.0^o C, how much ice (at 0.0^o) must be added. Neglect the heat content of the cup and heat exchanges with the surroundings. [C_w = 4186 J/(kg · K); $L_f = 3.33 \times 10^5$ J/kg]

C. A skateboarder moves along horizontally at 5.4 m/s when she ascends a ramp. The highest end of the ramp is 3 m above the ground. It is tilted at 48^o about the ground.

(a) What is her maximum height above the ground?

(b) How far has she traveled along the ramp when she is at the maximum height? (Neglect friction in this problem.)

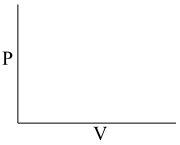
D. Io, a satellite of Jupiter, has an orbital period of 1.77 days and an orbital radius of 4.22 * 10^5 km. What is the mass of Jupiter?

69. One mole of a monatomic ideal gas, initially at STP (0^oC and $P=1.01 * 10^5$ Pa) is carried through the following cycle: [note that ln(3)=1.099]:

1. An isothermal expansion taking the gas to a new state with a volume 3 times the initial volume.
2. An isobaric compression to a new volume of 0.108 m^3 and a new temperature of 175 K.
3. An adiabatic compression that returns the gas to its starting state.

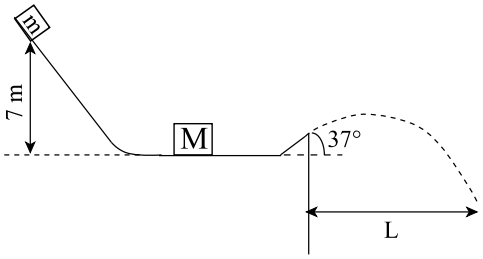
A. On the empty PV plot to the right, draw the plots of the 3 processes and use arrows to show the directions of each.

B. Fill in the following table. Show your work in the space below the table.

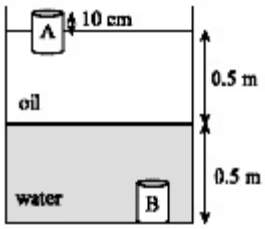


	W	ΔU	Q	ΔT
Isothermal Expansion				
Isobaric Compression				
Adiabatic Compression				
Complete Cycle				

70. A. A 2 kg block (m) is at the top of a frictionless ramp of height 7 m. After leaving the ramp and moving onto a frictionless horizontal surface, it collides with a 5 kg block (M) that is at rest and moves backward with a speed of 1 m/s. The larger block then goes off of a small incline (negligible height) and leaves the table at a 37^o angle with respect to the horizontal and hits the ground 5 seconds later. How far horizontally did the large block land from the end of the ramp it went off?



B. Two cylinders of uniform density are placed in a tank containing both oil and water. The tank is open to the air. Cylinder A is made of pine and is floating such that 10 cm of the cylinder floats above the surface of the oil (r_A = 2 cm, ρ_{pine} = 550 kg/m^3). Cylinder B is made of iron and rests on the bottom of the tank (r_B = 2 cm, h_B = 5 cm, D_{iron} = 7860 kg/m^3).



[1 atm = 1.01×10^5 Pa; ρ_{oil} = 800 kg/m3; ρ_{water} = 1000 kg/m^3]

(a) What is the total height of cylinder A?

(b) Find the gauge pressure 10 cm directly below the bottom surface of cylinder A?

71. A. Two objects, A of mass m and B of mass 2m, are subject to the same impulse. Assume both A and B are initially at rest. In the following statements fill in the blanks with either A for object A, B for object B, the same if objects A and B have the same value, or cannot tell. After the impulse

1. _____ is the object with the greatest speed.
2. _____ is the object with the greatest momentum.
3. _____ is the object with the greatest acceleration while accelerating.
4. _____ is the object with the greatest KE.
5. _____ is the object with the greatest amount of work done on it.

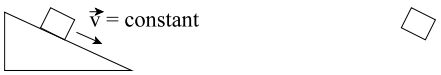
B. Two objects, A of mass m and B of mass 2m , are initially at rest on separate horizontal, frictionless surfaces. This time a pair of identical forces are applied to both A and B. These forces are applied for 5.0 s to both objects. If the physical quantity in the statement is the same for A and B, write same, otherwise write the letter of the object that fits the criteria.

1. The object that experiences the greatest net force.
2. The object experiencing the largest impulse.
3. The object with the largest momentum after 5.0 s.
4. The object with the greatest speed after 5.0 s.
5. The object that has traveled the smallest distance in 5.0 s
6. The object on which the force does the greatest amount of work in 5.0 s.
7. The object with the greatest kinetic energy after 5.0 s.
8. The object on which the force produces the largest average of power during the 5.0 s.

C. To the right of each drawing of a physical situation, construct a free-body diagram of the object shown. All arrows need labels and arrowheads.

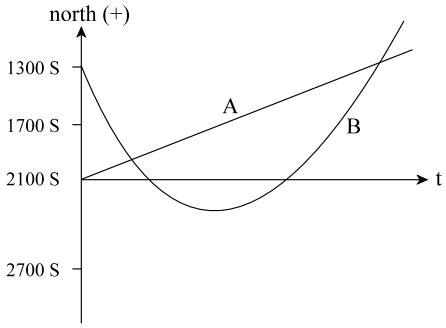
1. Baseball in flight (no air resistance).

2. Block traveling down an incline at constant speed.

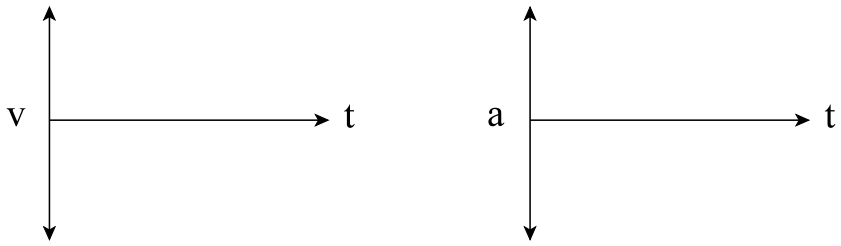


3. Two blocks being pushed across a frictionless horizontal surface. The top block does not slip.

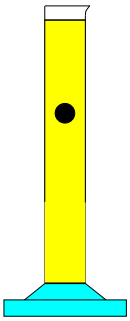
72. A. wo cars, A and B, are traveling along State Street as shown on the position vs. time plot below. On this plot, 2100 South State is the origin and north is the positive x direction. In the blanks below, enter A, B, both or neither that best answer the question posed.



1. Which car is traveling only in the northward direction for the time plotted?
2. Which car is moving more rapidly at the initial instant.
3. Which car momentarily stops and reverses direction?
4. At the instant the two cars have the same velocity, which car is more north?
5. Which car has the greatest speed when the two cars pass each other the second time?
6. Mark a point on the horizontal axis representing the instant the cars have the same velocity. Label the point P.
7. Below draw velocity vs. time and acceleration vs. time plots for each car. Make sure you label the cars on the graph.

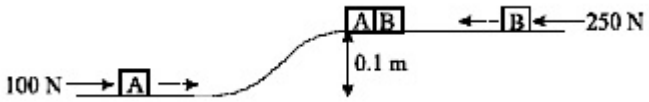


B. A spherical object is completely immersed in a liquid and is neutrally buoyant some distance above the bottom of the vessel. See figure. The upper surface of the liquid is open to the earth's atmosphere. In addition, the $\beta_{sphere} > \beta_{liquid}$ (coefficient of volume expansion). Assume the fluid and object are incompressible. For the following items below, indicate whether the object sinks to the bottom, rises to the top, or does nothing based on the changes described



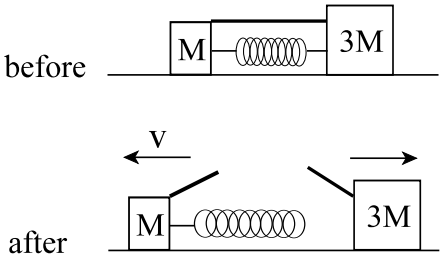
1. Atmospheric pressure drops by 20%.
2. Salt is dissolved in the liquid in the same way fresh water is turned into salt water.
3. The entire apparatus is warmed 10°C (liquid and object are both warmed).
4. The entire apparatus is transported to the surface of the moon. (g_{moon} = 1.6 m/s^2, P_{ATM} = 0 on moon)
5. 100 cm^3 of the liquid is removed from the top. The object is still initially submerged.
6. The object is uniform and taken out of the water, cut in half, then replaced in the initial location.
7. Oil with $\rho_{oil} < \rho_{liquid}$ is poured on top of the liquid.
8. The object is magically made into a hollow spherical shell with half the initial radius and one quarter of the initial mass..

73. A 100 N force acts on block A, initially at rest, over a distance of 0.4 m. A 250 N force acts on block B, which is also initially at rest, for 0.30 seconds. Both blocks slide towards each other on a frictionless table and then collide inelastically at the location shown. All of the force is provided while the blocks are on the horizontal surfaces. Mass of block A = 25 kg; mass of block B = 10 kg. Calculate the velocity of both blocks immediately after the collision.



74. A. A 0.026 kg bullet is fired straight up at a falling wooden block that has a mass of 4.0 kg. The bullet has a speed of 680 m/s when it strikes the block. The block originally was dropped from rest from the top of a building and had been falling for a time *t* when the collision with the bullet occurred. As a result of the collision, the block (with the bullet in it) reverses direction, rises, and comes to a momentary halt at the top of the building. Find the time *t*.

B. Two blocks of masses *M* and 3*M* are placed on a horizontal, frictionless surface. A massless spring is attached to one of them, and the blocks are pushed together with the spring between them as shown in the figure below. A cord initially holding the blocks together is burned; after that happens, the block of mass 3M moves to the right with a speed of 2.30 m/s.



1. What is the velocity of the block of mass *M*? Assume right is positive and left is negative.
2. Find the system's original elastic potential energy assuming all mechanical energy is conserved, taking M = 0.300 kg.
3. If the spring constant is k=1000 N/m, what is the initial displacement of the spring from equilibrium?

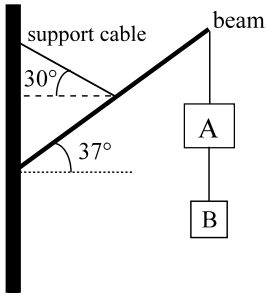
75. A. he hollow cylinder shown in the figure is free to rotate about a horizontal axis. One hole is cut in the side of the cylinder. The object of the game is to spin the cylinder so fast that an object dropped from rest through the hole when it is in the uppermost position will fall through the same hole when it has rotated to the bottom position.

1. If the diameter of the cylinder is 0.50 m, what is the minimum angular velocity of the cylinder?
2. If the cylinder is spun twice as fast as the minimum angular velocity, will the ball make it through the hole?

B. A ball is released from 2.7 m underwater. If the ball accelerates downward with an acceleration of magnitude 1.25 m/s^2, what is the ball's average density (kg/m^3)?

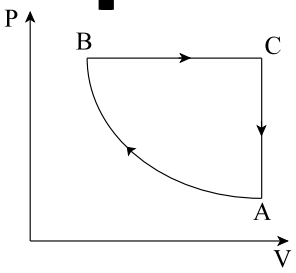
C. What is the average power (in standard units) of a heater that can transform 0.35 kg of ice at –12°C to steam at 100°C in 12 minutes?

76. A 1360 N uniform beam is attached to a vertical wall at one end and is supported by a cable that is connected halfway along the beam. A 137 kg crate (A) hangs from the far end of the beam. Another crate (B) of mass 50 kg is hanging on the end of the first crate. These crates are being pulled upward with an acceleration of 1.0 m/s^2. The beam is not moving.



A. Calculate the magnitude of the tension in the support cable.
B. Calculate the magnitude and direction of the force that the wall exerts on the left end of the beam.

77. Five moles of an ideal monatomic gas are going through the process cycle ABCA shown on the figure. The process AB is an isothermal compression with a temperature of 350 K, pressure at *A* of $1.2\times10^5 Pa$ and a pressure at B of 2.4×10^5 *Pa*.



1. Complete the following table and show all your work.

Process	ΔU	Q	W
A ⇒ B			
B ⇒ C			
C ⇒ A			
Entire Cycle			

2. What is the efficiency of this engine?

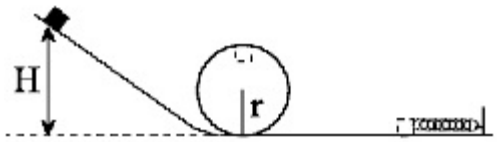
78. A. At amusement parks, there is a popular ride where the floor of a rotating cylindrical room falls away, leaving the backs of the riders "plastered" against the wall. Suppose the radius of the room is 3.3 m and the speed of the wall is 10 m/s when the floor falls away

1. What is the coefficient of kinetic friction that must exist between a rider's back and the wall if the 55 kg rider is to accelerate at 1 m/s^2 in the vertical direction (magnitude only) when the floor drops away? Assume static friction is not enough to keep the rider in place.

Now assume that the coefficient of static friction is just barely large enough to keep the rider in place

2. By what factor would the coefficient of static friction need to change to keep the rider in place if the radius was doubled?
3. By what factor would the coefficient of static friction need to change to keep the rider in place if the velocity was cut in half?
4. By what factor would the coefficient of static friction need to change to keep the rider in place if the mass of the rider tripled?

B. A large object of mass 988 kg slides without friction along a looped track of radius 10 m as shown. The object just barely remains on the track at the top of the circle.

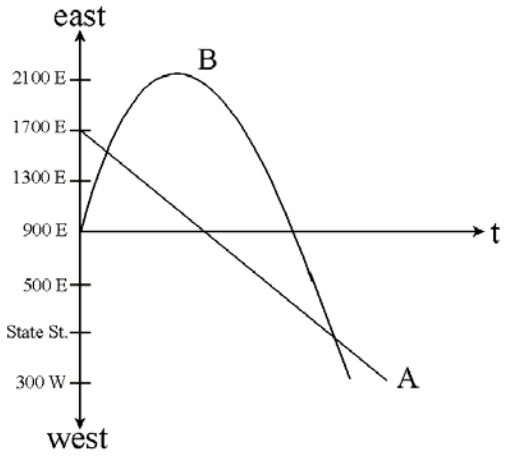


1. From what minimum height (H) must the object have been released from rest?

2. What is the maximum distance that the block will compress the spring if dropped from a height of 53 m? (k = 500,000 N/m)

79. A. Two vehicles are traveling east-west along 3300 South as shown on the position vs. time plot. On this plot 900 East is the origin and east is the positive direction. In the blanks below, enter A, B, both, or neither that best answers the questions

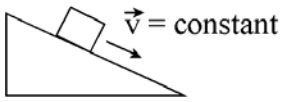
1. _____ Which car is traveling in an easterly direction during its entire motion?
2. _____ Which car is traveling in a westerly direction during its entire motion?
3. _____ Which car momentarily stops and reverses direction?
4. _____ Which car has the greater speed at the instant they pass one another for the second time?
5. _____ At the instant the two cars have the same velocity, which car is farther east?
6. _____ Which car has a nonzero acceleration?
7. _____ From the initial instant, which car has the greater displacement in getting to State Street?
8. Draw a vertical line on the graph passing through both plots that marks the instant the two cars have the same velocity.



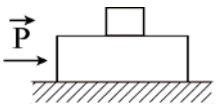
B. To the right of each drawing of a physical situation, construct a free-body diagram of the object shown. All vectors need arrowheads and labels.

1. Baseball in flight (no air resistance).

2. Block traveling down an incline at constant speed.



3. Two blocks accelerating to the right across a horizontal surface with friction. The top block does not slip.



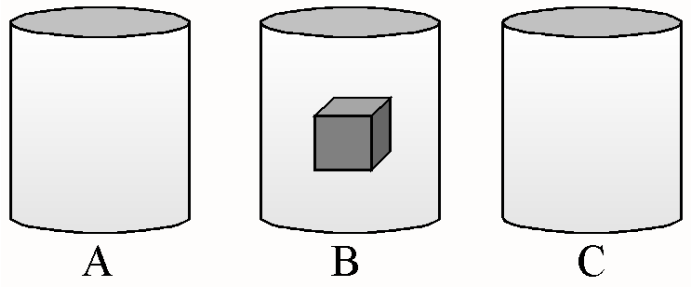
80. A. Two objects, A and B, are hurled vertically upward from the same starting location with the same kinetic energy. The mass of A is twice the mass of B. In the spaces provided enter A, B, same, or neither that best satisfies the statement. Take the starting location to be the reference position for gravitational PE for both objects

1. _____ The object with the greater initial speed.
2. _____ The object with the larger GPE at the highest position reached for that object.
3. _____ The object that travels the larger vertical distance.
4. _____ The object with the larger mechanical energy at the starting location.
5. _____ The object with the larger initial momentum.
6. _____ The object conserving momentum during the entire trip

B. Two objects, A of mass 2m and B of mass m, are subject to the same impulse. Assume both A and B are initially at rest and the time is the same for each impulse. In the following statements fill in the blanks with either A for object A, B for object B, the same if objects A and B have the same value, or cannot tell. At the end of the time interval,

1. _____ is the object with the greater momentum.
2. _____ is the object with the greater acceleration during the impulse time.
3. _____ is the object with the greater speed.
4. _____ is the object that traveled the greater distance.
5. _____ is the object with the greater KE.
6. _____ is the object that experienced the greater net force during the impulse.

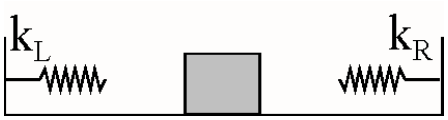
C. The picture depicts three glass vessels, each filled with a liquid. The liquids each have different densities, and $\rho_A > \rho_B > \rho_C$. In vessel B sits an unknown block halfway to the bottom and completely submerged



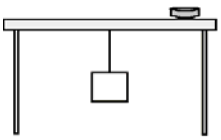
1. _____ In which vessel would the block sit on the bottom?
2. _____ In which vessel would the block float on the top?
3. _____ In which vessel would the block feel the smallest buoyant force?
4. _____ In which vessels are buoyant forces on the block are the same?
5. _____ Assume the coefficient of volume expansion for the liquid in B and the block are $\beta_B > \beta_{block}$. If the temperature of vessel B with the block is raised, would block B rise to the surface, sink to the bottom, or remain where it is?

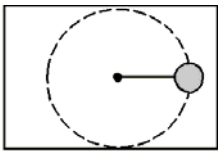
80. A. A solid sphere ($I = 2/5\ MR^2$) of mass 3.4 kg starts at rest on a ramp from a height of 10 m and rolls without slipping. If a 7 kg block is released from rest at the same height and has the same speed at the bottom of the ramp, how much work was done by friction on the block?

B. A 12.0 kg block moves back and forth on a frictionless horizontal surface between two springs. The spring on the right has a force constant k = 825 N/m. When the block arrives at the spring on the right, it compresses that spring 0.180 m from its unstretched position. With what speed does the block travel between the two springs while not in contact with either spring?



C. An air puck of mass 0.25 kg is tied to a string and allowed to revolve in a circle of radius 0.5 m on a frictionless horizontal table. The other end of the string passes through a hole in the center of the table, and has a mass of 1.5 kg tied to it. The suspended mass remains in equilibrium while the puck on the tabletop revolves. What is the speed of the puck?

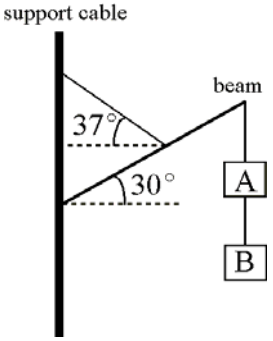

side


top

81. A. A 1.80 m radius playground merry-go-round has a mass of 120 kg and is rotating with an angular velocity of 2.0 rad/s ($I_{disk} = \frac{1}{2}\ MR^2$). A 22.0 kg child gets onto it by grabbing its outer edge. The child is initially at rest. How much energy is lost in the collision?

B. A thermos contains 150.0 cm^3 of water at 85°C. To cool the water you drop 22.0 g of ice cubes into the thermos. The ice cubes are initially at 0°C and melt completely. Assume the temperature of the thermos does not change. What is the final temperature of the water? [Specific heat water = C_{water} = 4.18 J/g°C; specific ice = C_{ice} = 2.03 J/g°C; latent heat water = 335 J/g]

82. A 400 N uniform beam is attached to a vertical wall at one end and is supported by a cable that is connected halfway along the beam. A 140 kg crate (A) hangs from the far end of the beam. Another crate (B) of mass 50 kg is hanging on the end of the first crate. The crates are being lowered with an acceleration of 1.0 m/s^2. The beam is not moving.

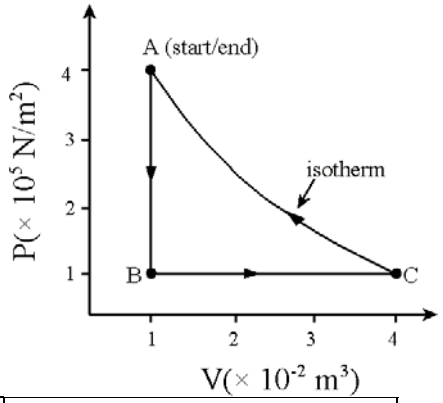


A. Calculate the magnitude of the tension in the support cable.

B. Calculate the magnitude and direction of the force the wall exerts on the left end of the beam.

F =	Θ = with respect to x-axis

83. Two moles of a monatomic ideal gas are taken through the three-step cycle ABCA shown.
[R = 8.31 J/mol·K]



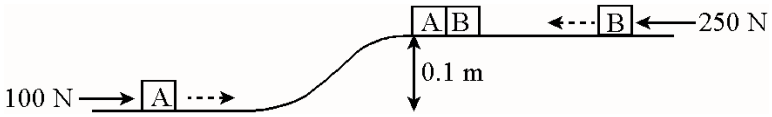
1. What are the temperatures in Kelvin at A, B and C?

T_A =	T_B =	T_C =

2. With the data from the graph, fill in the 12 missing items in the table below.

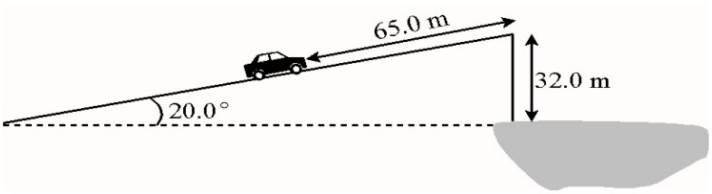
	ΔU	Q	W
A → B			
B → C			
C → A			
Entire Cycle			

84. A 100 N force acts on block A, initially at rest, over a distance of 0.5 m. A 250 N force acts on block B, which is also initially at rest, for 0.30 seconds. Both blocks slide towards each other on a frictionless table and then collide in a completely inelastic collision at the location shown. All of the force is provided while the blocks are on the horizontal surfaces and before the collision. Calculate the velocity of both blocks immediately after the collision. Mass of block A = 30 kg; mass of block B = 10 kg.

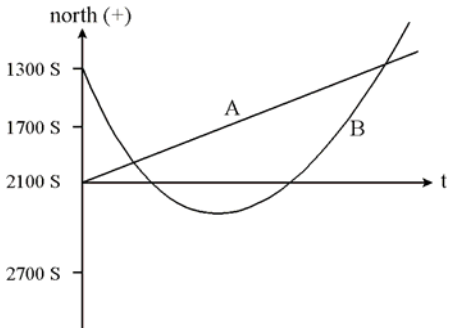


85. A car is traveling with a speed of 40.0 m/s up a hill that has a slope of 20.0° above the horizontal. The driver slams on his brakes to avoid going off a cliff which is 65.0 m ahead. The brakes lock, and the car slides up the hill and off the cliff. The coefficients of static and kinetic friction between the tires and the road are 0.8 and 0.6, respectively. The perfectly vertical cliff is 32.0 m high, and has a large lake at its base (shown in the figure). Do not worry--the driver escapes the car unharmed.

A. What is the speed of the car just as it is leaving the cliff?
B. What is the speed of the car just before it hits the lake?
C. How far from the base of the cliff does the car hit the water?



86. A. Two vehicles are traveling north-south along State Street as shown on the position vs. time plot. On this plot 2100 South is the origin and north is the positive direction. In the blanks below, enter A, B, both, or neither that best answers the questions.



1. _____ Which car is traveling in the northward direction for the entire time plotted?
2. _____ Which car is moving more rapidly at the initial instant?
3. _____ Which car momentarily stops and reverses direction?
4. _____ At the instant the two cars have the same velocity, which car is further north?
5. _____ Which car has the greatest speed when the two cars pass each other the second time?
6. Draw a vertical line through the graph where the cars have the same velocity. Label the line P.
7. Below draw velocity vs. time and acceleration vs. time plots for each car. Make sure you label the cars on the graphs.

B. A spherical object is completely immersed in a liquid and is neutrally buoyant some distance above the bottom of the vessel. See figure. The upper surface of the liquid is open to the earth's atmosphere. In addition, the $\beta_{sphere} > \beta_{liquid}$ (coefficient of volume expansion). Assume the fluid and object are incompressible. For the following items below, indicate whether the object sinks to the bottom, rises to the top, or does nothing based on the changes described.

1. _____ Atmospheric pressure drops by 20%
2. _____ Salt is dissolved in the liquid in the same way fresh water is turned into salt water.
3. _____ The entire apparatus is warmed 10°C (liquid and object are both warmed).
4. _____ The entire apparatus is transported to the surface of the moon. ($g_{moon} = 1.6$ m/s^2, $P_{ATM} = 0$ on the moon)
5. _____ 100 cm^3 of the liquid is removed from the top. The object is still initially submerged.
6. _____ The object is uniform and taken out of the water, cut in half, then replaced in the initial location.
7. _____ Oil with $\rho_{oil} < \rho_{liquid}$ is poured on top of the liquid.
8. _____ The object is magically made into a hollow spherical shell with half the initial radius and one quarter of the initial mass.

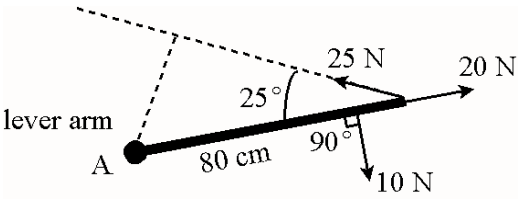
87. A. Two objects, A and B, are hurled vertically upward from the same starting location with the same kinetic energy. The mass of A is twice the mass of B. In the spaces provided enter A, B, same, or neither that best satisfies the statement. Take the starting location to be the reference position for gravitational PE for both objects.

1. _____ The object with the greater initial speed.
2. _____ The object with the larger GPE at the highest position reached for that object.
3. _____ The object that travels the larger vertical distance.
4. _____ The object with the larger mechanical energy at the starting location.
5. _____ The object with the larger initial momentum.
6. _____ The object conserving momentum during the entire trip

B. Two objects, A of mass 2m and B of mass m, are subject to the same impulse. Assume both A and B are initially at rest and the time is the same for each impulse. In the following statements fill in the blanks with either A for object A, B for object B, the same if objects A and B have the same value, or cannot tell. At the end of the time interval,

1. _____ is the object with the greater momentum.
2. _____ is the object with the greater acceleration during the impulse time.
3. _____ is the object with the greater speed.
4. _____ is the object that traveled the greater distance.
5. _____ is the object with the greater KE.
6. _____ is the object that experienced the greater net force during the impulse.

C. Three forces are applied to a rod as shown in the figure. The rod is free to rotate about the axis at point A. The rod has a mass of 2.40 kg and a total length of 1.00 m. Find the angular acceleration of the rod.

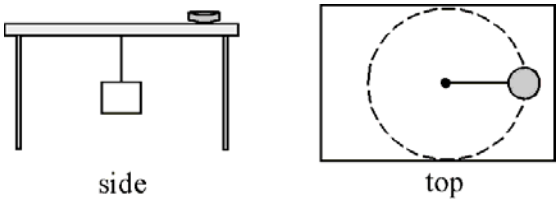


88. A. A baseball is thrown from a height of 1.5 m above the surface of the moon ($g = 1.60\ m/s^2$) with an initial speed of 35 m/s at an angle of 36.9° above the horizontal.

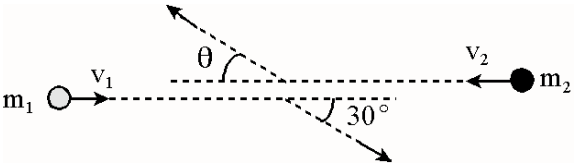
1. What is the maximum height above the surface that the ball will reach?
2. How far will the ball travel in the horizontal direction before it hits the ground?
3. Find the time of flight of the baseball.

B. A 90 N boy hangs from a rope suspended between two poles that are 5 meters apart. The rope to the left of the boy is 10° below the horizontal. The rope to the right of the boy is 5° below the horizontal. Find the tension on each side of the boy.

C. An air puck of mass 0.25 kg is tied to a string and allowed to revolve in a circle of radius 0.5 m on a frictionless table. The other end of the string passes through a hole in the center of the table and has a mass of 1.5 kg tied to it. The suspended mass remains in equilibrium while the puck on the table revolves in a circle. What is the speed of the puck?

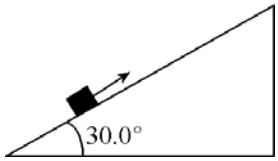


89. A. The two balls (m_1 has mass 800 g and velocity v_1 = 30 cm/s and m_2 has mass 500 g and velocity v_2 = -50 cm/s) collide off center and bounce off each other as shown in the drawing.



1. What is the final velocity (magnitude and direction) m_2 if the speed of m_1 is 0.15m/s after the collision?
2. Is the collision perfectly elastic? (You must show your work for credit.)

B. A 2.2 kg block slides up an incline 30° above the horizontal with an initial speed of 1.5 m/s. How far along the incline will the block go if the coefficient of kinetic friction between it and the incline is 0.15?

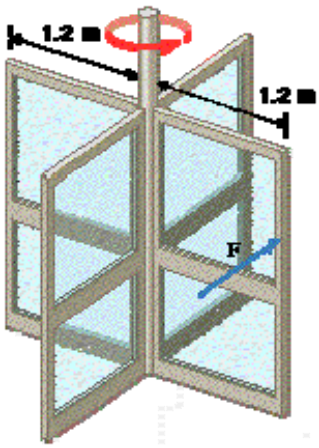


C. A 2.5 kg mass cube, 10cm wide, is at rest, but attached to two springs and is free to slide along a frictionless horizontal surface. The spring on the left is stretched 30cm from its relaxed length, while the spring on the right has a spring constant of 40 N/m. The total spring potential energy of the system is 3.6 J.

1. How far is the spring on the right stretched from its relaxed length?
2. What is the spring constant of the spring on the left?

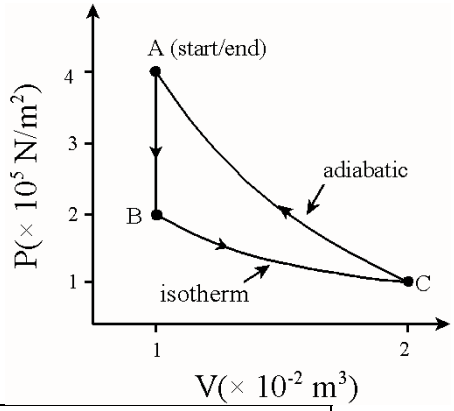
90. A. A 1.80 m radius playground merry-go-round has a mass of 120 kg, and is rotating with an angular velocity of 2.0 rad/s. A 22.0 kg child then gets onto it by grabbing its outer edge. The child is initially at rest. How much energy is lost in the collision.

B. A rotating door is made from four rectangular panes, 1.2 m wide as shown in the drawing. The mass of each pane is 60 kg. A person pushes on the outer edge of one pane with a force of F = 84 N that is directed perpendicular to the pane. Determine the magnitude of the angular acceleration of the door.



91. Two moles of a monatomic ideal gas are taken through the three-step Cycle ABCA shown. [R = 8.31 J/mol·K]

A. What are the temperatures in Kelvin at A, B and C?



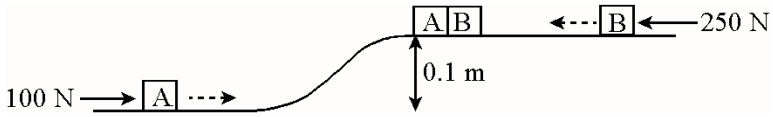
T_A =	T_B =	T_C =

B. With the data from the graph, fill in the table below.

	ΔU	Q	W
A → B			
B → C			
C → A			
Entire Cycle			

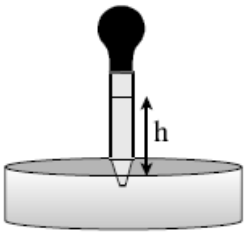
92. A 100 N force acts on block A, initially at rest, over a distance of 0.5 m. A 250 N force acts on block B, which is also initially at rest, for 0.30 seconds. Both blocks slide towards each other on a frictionless table and then collide in a completely inelastic collision at the location shown. All of the force is provided while the blocks are on the horizontal surfaces and before the collision. Calculate the velocity of both blocks immediately after the collision.

mass of block A = 30 kg;
mass of block B = 10 kg.



93. A. A 0.200 kg piece of aluminum that has a temperature of -165°C is added to 1.50 kg of water that has a temperature of 3.00°C. At equilibrium the temperature is 0.00°C. The specific heat of aluminum is 0.900 J/gm K. How much water turns to ice during the process?

B. A meat baster consists of a squeeze bulb attached to a plastic tube. When the bulb is squeezed and released, with the open end of the tube under the surface of the basting sauce, the sauce rises in the tube to a distance h, as the drawing shows. It can then be squirted over the meat. The atmospheric pressure is 1.013×10^5 Pa outside the tube in the drawing. The density of the basting sauce is 1200 kg/m^3. What is the absolute pressure in the bulb if the distance is h = 0.10 m?

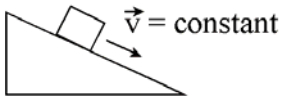


C. A ping-pong ball with an average density of 0.225 g/cm^3 is released from .3 m nderwater. What is its initial acceleration? (Acceleration is a vector.)

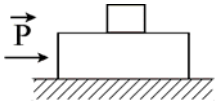
94. A. To the right of each drawing of a physical situation, construct a free-body diagram of the object s hown. All vectors need arrowheads and labels.

1. Baseball in flight (no air resistance).

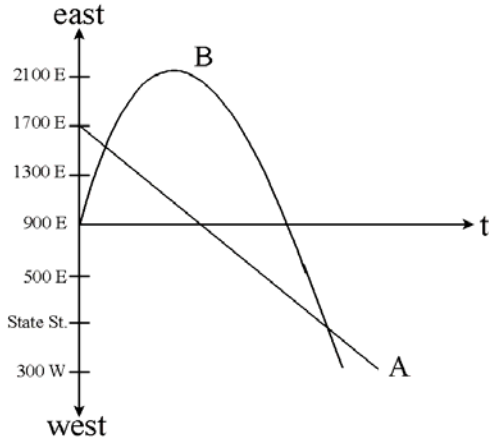
2. Block traveling down an incline at constant speed.



3. Two blocks are sliding to the right across a horizontal surface with friction and are slowing down. The top block does not slip.

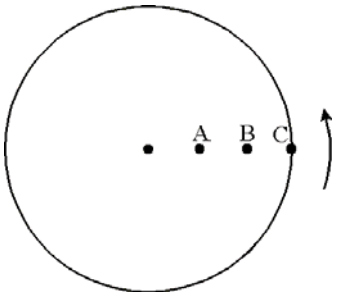


B. Two vehicles are traveling east-west along 3300 South as shown on the position vs. time plot. On this plot 900 East is the origin and east is the positive direction. In the blanks below, enter A, B, both, or neither that best answers the questions



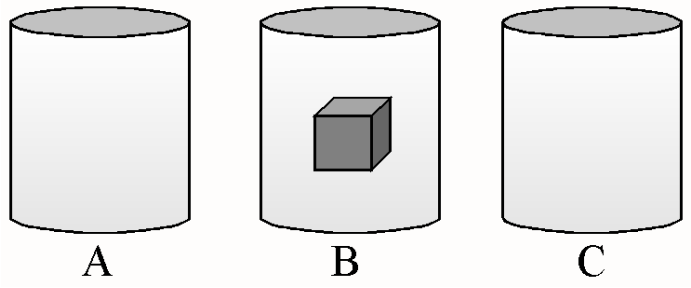
1._____ Which car is traveling in an easterly direction during its entire motion?
2,_____ Which car is traveling in a westerly direction during its entire motion?
3._____ Which car momentarily stops and reverses direction?
4._____ Which car has the greater speed at the instant they pass one another for the second time?
5._____ At the instant the two cars have the same velocity, which car is farther east?
6._____ Which car has a nonzero acceleration?
7._____ From the initial instant, which car has the greater displacement in getting to State Street?
9._____ From the initial instant, which car has the traveled the greater distance in getting to State Street?
10. Draw a vertical line on the graph passing through both plots that marks the instant the two cars have the same velocity.

95. A. A disk (as shown) starting from rest rotates about a fixed axis with a constant angular acceleration. Three, identical masses, A, B and C are on the disk and rotate with the disk. In the spaces below enter A, B, C, same or none to best fit the statement. Enter same if all are the same value. Note: $r_A < r_B < r_C$.



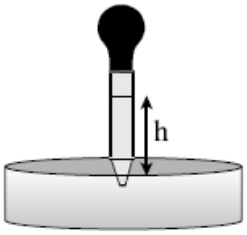
1. _____ The mass(es) with the smallest angular speed.
2. _____ The mass(es) with the largest tangential speed.
3. _____ The mass(es) with the smallest angular acceleration.
4. _____ The mass(es) with the smallest tangential acceleration.
5. _____ The mass(es) with the smallest centripetal acceleration.
6. _____ The mass(es) with the greatest kinetic energy after 3 seconds.
7. _____ The mass(es) with the smallest angular momentum after 3 seconds.
8. _____ The mass(es) that has the largest impulse after 3 seconds.
9. _____ The mass(es) that has the largest angular displacement after 3 seconds.
10. _____ The mass(es) conserving angular momentum during the first 3 seconds.

B. The picture depicts three glass vessels, each filled with a liquid. The liquids each have different densities, and $\rho_A > \rho_B > \rho_C$. In vessel B sits an unknown block halfway to the bottom and completely submerged



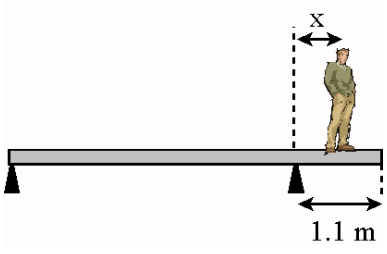
1. _____ In which vessel would the block sit on the bottom?
2. _____ In which vessel would the block float on the top?
3. _____ In which vessel would the block feel the smallest buoyant force?
4. _____ In which vessels are buoyant forces on the block are the same?
5. _____ Assume the coefficient of volume expansion for the liquid in B and the block are $\beta_B < \beta_{block}$. If the temperature of vessel B with the block is lowered, would the block rise to the surface, sink to the bottom, or remain where it is?
6. _____ Vessel B is moved to the moon. Does the block rise to the surface, sink to the bottom,
   or remain where it is?
7. _____ The block is held in place in vessel B and some liquid is removed. The block is still covered with liquid. The block is now released. Does the block rise to the surface, sink to the bottom, or remain where it is?

95. A. A meat baster consists of a squeeze bulb attached to a plastic tube. When the bulb is squeezed and released, with the open end of the tube under the surface of the basting sauce, the sauce rises in the tube to a distance h, as the drawing shows. It can then be squirted over the meat. The atmospheric pressure is 1.013×10^5 Pa outside the tube in the drawing. The density of the basting sauce is 1200 kg/m^3. What is the absolute pressure P in the bulb of the basting tube if h = 0.20 m?

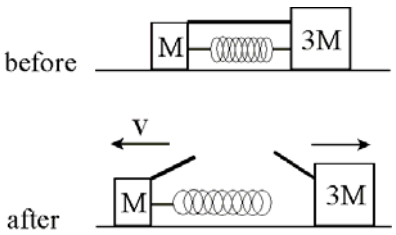


B. A solid disk rotates at an angular velocity of 0.49 rad/s with respect to an axis perpendicular to the disk at its center. The moment of inertia of the disk is 0.14 kg/m^2. From above, sand is dropped straight down onto this rotating disk, so that a thin uniform ring of sand is formed at a distance of 0.40 m from the axis. The sand in the ring has a mass of 0.50 kg. After all the sand is in place, what is the angular velocity of the disk?

C. A uniform plank of length 4.5 m and weight 218 N rests horizontally on two supports, with 1.1 m of the plank hanging over the right support (see the drawing). To what distance x can a person who weighs 441 N walk on the overhanging part of the plank before it just begins to tip?

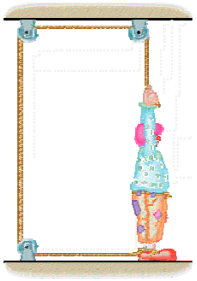


96. A. Two blocks of mass M and 3M are placed on a horizontal, frictionless surface. A massless spring is attached to one of them, and the blocks are pushed together with the spring between them as shown in the figure to the right. A cord initially holding the blocks together is burned; after that happens, the block of mass 3M moves to the right with a speed of 2.30 m/s.

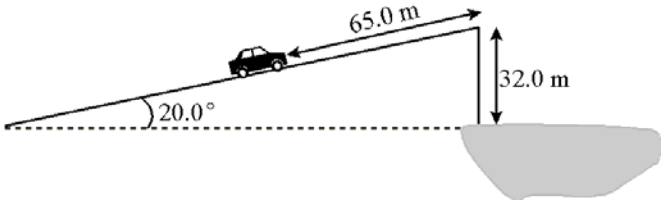


1. What is the velocity of the block of mass M? Assume right is positive and left is negative.
2. Find the system's original elastic potential energy assuming all mechanical energy is conserved, taking M = 0.300 kg.
3. If the spring constant is k = 1000 N/m, what is the initial displacement of the spring from equilibrium?

B. The drawing shows a circus clown who weighs 920 N. The coefficient of static friction between the clown's feet and the ground is 0.41 and the coefficient of kinetic friction between the clown's feet and the ground is 0.30. He pulls vertically downward on a rope that passes around three pulleys and is tied around his feet. What is the minimum pulling force that the clown must exert to yank his feet out from under himself?



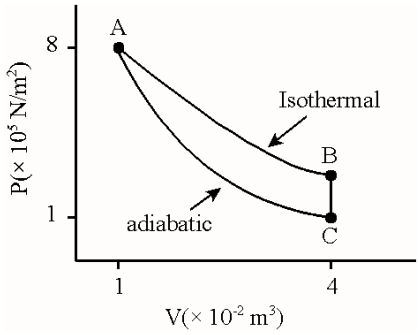
97. A car is traveling with a speed of 40.0 m/s up a hill that has a slope of 20.0° above the horizontal. The driver slams on his brakes to avoid going off a cliff which is 65.0 m ahead. The brakes lock, and the car slides up the hill and off the cliff. The car leaves the edge of the cliff with a speed of 21.1 m/s. The perfectly vertical cliff is 32.0 m high, and has a large lake at its base (shown in the figure). Do not worry--the driver escapes the car unharmed. [Note: C and D can be done without B.]



1. Is the friction static or kinetic?
2. What is the coefficient of friction between the tire and the road?
3. What is the speed of the car just before it hits the lake?
4. How far from the base of the cliff does the car hit the water?

98. Three moles of a monatomic ideal gas are taken through the three-step cycle ABCA shown. [R = 8.31 J/mol·K]

1. What are the temperatures in Kelvin at A, B and C?



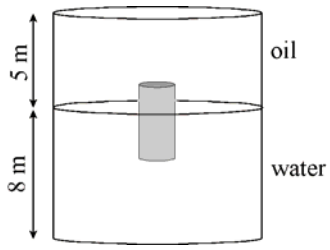
T_A =	T_B =	T_C =

2. With the data from the graph, fill in the 12 missing items in the table below.

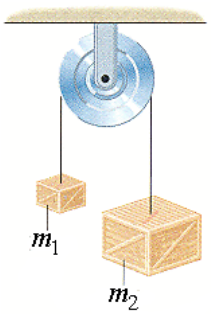
	ΔU	Q	W
A → B			
B → C			
C → A			
Entire Cycle			

99. A. What is the average power (in standard units) of a heater that can transform 0.35 kg of ice at –15°C to steam at 100°C in 15 minutes?

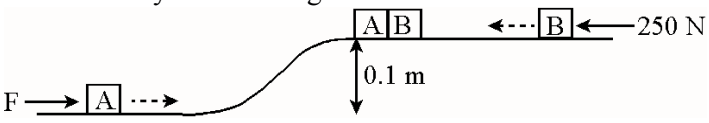
B. A solid cylinder ($\rho_{cylinder}$ = 750 kg/m^3) of length 4 m is floating in water so that 1 m of the cylinder is in the air and 3 m of the cylinder is in the water. Oil (ρ_{oil} = 600 kg/m^3) is poured into the container and the oil rises to a height of 5 meters above the water (see picture). How many meters of the cylinder is in the oil?



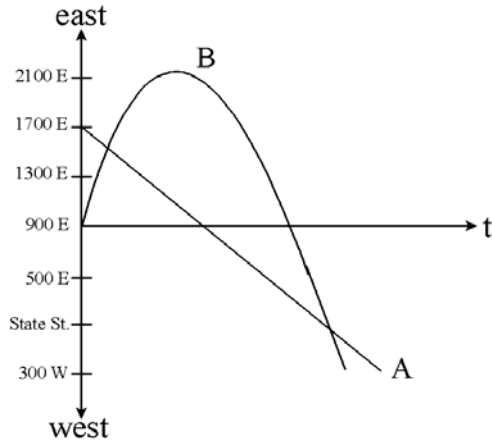
C. By means of a rope whose mass is negligible, two blocks are suspended over a pulley, as the drawing shows, with m_1 = 10.9 kg and m_2 = 44.4 kg. The pulley can be treated as a uniform, solid, cylindrical disk. The downward acceleration of the 44.4 kg block is observed to be exactly one-half the acceleration due to gravity. Noting that the tension in the rope is not the same on each side of the pulley, find the mass of the pulley.



100. A force F acts on block A (mass 30 kg), initially moving at 1.0 m/s to the right, ver a distance of 0.5 m. A 250 N force acts on block B (mass 10 kg), which is initially at rest for t seconds. Both blocks slide towards each other on a frictionless table and then collide in a completely inelastic collision at the location shown. All of the force is provided while the blocks are on the horizontal surfaces and before the collision. The velocity of the two blocks is 1.00 m/s to the left after the collision. The kinetic energy of block B is reduced by 276 J during the collision. Find F and t.



101. A. Two vehicles are traveling east-west along 3300 South as shown on the position vs. time plot. On this plot 900 East is the origin and east is the positive direction. In the blanks below, enter A, B, both, or neither that best answers the questions



1._____ Which car is traveling in a westerly direction during its entire motion?
2,_____ Which car is traveling in an easterly direction during its entire motion?
3._____ Which car momentarily stops and reverses direction?
4._____ Which car has the greater speed at the instant they pass one another for the second time?
5._____ At the instant the two cars have the same velocity, which car is farther west?
6._____ Which car has a nonzero acceleration?
7._____ From the initial instant, which car has the greater displacement in getting to State Street?
9._____ From the initial instant, which car has the traveled the greater distance in getting to State Street?
10. Draw a vertical line on the graph passing through both plots that marks the instant the two cars have the same velocity.

B. A uniformly solid spherical object is completely immersed in a liquid and is neutrally buoyant some distance above the bottom of the vessel. The upper surface of the liquid is open to the earth's atmosphere. In addition, $\beta_{sphere} > \beta_{liquid}$ (coefficient of volume expansion). For the following items below, indicate whether the object sinks to the bottom, rises to the top, or does nothing based on the changes described.

1. _____ Atmospheric pressure increases by 20%.
2. _____ Salt is dissolved in the liquid in the same way fresh water is turned into salt water.
3. _____ The entire apparatus is cooled 10°C (liquid and object are both cooled).
4. _____ The entire apparatus is transported to the surface of the moon. ($g_{moon} = 1.6$ m/s^2, $P_{ATM} = 0$ on the moon)
5. _____ 100 cm^3 of the liquid is removed from the top. The object is still initially submerged.
6. _____ The object is uniform and taken out of the water, cut in half, then replaced in the initial location.
7. _____ Oil with $\rho_{oil} < \rho_{liquid}$ is poured on top of the liquid.
8. _____ The object is magically made into a hollow spherical shell with twice the initial radius and twice the initial mass.

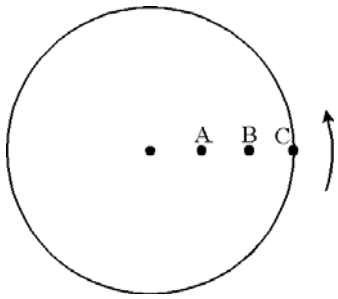
102. A. Two blocks, A of mass m and B of mass 2m, are subject to the same impulse. Assume both A and B are initially at rest. In the following statements fill in the blanks with either A for object A, B for object B, the same if objects A and B have the same value, or cannot tell. After the impulse

1. _____ is the object with the lesser speed.
2. _____ is the object with the greater momentum.
3. _____ is the object with the lesser acceleration while accelerating.
4. _____ is the object with the greater KE.
5. _____ is the object with the lesser amount of work done on it.

B. Two blocks, A of mass m and B of mass 2m , are initially at rest on separate horizontal, frictionless surfaces. This time a pair of identical forces are applied to both A and B. These forces are applied for 5.0 s to both objects. If the physical quantity in the statement is the same for A and B, write same, otherwise write the letter of the object that fits the criteria.

1. _____ The object that experiences the greater net force.
2. _____ The object experiencing the larger impulse.
3. _____ The object with the larger momentum after 5.0 s.
4. _____ The object with the greater speed after 5.0 s.
5. _____ The object that has traveled the larger distance in 5.0 s
6. _____ The object on which the force does the greater amount of work in 5.0 s.
7. _____ The object with the lower kinetic energy after 5.0 s.
8. _____ The object on which the force produces the largest average power during the 5.0 s.

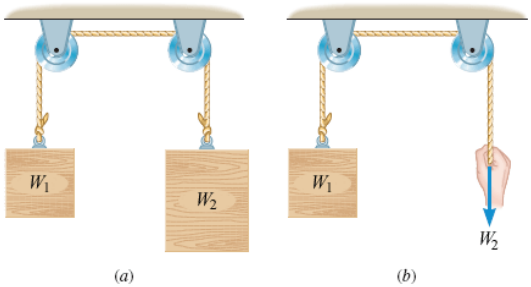
C. A disk (as shown) starting from rest rotates about a fixed axis with a constant angular acceleration. Three, identical masses, A, B and C are on the disk and rotate with the disk. In the spaces below enter A, B, C, same or none to best fit the statement. Enter same if all are the same value. Note: $r_A < r_B < r_C$.



1. _____ The mass(es) with the largest angular speed.
2. _____ The mass(es) that will slip first.
3. _____ The mass(es) with the smallest angular momentum after 3 seconds.
4. _____ The mass(es) with the smallest centripetal acceleration after 3 s.
5. _____ The mass(es) with the largest tangential acceleration after 3 s.

103. A. A 1.01×10^{-2} kg bullet is fired horizontally into a 2.65 kg wooden block attached to one end of a massless, horizontal spring (k = 846 N/m). The other end of the spring is fixed in place, and the spring is unstrained initially. The block rests on a horizontal, frictionless surface. The bullet strikes the block perpendicularly and quickly comes to a halt within it. As a result of this completely inelastic collision, the spring is compressed along its axis and causes the block/bullet to oscillate with a maximum compression of 0.200 m. What is the speed of the bullet?

B. As part (a) of the drawing shows, two blocks are connected by a rope that passes over a set of pulleys. One block has a weight of $W_1 = 512$ N, and the other has a weight of $W_2 = 908$ N. The rope and the pulleys are massless and there is no friction.

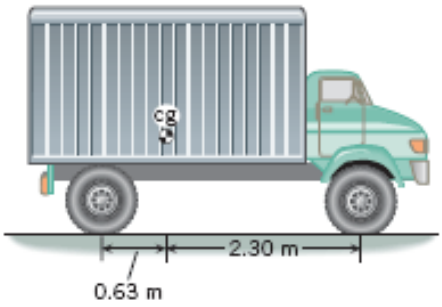


1. What is the acceleration of the lighter block?
2. Suppose that the heavier block is removed, and a downward force of 908 N is provided by someone pulling on the rope, as part *b* of the drawing shows. Find the acceleration of the remaining block.
3. Explain why the answers in (a) and (b) are different.

104. A. A hand-pumped water gun is held level at a height of 0.74 m above the ground and fired. The water stream from the gun hits the ground a horizontal distance of 7.55 m from the muzzle. Find the gauge pressure of the water gun's reservoir at the instant when the gun is fired. Assume that the speed of the water in the reservoir is zero and that the water flow is steady. Ignore both air resistance and the height difference between the reservoir and the muzzle. (density of water = 1000 kg/m^3)

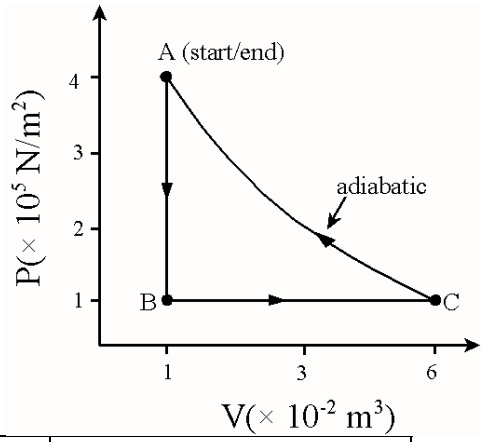
B. When some stars use up their fuel, they undergo a catastrophic explosion called a *supernova*. This explosion blows much or all of the star's mass outward, in the form of a rapidly expanding spherical shell. As a simple model of the supernova process, assume that the star is a solid sphere of radius R that is initially rotating about its center at 2.0 revolutions per day. After the star explodes, find the angular velocity, in revolutions per day, of the expanding supernova shell when its radius is 4.0R. Assume that all of the star's original mass is contained in the shell.

C. Workers have loaded a delivery truck in such a way that its center of gravity is only slightly forward of the rear axle, as shown in the drawing. The mass of the truck and its contents is 8890 kg. Find the difference in the magnitudes of the forces exerted by the ground on front wheels and the rear wheels.



105. Three moles of a monatomic ideal gas are taken through the three-step cycle ABCA shown. [R = 8.31 J/mol·K]

1. What are the temperatures in Kelvin at A, B and C?



T_A =	T_B =	T_C =

2. With the data from the graph, fill in the 12 missing items in the table below.

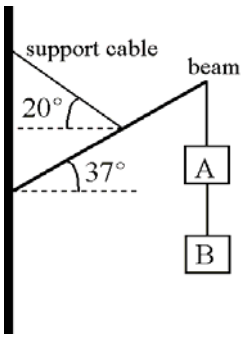
	ΔU	Q	W
A → B			
B → C			
C → A			
Entire Cycle			

106. A. What is the average power (in standard units) of a heater that can transform 0.25 kg of ice at –10°C to steam at 100°C in 15 minutes?

B. A spring is attached to the bottom of an empty swimming pool, with the axis of the spring oriented vertically. A7.60 kg block of wood ($\rho = 835$ kg/m^3) is fixed to the top of the spring and compresses it. Then the pool is filled with water, completely covering the block. The spring is now observed to be stretched twice as much as it had been compressed. Determine the percentage of the block's total volume that is hollow. Ignore any air in the hollow space. (density of water = 1000 kg/m^3)

C. A 14.8 m length of hose is wound around a reel, which is initially at rest. The moment of inertia of the reel is 0.45 kg · m^2, and its radius is 0.159 m. When the reel is turning, friction at the axle exerts a torque of magnitude 3.54 N · m on the reel. If the hose is pulled so that the tension in it remains a constant 27.3 N, how long does it take to completely unwind the hose from the reel? Neglect the mass of the hose, and assume that the hose unwinds without slipping.

107. A 1560 N uniform beam is attached to a vertical wall at one end and is supported by a cable that is connected halfway along the beam. A 37 kg crate (A) hangs from the far end of the beam. Another crate (B) of mass 150 kg is hanging on the end of the first crate. The crates are being lowered with an acceleration of 1.0 m/s^2. The beam is not moving.

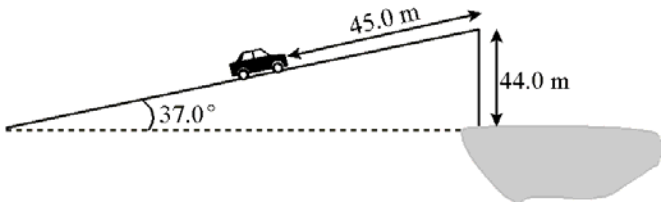


A. Calculate the magnitude of the tension in the support cable.

B. Calculate the magnitude and direction of the force the wall exerts on the left end of the beam.

F =	θ = with respect to x-axis

108. A stunt car is traveling with a speed of 30.0 m/s up a hill that has a slope of 37.0° above the horizontal. The driver slams on his brakes to avoid going off a cliff which is 45.0 m ahead. The brakes lock, and the car slides up the hill and off the cliff. The car leaves the edge of the cliff with a speed of 15.1 m/s. The perfectly vertical cliff is 44.0 m high, and has a large lake at its base (shown in the figure). Do not worry--the driver escapes the car unharmed. [NOTE: C and D can be done without B.]



A. As the car slides up the hill, is the friction between the tires and the ground static or kinetic?

B. What is the coefficient of friction between the tire and the road?

C. What is the speed of the car just before it hits the lake?

D. How far from the base of the cliff does the car hit the water?