Physics 105 Homework Problems, Fall 2009

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1-1. Complete the vector tutorial found in the course packet or on the course website. Submit your work through the Physics 105 slots below the homework bins outside N357 ESC.

2-1. A person travels by car from one city to another with different constant speeds between pairs of cities. She drives [01] ________ min at 83.7 km/h, 11.8 min at 126 km/h, and 45.5 min at [02] ________ km/h, and spends 15.1 min eating lunch and buying gas.
(a) Determine the distance between the initial and final cities along this route.
(b) Determine the average speed for the trip.

2-2. A motorist drives north for [03] ________ minutes at 85.8 km/h and then stops for 15.2 minutes. He then continues north, traveling 133 km in 2.00 h. (a) What is his total displacement? (b) What is his average velocity?

2-3. A car accelerates uniformly from rest to a speed of [04] ________ mi/h in [05] ________ s. (a) Find the acceleration of the car and (b) the distance the car travels during this time.

2-4. A jet plane lands with a speed of [06] ________ m/s and can accelerate at a maximum rate of -5.31 m/s^2 as it comes to rest. (a) From the instant the plane touches the runway, what is the minimum time needed before it can come to rest. (b) What is the minimum distance needed?

2-5. A young woman named Kathy Kool buys a sports car that can accelerate at the rate of 4.92 m/s^2. She decides to test the car by drag racing with another speedster, Stan Speedy. Both start from rest, but experienced Stan leaves the starting line [07] ________ s before Kathy. If Stan moves with a constant acceleration of 3.56 m/s^2 and Kathy maintains an acceleration of 4.92 m/s^2, find (a) the time it takes Kathy to overtake Stan (from the time Kathy starts), and (b) the distance she travels before she catches him.

3-1. A ball is thrown vertically upward with a speed of [01] __________ m/s. (a) How high does it rise? (b) How long does it take to reach its highest point? (c) How long after it reaches its highest point does it take to return to the level from which it started? (d) What is its velocity when it returns to the level from which it started? (Use negative sign for downward velocity.)

3-2. Another scheme to catch the roadrunner has failed. A safe falls from rest from the top of a 25.0-m-high cliff toward Wile E. Coyote, who is standing at the base. Wile first notices the safe after it has fallen [02] __________ m. How long does he have to get out of the way?

3-3. A student throws a set of keys vertically upward to her sorority sister, who is in a window [03] __________ m above. The keys are caught 1.53 s later by the sister's outstretched hand. (a) With what initial velocity were the keys thrown? (b) What was the velocity of the keys just before they were caught?

3-4. A model rocket is launched straight upward with an initial speed of [04] __________ m/s. It accelerates with a constant acceleration of [05] __________ m/s^2 until its engines stop at an altitude of [06] __________ m. (a) What is the maximum height reached by the rocket? (b) How long after lift-off does the rocket reach its maximum height? (c) How long is the rocket in the air?

4-1. A stone is kicked so that it leaves the ground with an initial velocity of 13.7 m/s at an angle of [01] __________°. The stone is kicked toward a loading dock whose near edge is 3.18 m away and 1.21 m high. What are the (a) x and (b) y components of the stone's initial velocity? (c) How high does it go? (d) How far from the edge does it strike the dock? (e) How fast is it moving just before it hits the dock?

4-2. A student decides to measure the muzzle velocity of a pellet from his gun. He points the gun horizontally. He places a target on a vertical wall a distance 3.27 m away from the gun. The pellet hits the target a vertical distance [02] __________ m below the gun. What is the speed of the pellet?

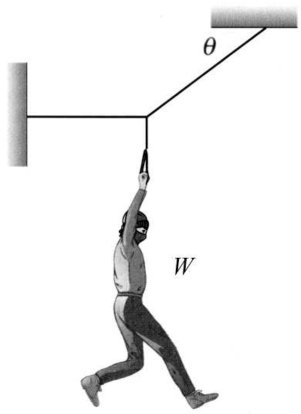
4-3. Cliff divers at Acapulco jump into the sea from a cliff 36.3 m high. At the level of the sea, a rock sticks out a horizontal distance of [03] __________ m. With what minimum horizontal velocity must the cliff divers leave the top of the cliff if they are to miss the rock?

4-4. A firefighter, [04] __________ m away from a burning building, directs a stream of water from a ground level fire hose at an angle of [05] __________° above the horizontal. If the speed of the stream as it leaves the hose is [06] __________ m/s, at what height will the stream of water strike the building?

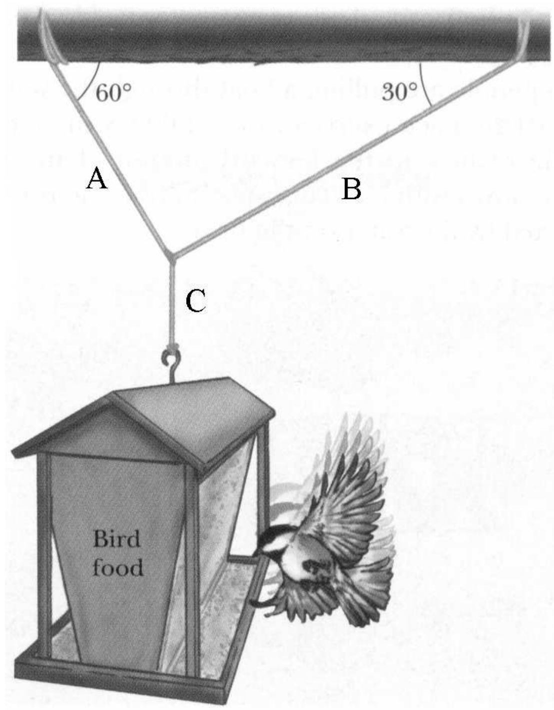
4-5. One strategy in a snowball fight is to throw a snowball at a high angle over level ground. While your opponent is watching the first one, you throw a second snowball at a low angle timed to arrive before or at the same time as the first one. Assume both snowballs are thrown with a speed of 25.3 m/s. The first one is thrown at an angle of [07] __________° with respect to the horizontal. (a) At what angle should the second snowball be thrown to arrive at the same point as the first? (b) How many seconds later should the second snowball be thrown after the first to arrive at the same time?

5-1. A bag of sugar weighs [01] __________ lb on Earth. (a) What should it weigh in newtons on the Moon, where the free-fall acceleration is $\frac{1}{6}$ that on Earth? (b) Repeat for Jupiter, where g is 2.64 times that on Earth. Find the mass of the bag of sugar in kilograms on (c) Earth, (d) the Moon, and (e) Jupiter.

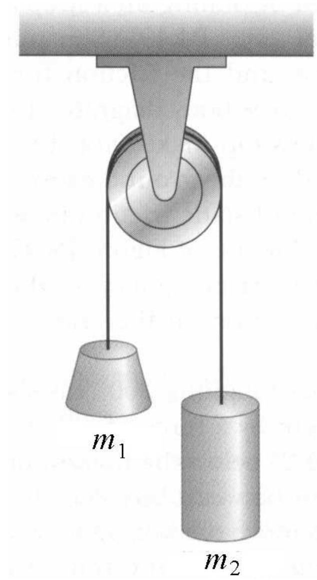
5-2. Two cables support a cat burglar. In the figure, $W =$ [02] __________ N, and $\theta =$ [03] __________°. Find (a) the tension in the cable connected to the ceiling and (b) the tension in the cable connected to the wall on the left. Neglect the mass of the cables.



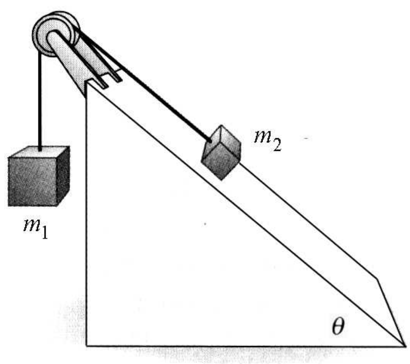
5-3. A [04] __________-N bird feeder is supported by three cables as shown in the figure. Find the tension in (a) cable A, (b) cable B, and (c) cable C.



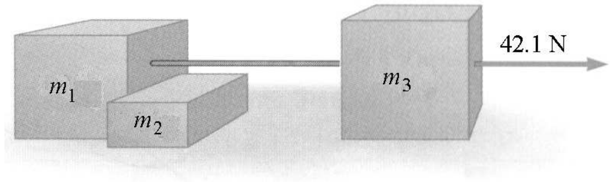
6-1. Two objects with masses $m_1 = 3.24$ kg and $m_2 =$ [01] __________ kg are connected by a light string that passes over a frictionless pulley as in the figure. Determine (a) the acceleration of each object, (b) the tension in the string, and (c) the distance each object will move in the first second of motion if both objects start from rest.



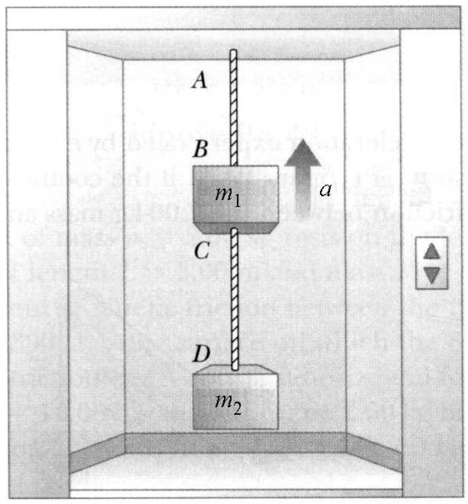
6-2. Two objects are connected by a light string that passes over a frictionless pulley as in the figure. One object lies on a smooth incline. In the figure, $m_1 =$ [02] __________ kg, $m_2 =$ [03] __________ kg, and $\theta =$ [04] __________°. Find (a) the magnitude of the acceleration of the objects and (b) the tension in the string.



6-3. Assume that the three blocks in the figure move on a frictionless surface. In the figure, $m_1 =$ [05] ________ kg, $m_2 =$ [06] ________ kg, and $m_3 =$ [07] ________ kg. The 42.1-N force acts as shown on the right block. Determine (a) the acceleration of the blocks, (b) the tension in the cord connecting the left and right blocks, and (c) the force exerted on the center block by the left block.

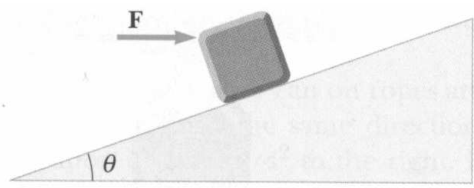


6-4. Two blocks are fastened to the ceiling of an elevator, as in the figure. In the figure, $m_2 =$ [08] ________ kg (bottom block) and $m_1 =$ [09] ________ kg (top block). The elevator accelerates upward at $a =$ [10] ________ m/s^2. Find the tension in (a) the rope CD and (b) the rope AB.

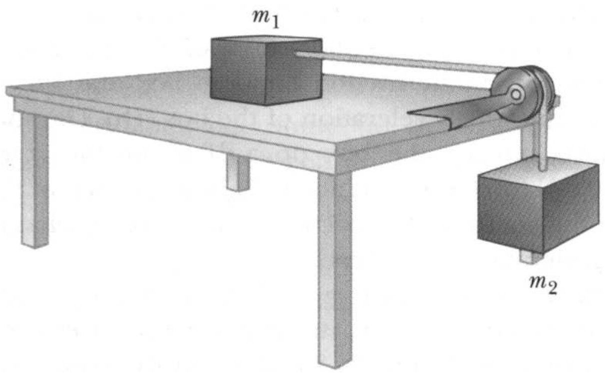


7-1. A dockworker loading crates on a ship finds that a [01] ________-kg crate, initially at rest on a horizontal surface, requires a 75-N horizontal force to set it in motion. However, after the crate is in motion, a horizontal force of 60 N is required to keep it moving with a constant speed. Find the coefficients of (a) static and (b) kinetic friction between crate and floor.

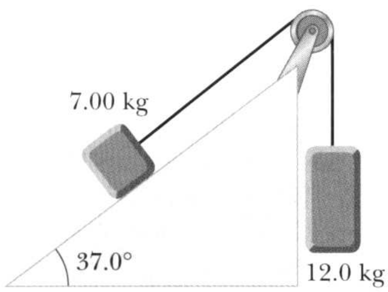
7-2. A 2.00-kg block is held in equilibrium on an incline of angle $\theta =$ [02] ________° by a horizontal force **F** applied in the direction shown in the figure. If the coefficient of static friction between the block and incline is $\mu_s = 0.334$, determine (a) the minimum value of **F** and (b) the normal force of the incline on the block.



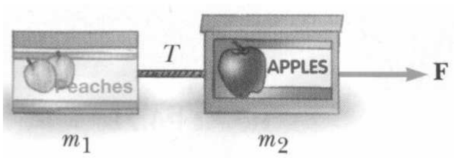
7-3. Objects with masses $m_1 = 8.83$ kg and $m_2 =$ [03] ________ kg are connected by a light string that passes over a frictionless pulley as in the figure. If, when the system starts from rest, m_2 falls 1.28 m in 1.22 s, determine the coefficient of kinetic friction between m_1 and the table.



7-4. Find the acceleration experienced by each of the two objects shown in the figure if the coefficient of kinetic friction between the 7.00-kg object and the plane is [04] ________.



7-5. Two boxes of fruit on a frictionless horizontal surface are connected by a light string as in the figure, where $m_1 =$ [05] ________ kg and $m_2 = 25.4$ kg. A force of 52.1 N is applied to the 25.4-kg box. Determine (a) the acceleration of each box and (b) the tension in the string. Suppose now that the surface is not frictionless, the coefficient of kinetic friction between each box and the surface being 0.10. Determine (c) the acceleration of each box and (d) the tension in the string.



8-1. Starting from rest, a 5.00-kg block slides 2.50 m down a rough [01] ________° incline. The coefficient of kinetic friction between the block and the incline is $\mu_k = 0.436$. Determine (a) the work down by the force of gravity, (b) the work done by the friction force between block and incline, and (c) the work done by the normal force.

8-2. A scraper is drawn over a tooth 20 times, each time moving a distance of 0.75 cm. The scraper is held against the tooth with a normal force of [02] ________ N. Assuming a coefficient of kinetic friction of 0.90 between the scraper and the tooth, determine the work done to clean the tooth.

8-3. A block of mass 2.56 kg is pushed [03] ________ m along a frictionless horizontal table by a constant 16.5 N force directed 25.3° below the horizontal. Determine the work done by (a) the applied force, (b) the normal force exerted by the table, (c) the force of gravity, and (d) the net force on the block.

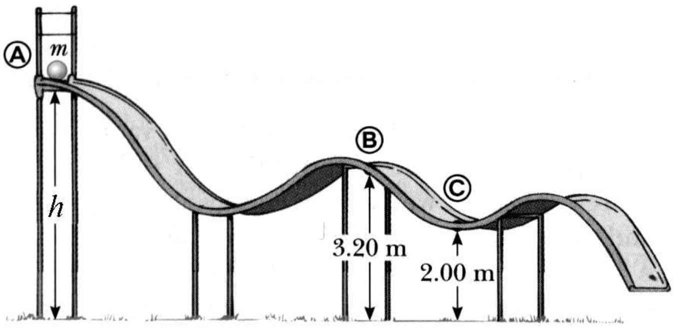
8-4. A 72.9-kg base runner begins his slide into second base when moving at a speed of [04] ________ m/s. The coefficient of friction between his clothes and Earth is [05] ________. He slides so that his speed is zero just as he reaches the base. (a) How much mechanical energy is lost due to friction acting on the runner? (b) How far does he slide?

9-1. A 42.6-N toy is placed in a light swing that is attached to ropes [01] ________ m long. Find the gravitational potential energy associated with the toy relative to its lowest position (a) when the ropes are horizontal, (b) when the ropes make a 32.7° angle with the vertical, and (c) at the bottom of the circular arc.

9-2. A crate of mass [02] ________ kg is pulled up a rough incline with an initial speed of 1.53 m/s. The pulling force is 92 N parallel to the incline, which makes an angle of 19.1° with the horizontal. The coefficient of kinetic friction is 0.431, and the crate is pulled 5.41 m. (a) How much work is done by gravity? (b) How much work is done by friction? (c) How much work is done by the 92-N force? (d) What is the change in kinetic energy of the crate? (e) What is the speed of the crate after being pulled 5.41 m?

9-3. An archer pulls her bowstring back 0.416 m by exerting a force that increases uniformly from zero to [03] ________ N. (a) What is the equivalent spring constant of the bow? (b) How much work does the archer do in pulling the bow?

10-1. A bead of mass $m = 5.00$ kg is released from point A at a height $h =$ [01] ________ m and slides on the frictionless track shown in the figure. Determine (a) the bead's speed at point B, (b) its speed at point C and (c) the net work done by the force of gravity in moving the bead from A to C.



10-2. A 51.3-kg pole vaulter running at [02] __________ m/s vaults over the bar. Her speed when she is over the bar is [03] __________ m/s. Neglect air resistance, as well as any energy absorbed by the pole, and determine her altitude as she crosses the bar.

10-3. A skier of mass 74.9 kg is pulled up a slope by a motor-driven cable. (a) How much work is required to pull him 63.2 m up a [04] __________°-slope (assumed frictionless) at a constant speed of [05] __________ m/s? (b) How many horsepower must a motor have to perform this task?

10-4. A child and sled with a combined mass of 53.9 kg slide down a frictionless slope. If the sled starts from rest and has a speed of [06] __________ m/s at the bottom, what is the height of the hill?

10-5. While running, a person dissipates about 0.65 J of mechanical energy per step per kilogram of body mass. If a [07] __________-kg person develops a power of 78 W during a race, how fast is the person running? Assume a running step 1.5 m long.

10-6. Energy is conventionally measured in Calories as well as in joules. One Calorie in nutrition is 1 kcal=4186 J. Metabolizing one gram of fat can release 9.00 kcal. A student decides to try to lose weight by exercising. She plans to run up and down the stairs in a football stadium as fast as she can and as many times as necessary. To evaluate the program, suppose she runs up a flight of 80 steps, each 0.150 m high, in 65.0 s. For simplicity ignore the energy she uses in coming down, (which is small). Assume that a typical efficiency for human muscles is 20.0%. This means that when your body converts 100 J from metabolizing fat, 20 J goes into doing mechanical work (here, climbing stairs). The remainder goes into internal energy. Assume the student's mass is [08] __________ kg. (a) How many times must she run the flight of stairs to lose one pound of fat? (b) What is her average power output as she is running up the stairs?

11-1. A pitcher throws a [01] __________-kg baseball so that it crosses home plate horizontally with a speed of 20.3 m/s. It is hit straight back at the pitcher with a final speed of 22.7 m/s. (a) What is the impulse delivered to the ball? (b) Find the average force exerted by the bat on the ball if the two are in contact for 2.38 ms.

11-2. A rifle with a weight of [02] __________ N fires a [03] __________-g bullet with a speed of 309 m/s. (a) Find the recoil speed of the rifle. (b) If a 685-N man holds the rifle firmly against his shoulder, find the recoil speed of man and rifle.

11-3. A friend claims that he can hold on to a 12.4-kg child in a [04] ________-mi/h collision lasting for 0.052 s as long as he has his seat belt on. (a) Calculate the average force the child exerts on the other person during the collision. (b) Can he hold on to the child? (A child should always be in a toddler seat secured with a seat belt in the back seat of a car.)

11-4. The front of a 1460 kg car is designed to absorb the shock of a collision by having a "crumple zone" in which the front 1.27 m of the car collapses in absorbing the shock of a collision. If a car traveling [05] ________ m/s stops uniformly in 1.27 m, (a) how long does the collision last, (b) what is the magnitude of the average force on the car, and (c) what is the acceleration of the car? Express the acceleration as a multiple of g, the acceleration of gravity.

11-5. A car is stopped for a traffic signal. When the light turns green, the car accelerates, increasing its speed from 0 to 5.24 m/s in [06] ________ s. What is the average total force experienced by a 75.2-kg passenger in the car during this time?

12-1. A billiard ball rolling across a table at [01] ________ m/s makes a head-on elastic collision with an identical ball. If the second ball is initially at rest, find the velocity of (a) the first ball and (b) the second ball. If the second ball is initially moving toward the first at a speed of [02] ________ m/s, find the final velocity of (c) the first ball and (d) the second ball. If the second ball is initially moving away from the first at a speed of [03] ________ m/s, find the final velocity of (e) the first ball and (f) the second ball. Use a plus sign for velocities in the same direction as the initial velocity of the first ball, and use a minus sign for velocities in the opposite direction as the initial velocity of the first ball.

12-2. A [04] ________-kg fullback moving east with a speed of 5.15 m/s is tackled by a 95.3-kg opponent running north at 3.21 m/s. If the collision is perfectly inelastic, calculate (a) the direction and (b) the magnitude of the players' velocity just after the tackle and (c) the kinetic energy lost as a result of the collision.

12-3. A [05] ________-kg ice skater, moving at 10.6 m/s, crashes into a stationary skater of equal mass. After the collision, the two skaters move as a unit at 4.87 m/s. Suppose the average force a skater can experience without breaking a bone is 4500 N. (a) If the impact time is 0.115 s, what is the average force exerted on each skater during the collision? (b) Does a bone break?

13-1. The tires on a new compact car have a diameter of [01] __________ ft and are warranted for 60000 miles. (a) Determine the angle (in radians) through which one of these tires will rotate during the warranty period. (b) How many revolutions of the tire are equivalent to your answer in (a) above?

13-2. A wheel has a radius of [02] __________ m. How far (path length) does a point on the circumference travel if the wheel is rotated through angles of (a) 30°, (b) 30 rad, and (c) 30 rev, respectively?

13-3. A mass attached to a 57.8-cm-long string starts from rest and is rotated [03] __________ times in 60.0 s before reaching a final angular speed. (a) Determine the angular acceleration of the mass, assuming that it is constant. (b) What is the final angular speed of the mass?

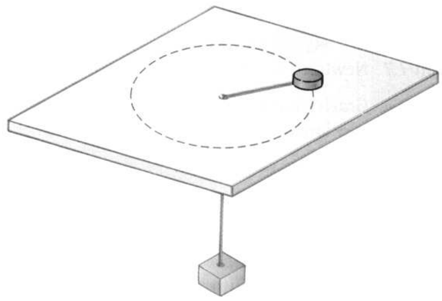
13-4. A potter's wheel moves from rest to an angular speed of 0.247 rev/s in [04] __________ s. Find its angular acceleration.

13-5. A machine part rotates at an angular speed of 0.66 rad/s. Its speed is then increased to [05] __________ rad/s at an angular acceleration of 0.713 rad/s^2. Find the angle through which the part rotates before reaching the final speed.

13-6. A coin with a diameter of 2.46 cm is dropped on edge onto a horizontal surface. The coin starts out with an initial angular speed of [06] __________ rad/s and rolls in a straight line without slipping. If the rotation slows with an angular acceleration of magnitude 1.97 rad/s^2, how far does the coin roll before coming to rest?

14-1. (a) What is the tangential acceleration of a bug on the rim of a 10-in.-diameter disk if the disk moves from rest to an angular speed of 78 rev/min in [01] __________ s? (b) When the disk is at its final speed, what is the tangential velocity of the bug? One second after the bug starts from rest, what are its (c) tangential acceleration, (d) centripetal acceleration, and (e) magnitude of its total acceleration?

14-2. An air puck of mass 255 g is tied to a string and allowed to revolve in a circle of radius 1.04 m on a frictionless horizontal table. The other end of the string passes through a hole in the center of the table, and a mass of [02] ________ g is tied to it. The suspended mass remains in equilibrium while the puck on the tabletop revolves. (a) What is the tension in the string? (b) What is the force causing the centripetal acceleration of the puck? (c) What is the speed of the puck?

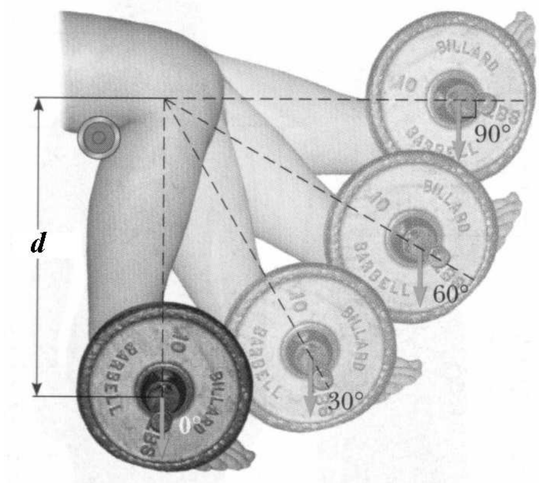


14-3. A 2310-kg car rounds a circular turn of radius [03] ________ m. If the road is flat and the coefficient of friction between tires and road is 0.721, how fast can the car go without skidding?

14-4. A car moves at speed v across a bridge made in the shape of a circular arc of radius r. At what minimum speed at the top of the arc will the normal force acting on the car become zero (causing occupants of the car to seem weightless) if $r =$ [04] ________ m?

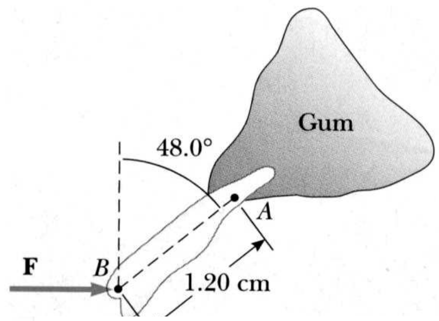
15-1. If the torque required to loosen a nut that is holding a flat tire in place on a car has a magnitude of 45.2 N·m, what *minimum* force must be exerted by the mechanic at the end of a [01] ________ cm lug wrench to accomplish the task?

15-2. As part of a physical therapy program following a knee operation, a 10.0-kg object is attached to an ankle, and leg lifts are done as sketched in the figure. The value of d in the figure is [02] ________ cm. Calculate the torque about the knee due to this weight for the position at (a) 0°, (b) 30°, (c) 60°, and (d) 90°.

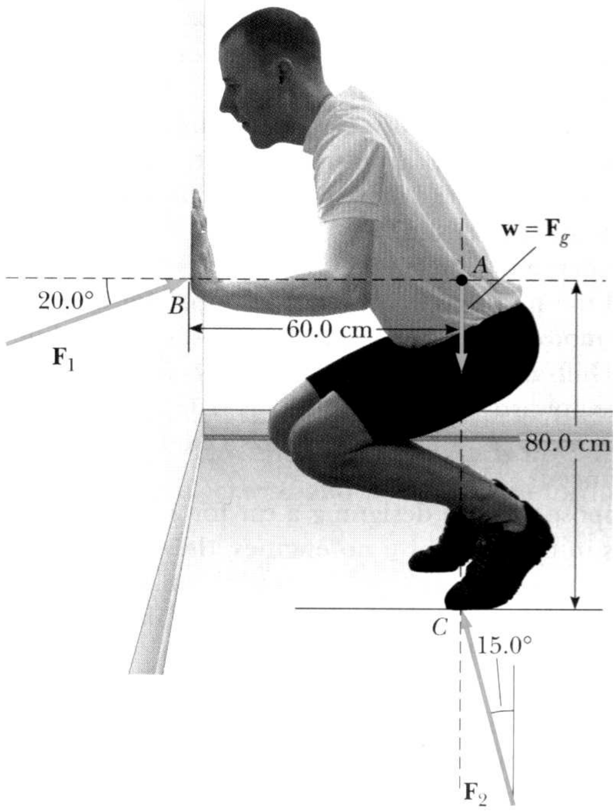


15-3. A simple pendulum consists of a small object of mass 3.3 kg hanging at the end of a 2.9-m-long light string that is connected to a pivot point. Calculate the magnitude of the torque (due to the force of gravity) about this pivot point when the string makes a [03] ________° angle with the vertical.

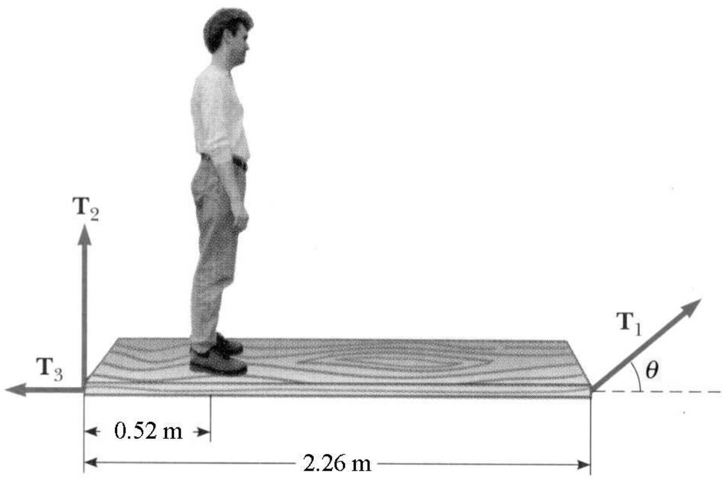
15-4. A steel band exerts a horizontal force F of [04] ________ N on a tooth at point B in the figure. What is the magnitude of the torque on the root of the tooth at point A?



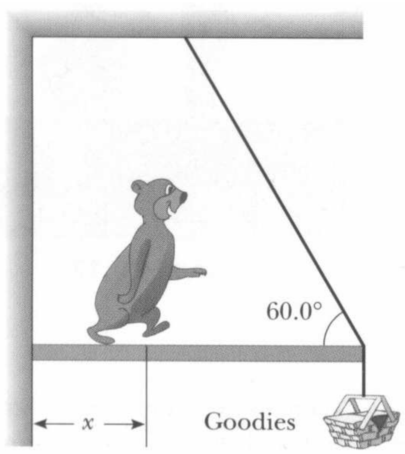
15-5. The person in the figure weighs 843 N. He is exercising by bending back and forth as he pushes against a wall. At one moment, $F_1 = 115$ N and $F_2 =$ [05] ________ N. Assume the force of gravity acts downward through point A as shown. Determine the net torque on the person about axes through (a) point A, (b) point B, and (c) point C perpendicular to the plane of the paper.



16-1. A uniform plank of length 2.26 m and mass [01] ________ kg is supported by three ropes, as indicated by the vectors in the figure. In the figure, $\theta =$ [02] ________°. A 705-N person is standing 0.52 m from the left end. Find the tensions (a) T_2, (b) T_1, and (c) T_3.

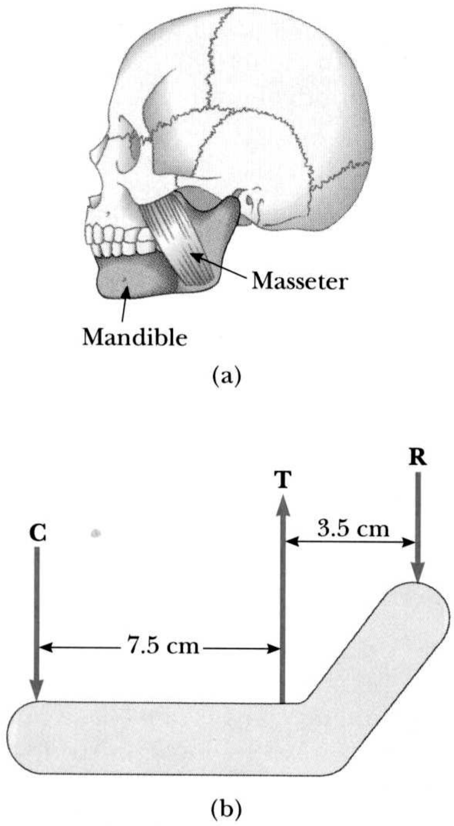


16-2. A hungry 728-N bear walks out on a beam in an attempt to retrieve some "goodies" hanging at the end (see figure). The beam is uniform, weighs 216 N, and is [03] ________ m long; the goodies weigh 82 N. When the bear is at $x = 1.00$ m, find (a) the tension on the wire and (b) the magnitude of the reaction force at the hinge. (c) If the wire can withstand a maximum tension of 900 N, what is the maximum distance the bear can walk before the wire breaks?

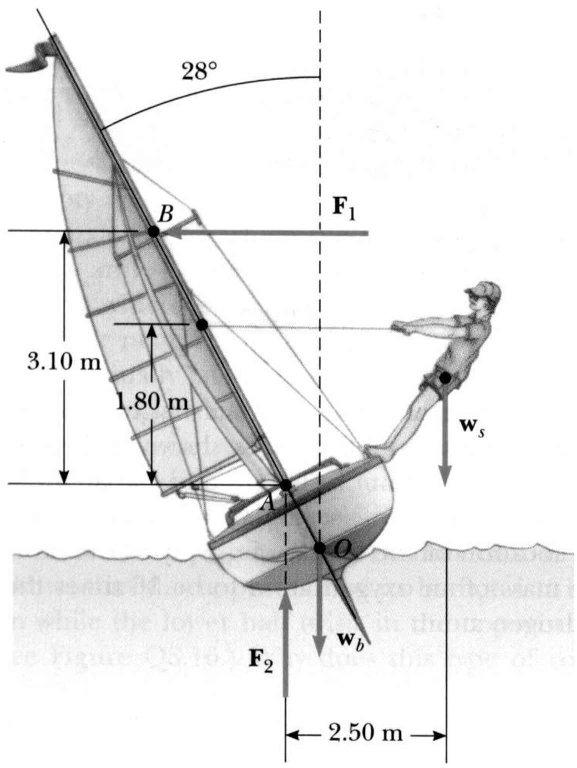


16-3. An 8.31-m, 267-N uniform ladder rests against a smooth wall. The coefficient of static friction between the ladder and the ground is 0.582, and the ladder makes a 52.6° angle with the ground. How far up the ladder can a [04] ________-N person climb before the ladder begins to slip?

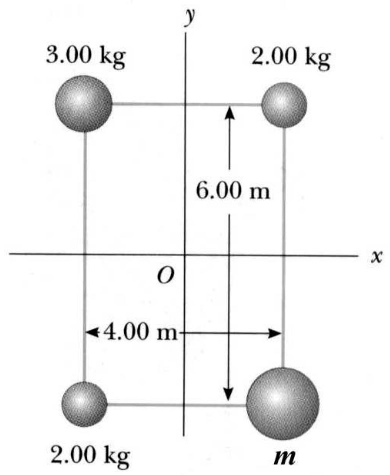
16-4. The chewing muscle, the masseter, is one of the strongest in the human body. It is attached to the mandible (lower jawbone). The jawbone is pivoted about a socket just in front of the auditory canal. The forces acting on the jawbone are equivalent to those acting on the curved bar as shown in the figure. **C** is the force exerted against the jawbone by the food being chewed, **T** is the tension in the masseter, and **R** is the force exerted on the mandible by the socket. Find (a) **T** and (b) **R** if you bite down on a piece of steak with a force of [05] ________ N.



16-5. The sailor in the figure weighs [06] ________ N. The force $\mathbf{F}_1$ exerted by the wind on the sail is horizontal and acts through point B. The weight of the boat is 1250 N and acts through point O. The distance from point O and point A is 0.8 m. The force $\mathbf{F}_2$ exerted by the water acts through point A. Determine the net force exerted by the wind on the sail.



17-1. Four objects are held in position at the corners of a rectangle by light rods as shown in the figure. If $m =$ [01] ________ kg, find the moment of inertia of the system about (a) the x axis, (b) the y axis, and (c) an axis through O and perpendicular to the page.



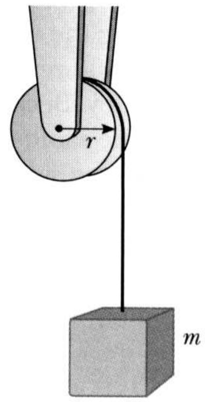
17-2. A constant torque of [02] ________ N·m is applied to a grindstone whose moment of inertia is 0.136 kg·m^2. Using energy principles, and neglecting friction, find the angular speed after the grindstone has made 15.0 revolutions. (Hint: The angular equivalent of $W_{\text{net}} = F\Delta x = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ is $W_{\text{net}} = \tau\Delta\theta = \frac{1}{2}I\omega_f^2 - \frac{1}{2}I\omega_i^2$.)

17-3. A 13.7-kg solid cylinder rolls without slipping on a rough surface. At an instant when its center of gravity has a speed of [03] ________ m/s, determine (a) the translational kinetic energy of its center of gravity, (b) the rotational kinetic energy about its center of gravity, and (c) its total kinetic energy. Note: the answer does not depend on the radius of the cylinder.

17-4. A 240-N solid sphere [04] ________ m in radius rolls, without slipping, 6.0 m down a ramp that is inclined at 37° with the horizontal. What is the angular speed of the sphere at the bottom of the slope if it starts from rest?

17-5. A potter's wheel having a radius of 0.561 m and a moment of inertia of 12.5 kg·m^2 is rotating freely at 53.7 rev/min. The potter can stop the wheel in [05] ________ s by pressing a wet rag against the rim and exerting a radially inward force of 68.2 N. Find the effective coefficient of kinetic friction between the wheel and the wet rag.

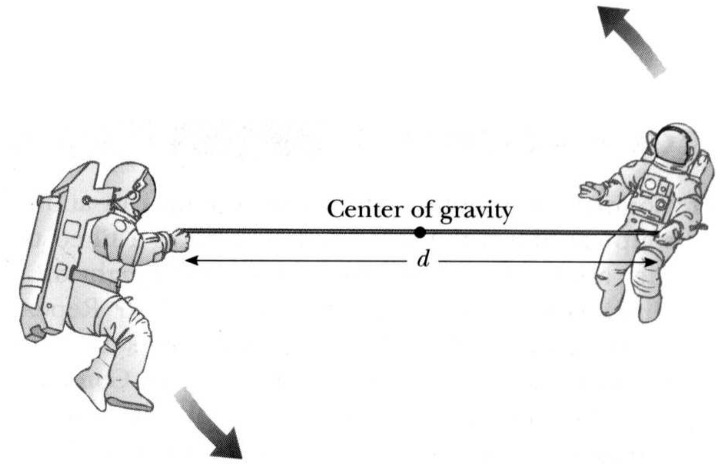
17-6. A light string is wrapped around a solid cylindrical spool of radius 0.565 m and mass [06] ________ kg. A 5.04 kg mass is hung from the string, causing the spool to rotate and the string to unwind. Assume that the system starts from rest and no slippage takes place between the string and the spool. By direct application of Newton's second law, determine the angular speed of the spool after the mass has dropped 4.19 m. *Caution:* The tension T in the string is *not* equal to the weight of the hanging mass. You must write down Newton's second law for the mass as well as for the spool. This will result in two equations and two unknowns, α and T (assuming that you used $a = \alpha r$ for the hanging mass).



18-1. A student sits on a rotating stool holding two 3.09-kg masses. When his arms are extended horizontally, the masses are 1.08 m from the axis of rotation, and he rotates with an angular speed of [01] ________ rad/s. The moment of inertia of the student plus stool is 3.25 kg·m^2 and is assumed to be constant. (Note that this moment of inertia does not include the two 3.09-kg masses.) The student then pulls the masses horizontally to 0.34 m from the rotation axis. (a) Find the new angular speed of the student. Find the kinetic energy of the rotating system (student, stool, and masses) (b) before and (c) after the masses are pulled in.

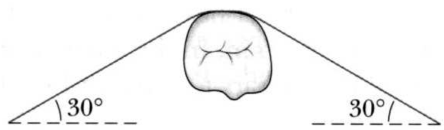
18-2. A playground merry-go-round of radius $R = 1.92$ m has a moment of inertia $I =$ [02] ________ kg·m^2 and is rotating at 10.8 rev/min about a frictionless vertical axle. Facing the axle, a 25.8-kg child hops onto the merry-go-round, and manages to sit down on the edge. What is the new angular speed of the merry-go-round?

18-3. Two astronauts (see figure), one having a mass of 75.4 kg and the other a mass of [03] ________ kg, are connected by a 10.0-m rope of negligible mass. They are isolated in space, moving in a circle around the point halfway between them at speeds of 5.00 m/s. Treating the astronauts as particles, calculate (a) the magnitude of the angular momentum and (b) the rotational energy of the system. By pulling on the rope, the astronauts shorten the distance between them to 5.00 m. (c) what is the new angular momentum of the system? (d) What are their new speeds? (e) What is the new rotational energy of the system? (f) How much work is done by the astronauts in shortening the rope?



19-1. If the shear stress in steel exceeds about 4.00×10^8 N/m^2, the steel ruptures. Determine the shearing force necessary to (a) shear a steel bolt [01] ________ cm in diameter and (b) punch a [02] ________-cm-diameter hole in a steel plate 0.500 cm thick.

19-2. A stainless steel orthodontic wire is applied to a tooth, as in the figure. The wire has an unstretched length of 3.1 cm and a diameter of 0.22 mm. If the wire is stretched [03] ________ mm, find the magnitude of the force on the tooth. Disregard the width of the tooth and assume the Young's modulus for stainless steel is 18×10^{10} Pa.



19-3. Bone has a Young's modulus of about 18×10^9 Pa. Under compression, it can withstand a stress of about 160×10^6 Pa before breaking. Assume that a femur (thigh bone) is [04] ________ m long and calculate the amount of compression this bone can withstand before breaking.

19-4. If the elastic limit of steel is 5.26×10^8 Pa, determine the minimum diameter a steel wire can have if it is to support a [05] ________-kg circus performer without its elastic limit being exceeded.

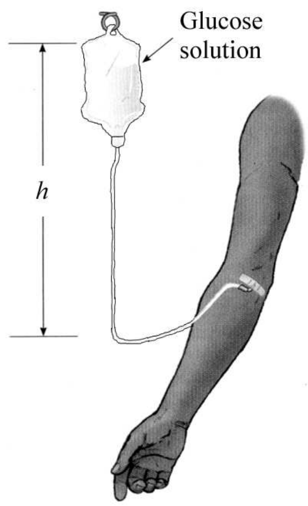
19-5. The four tires of an automobile are inflated to a gauge pressure of 2.0×10^5 Pa. Each tire has an area of [06] ________ m^2 in contact with the ground. Determine the weight of the automobile.

19-6. A specimen of urea dissolved in water has a volume of 100 cm^3 and a mass of [07] ________ g. Determine the density of the solution.

19-7. A [08] ________-kg man in a 5.3-kg chair tilts back so that all the weight is balanced on two legs of the chair. Assume that each leg makes contact with the floor over a circular area with a radius of 1.1 cm, and find the pressure exerted by each leg on the floor.

19-8. A [09] ________-kg ballet dancer stands on her toes during a performance with 26.5 cm^2 in contact with the floor. What is the pressure exerted by the floor over the area of contact (a) if the dancer is stationary, and (b) if the dancer is jumping upwards with an acceleration of 4.41 m/s^2?

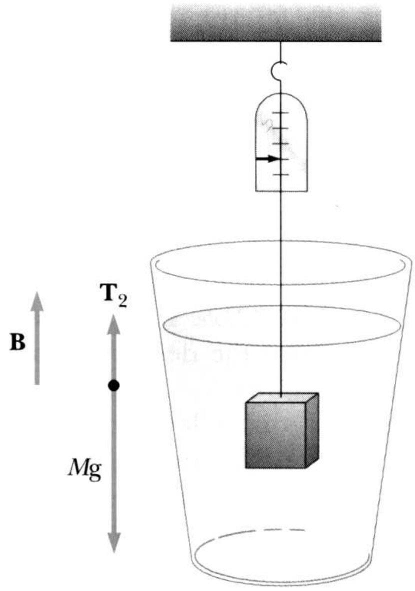
20-1. A collapsible plastic bag contains a glucose solution. If the average gauge pressure in the artery is [01] ________ Pa, what must be the minimum height h of the bag in order to infuse glucose into the artery? Assume that the specific gravity of the solution is 1.02.



20-2. Water is to be pumped to the top of a skyscraper, which is [02] ________ ft high. What gauge pressure is needed in the water line at the base of the building to raise the water to this height? (This building is about the same height as the Empire State Building in New York City.)

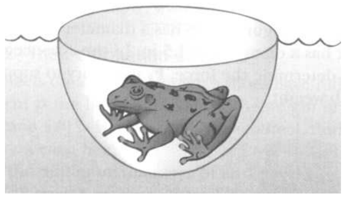
20-3. A small ferry boat is 4.00 m wide and 6.00 m long. When a loaded truck pulls onto it, the boat sinks an additional [03] ________ cm into the river. What is the weight of the truck?

20-4. A 10.0-kg block of metal is suspended from a scale and immersed in water as in the figure. The dimensions of the block are 12.0 cm $\times$ 10.0 cm $\times$ [04] ________ cm. The 12.0-cm dimension is vertical, and the top of the block is 5.00 cm below the surface of the water. What are the forces exerted by the water on (a) the top and (b) the bottom of the block? (Take atmospheric pressure to be 1.0130×10^5 N/m^2.) (c) What is the buoyant force? (d) What is the reading of the spring scale?



20-5. A rectangular air mattress is 2.1 m long, 0.48 m wide, and [05] ________ m thick. If it has a mass of 2.3 kg, what additional mass can it support in water?

20-6. A frog in a hemispherical pod finds that he just floats without sinking in a fluid of density 1.27 g/cm^3. If the pod has a radius of [06] ________ cm and negligible mass, what is the mass of the frog?



20-7. A 605-kg weather balloon is designed to lift a [07] ________-kg package. What volume should the balloon have after being inflated with helium at standard temperature and pressure (STP) in order that the total load can be lifted? Be sure to include the *weight* of the helium. Note that the densities of gases at STP are given in Table 9.3 on p. 262 in the textbook (Table 9.2 in the 5th edition of the textbook).

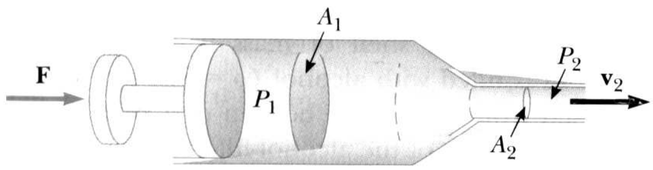
21-1. Water is pumped into a storage tank from a well delivering 17.8 gallons of water in 30.0 s through a pipe of [01] ________ in.^{2} cross-sectional area. What is the average velocity of the water in the pipe as the water is pumped from the well?

21-2. When a person inhales, air moves down the bronchus (windpipe) at [02] ________ cm/s. The average flow speed of the air doubles through a constriction in the bronchus. Assuming incompressible flow, determine the pressure drop in the constriction. Neglect the change of pressure due to change in height y in the wind pipe. Use 1.20 kg/m^3 for the density of air.

21-3. A large storage tank, open to the atmosphere at the top and filled with water, develops a small hole in its side at a point [03] ________ m below the water level. If the rate of flow from the leak is 2.53×10^{-3} m^3/min, determine (a) the speed at which the water leaves the hole and (b) the diameter of the hole.

21-4. A cowboy at a dude ranch fills a horse trough that is 1.53 m long, 61 cm wide, and 42 cm deep. He uses a 2.0-cm-diameter hose from which water emerges at [04] ________ m/s. How long does it take him to fill the trough?

21-5. A hypodermic syringe contains a medicine with a density of water (see figure). The barrel of the syringe has a cross-sectional area of 2.54×10^{-5} m^2. In the absence of a force on the plunger, the pressure everywhere is 1.00 atm. A force F of magnitude [05] ________ N is exerted on the plunger, making medicine squirt from the needle. Determine the medicine's flow speed through the needle. Assume that the pressure in the needle remains equal to 1.00 atm and that the syringe is horizontal.



21-6. (a) Calculate the mass flow rate (in grams per second) of blood ($\rho = 1.0$ g/cm^3) in an aorta with a cross-sectional area of 2.0 cm^2 if the flow speed is [06] ________ cm/s.
(b) Assume that the aorta branches from a large number of capillaries with a combined cross-sectional area of 3.0×10^3 cm^2. What is the flow speed in the capillaries?

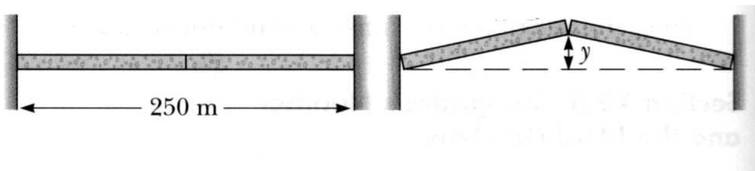
21-7. A water tank open to the atmosphere at the top has two small holes punched in its side, one above the other. The holes are 5.3 cm and [07] ________ cm above the floor. How high does water stand in the tank if the two streams of water hit the floor at the same place?

21-8. Go to the course home page. Click on the "calculate my grade" link and follow the directions. (a) What is your overall percentage thus far in the class? (b) What letter grade does this correspond to?

22-1. In your own words, in one paragraph each, tell me: "What makes an object float or sink?" and "How does an airplane fly?" Submit your work through the Physics 105 slots below the homework bins outside N357 ESC.

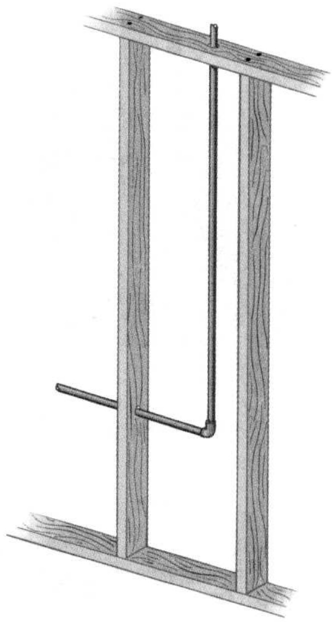
23-1. For each of the following temperatures, find the equivalent temperature on the indicated temperature scale: (a) [01] ________°C on the Fahrenheit scale, (b) [02] ________°F on the Celsius scale, and (c) [03] ________ K on the Fahrenheit scale.

23-2. Two concrete spans of a 250-m-long bridge are placed end to end so that no room is allowed for expansion [Figure (a)]. If the temperature increases by [04] ________°C, what is the height y to which the spans rise when they buckle [Figure (b)]?



(a) (b)

23-3. Inside the wall of a house, an L-shaped section of hot water pipe consists of a straight horizontal piece 28 cm long, an elbow, and a straight vertical piece [05] ________ cm long (see figure). A stud and a second-story floorboard hold stationary the ends of this section of copper pipe. Find (a) the magnitude and (b) the direction of the displacement of the pipe elbow when the water flow is turned on, raising the temperature of the pipe from 18°C to 46°C.



23-4. A concrete walk is poured on a day when the temperature is 20°C in such a way that the ends are unable to move. (a) What is the stress in the cement when its temperature is [06] __________°C on a hot sunny day? (b) Does the concrete fracture? Take Young's modulus for concrete to be 7.00×10^9 N/m^2 and the compressive strength to be 2.00×10^7 N/m^2.

23-5. A grandfather clock is controlled by a swinging brass pendulum that is 1.3 m long at a temperature of 20°C. (a) By how much does the length of the pendulum rod change when the temperature drops to [07] __________°C? (b) If a pendulum's period is given by $T = 2\pi\sqrt{L/g}$, where L is its length, does the change in length of the rod cause the clock to run fast or slow?

24-1. Gas is contained in an 8.71-L vessel at a temperature of [01] __________°C and a pressure of 9.37 atm. (a) Determine the number of moles of gas in the vessel. (b) How many molecules are in the vessel?

24-2. A weather balloon is designed to expand to a maximum radius of [02] __________ m when in flight at its working altitude, where the air pressure is 0.0282 atm and the temperature is −65°C. If the balloon is filled at 0.873 atm and 21°C, what is its radius at lift-off?

24-3. Before beginning a long trip on a hot day, a driver inflates an automobile tire to a gauge pressure of 1.80 atm at 300 K. At the end of the trip the gauge pressure has increased to [03] __________ atm. (a) Assuming the volume has remained constant, what is the temperature of the air inside the tire? (b) What percentage of the original mass of air in the tire should be released so the pressure returns to the original value? Assume the temperature remains at the value found in (a), and the volume of the tire remains constant as air is released. Also assume that the atmospheric pressure is 1.00 atm and remains constant.

24-4. A tank having a volume of 100 liters contains helium gas at 150 atm. How many balloons can the tank blow up if each filled balloon is a sphere [04] __________ cm in diameter at an absolute pressure of 1.20 atm?

24-5. Gas is confined in a tank at a pressure of 10.0 atm and a temperature of 15°C. If half of the gas is withdrawn and the temperature is raised to [05] __________°C, what is the new pressure in the tank?

24-6. An air bubble has a volume of 1.50 cm^3 when it is released by a submarine [06] ________ m below the surface of a lake. What is the volume of the bubble when it reaches the surface where the atmospheric pressure is 1.00 atm? Assume that the temperature and the number of air molecules in the bubble remains constant during the ascent.

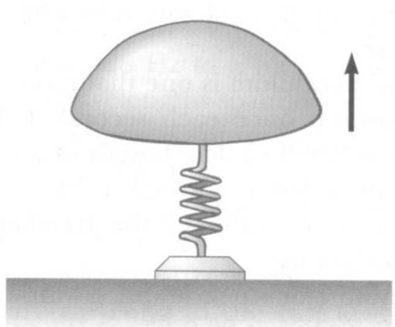
24-7. (a) An ideal gas occupies a volume of [07] ________ cm^3 at 20°C and atmospheric pressure (1.00 atm). Determine the number of molecules of gas in the container. (b) If the gas is pumped out of the container so that the pressure is reduced to 1.00×10^{-11} Ps (an extremely good vacuum) while the temperature remains constant, how many moles of gas remain in the container?

24-8. A cylindrical diving bell, 3.29 m in diameter and 4.09 m tall with an open bottom, is submerged to a depth of [08] ________ m in the ocean. The surface temperature is 25°C, and the pressure of the atmosphere at the surface is 1.00 atm. The temperature at the bottom of the dive is 5°C. The density of sea water is 1025 kg/m^3. How high does the sea water rise in the bell when it is submerged?

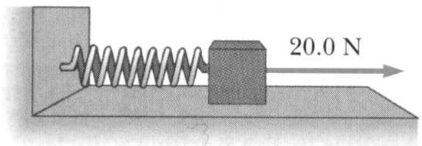
25-1. A 0.432-kg object is attached to a spring with a spring constant [01] ________ N/m so that the object is allowed to move on a horizontal frictionless surface. The object is released from rest when the spring is compressed 0.158 m. Find (a) the force on the object and (b) its acceleration at this instant.

25-2. An archer pulls her bow string back 0.412 m by exerting a force that increases uniformly from zero to [02] ________ N. (a) What is the equivalent spring constant of the bow? (b) How much work is done in pulling bow?

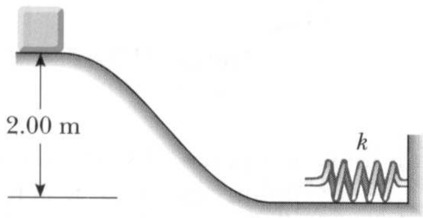
25-3. A child's toy consists of a piece of plastic attached to a spring (see figure). The spring is compressed against the floor by an amount 2.25 cm, and the toy is released. If the toy has a mass of 112 g and rises to a maximum height of [03] ________ cm above its compressed position, find the force constant of the spring.



25-4. A 1.54-kg block at rest on a tabletop is attached to a horizontal spring having constant 18.2 N/m as in the figure. The spring is initially unstretched. A constant [04] ________-N horizontal force is applied to the object causing the spring to stretch. (a) Determine the speed of the block after it has moved 0.331 m from equilibrium if the surface between the block and tabletop is frictionless. (b) Answer part (a) if the coefficient of kinetic friction between block and tabletop is 0.192.



25-5. A [05] ________-g block is released from rest and slides down a frictionless track that begins 2.00 m above the horizontal, as shown in the figure. At the bottom of the track, where the surface is horizontal, the block strikes and sticks to a light spring with a spring constant of 18.3 N/m. Find the maximum distance the spring is compressed.



25-6. A slingshot consists of a light leather cup containing a stone that is pulled back against two rubber bands. It takes a force of [06] ________ N to stretch the bands 1.08 cm. (a) What is the potential energy stored in the bands when a 55.4-g stone is placed in the cup and pulled back 17.6 cm from the equilibrium position? (b) With what speed does the stone leave the slingshot?

26-1. When four people with a combined mass of 321 kg sit down in a car, they find that the car drops [01] ________ mm lower on its springs. Then they get out of the car and bounce it up and down. What is the frequency of the car's vibration if its mass when empty is 2370 kg?

26-2. If the frequency of oscillation of the wave emitted by an FM radio station is [02] ________ MHz, determine the wave's (a) period of vibration and (b) wavelength. (*Hint:* Radio waves travel at the speed of light, 3.00×10^8 m/s.)

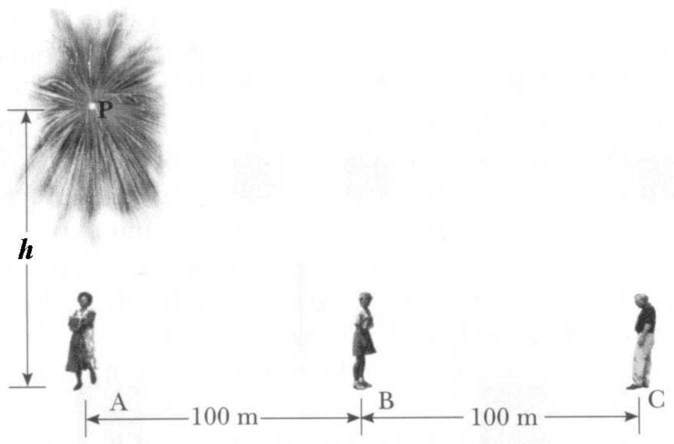
26-3. A circus performer stretches a tightrope between two towers. He strikes one end of the rope and sends a wave along it toward the other tower. He notes that it takes the wave [03] ________ s to reach the opposite tower, 28.2 m away. If 1.00 meter of the rope has a mass of 0.356 kg, find the tension in the tightrope.

26-4. A 0.428-kg object connected to a light spring with a spring constant of 21.5 N/m oscillates on a frictionless horizontal surface. If the spring is compressed [04] ________ cm and released from rest, determine (a) the maximum speed of the object, (b) the speed of the object when the spring is compressed 1.50 cm, and (c) the speed of the object when the spring is stretched 1.50 cm. (d) For what value of x does the speed equal one half of the maximum speed?

26-5. A 2.00-kg object on a frictionless horizontal track is attached to the end of a horizontal spring whose force constant is [05] ________ N/m. The object is displaced 3.14 m to the right from its equilibrium position and then released, which initiates simple harmonic motion. (a) What is the force (magnitude and direction) acting on the object 3.57 s after it is released? (b) How many times does the object oscillate in 3.57 s? (Find the number of periods.)

27-1. You are watching a pier being constructed on the far shore of a saltwater inlet when some blasting occurs. You hear the sound in the water [01] ________ s before it reaches you through the air. How wide is the inlet? (Hint: See Table 14.1. Assume the air temperature is 25°C. Be sure to use the speed of sound in "Sea water", not "Water".)

27-2. A skyrocket explodes at a height $h =$ [02] ________ m above the ground (see figure). Three observers are spaced 100 m apart, with observer A directly under the point of the explosion. (a) What is the ratio of sound intensities heard by observers A and B? (b) What is the ratio of intensities heard by observers A and C? Neglect the height of the observers.



27-3. A family ice show is held at an enclosed arena. The skaters perform to music with level 81.7 dB. This is too loud for your baby who yells at [03] ________ dB. (a) What total sound intensity engulfs you? (b) What is the combined sound level?

27-4. A stereo speaker (considered a small source) emits sound waves with a power output of [04] ________ W. (a) Find the intensity 10.5 m from the source. (Assume that the sound is emitted uniformly in all directions from the speaker.) (b) Find the intensity level, in decibels, at this distance. (c) At what distance would you experience the sound at the threshold of pain, 120 dB?

27-5. A person wears a hearing aid that uniformly increases the intensity level of all audible frequencies of sound by 30.0 dB. The hearing aid picks up sound having a frequency of 100 Hz and an intensity of [05] ________ W/m^2. What is the intensity delivered to the eardrum?

27-6. A microphone in the ocean is sensitive to sounds emitted by porpoises. To produce a usable signal, sound waves striking the microphone must have an intensity of 10 dB. If porpoises emit sound waves with a power of [06] ________ W, how far can a porpoise be from the microphone and still be heard? Disregard absorption of sound waves by the water.

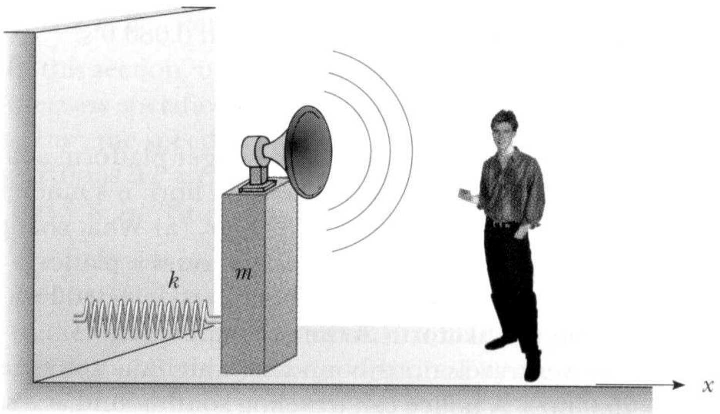
28-1. An alert physics student stands beside the tracks as a train rolls slowly past. He notes that the frequency of the train whistle is 442.28 Hz when the train is approaching him and [01] ________ Hz when the train is receding from him. From this he can find the speed of the train. What value does he find? (Take the speed of sound to be 345 m/s.)

28-2. Two trains on separate tracks move toward one another. Train 1 has a speed of [02] ________ km/h and train 2 a speed of 93 km/h. Train 2 blows its horn, emitting a frequency of 532.9 Hz. What is the frequency heard by the engineer on train 1? Use 345 m/s for the speed of sound.

28-3. A pair of speakers separated by [03] ________ m are driven by the same oscillator at a frequency of 690 Hz. An observer, originally positioned at one of the speakers, begins to walk along a line perpendicular to the line joining the two speakers. (a) How far must the observer walk before reaching a relative maximum in intensity? (b) How far will the observer be from the speaker when the first relative minimum is detected in the intensity? (Take the speed of sound to be 345 m/s.)

28-4. Two identical mandolin strings under 205.6 N of tension are sounding tones with fundamental frequencies of 523 Hz. The peg of one string slips slightly, and the tension in it drops to [04] ________ N. How many beats per second are heard?

28-5. A block with a speaker bolted to it is connected to a spring having spring constant $k = 18.4$ N/m, as shown in the figure. The total mass of the block and speaker is 5.21 kg, and the amplitude of this unit's motion is [05] ________ m. If the speaker emits sound waves of frequency 440.0 Hz, determine (a) the highest and (b) the lowest frequencies heard by the person to the right of the speaker. (c) If the maximum sound level heard by the person is 62.6 dB when he is closest to the speaker, 1.24 m away, what is the minimum sound level heard by the observer? Assume that the speed of sound is 343 m/s.



28-6. Go to the course home page. Click on the "calculate my grade" link and follow the directions. (a) What is your overall percentage thus far in the class? (b) What letter grade does this correspond to?

Answers to Homework Problems, Physics 105, Fall Semester, 2009
Sec. 3, Stephanie Magleby

2-1a. 70.0, 120.0 km
2-1b. 45.0, 65.0 km/h
2-2a. 150, 210 km
2-2b. 60.0, 70.0 km/h
2-3a. 1.10, 1.90 m/s^2
2-3b. 100, 170 m
2-4a. 15.0, 25.0 s
2-4b. 0.60, 1.50 km
2-5a. 2.50, 9.00 s
2-5b. 10, 200 m
3-1a. 20.0, 50.0 m
3-1b. 2.00, 3.20 s
3-1c. 2.00, 3.20 s
3-1d. −20.0, −30.0 m/s
3-2. 0.20, 0.90 s
3-3a. 10.0, 12.0 m/s
3-3b. −3.50, −5.00 m/s
3-4a. 240, 390 m
3-4b. 7.0, 10.0 s
3-4c. 14.0, 19.0 s
4-1a. 10.0, 13.0 m/s
4-1b. 5.0, 9.0 m/s
4-1c. 1.0, 4.0 m
4-1d. 8.0, 15.0 m
4-1e. 12.0, 13.0 m/s
4-2. 10.0, 20.0 m/s
4-3. 1.40, 2.50 m/s
4-4. 4.0, 32.0 m
4-5a. 10.0, 30.0°
4-5b. 1.50, 4.50 s
5-1a. 3.0, 8.0 N
5-1b. 50.0, 120.0 N
5-1c. 2.00, 5.00 kg
5-1d. 2.00, 5.00 kg
5-1e. 2.00, 5.00 kg
5-2a. 700, 1100 N
5-2b. 500, 900 N
5-3a. 130, 180 N
5-3b. 70, 100 N
5-3c. 150, 200 N
6-1a. 1.00, 3.00 m/s^2
6-1b. 30.0, 40.0 N
6-1c. 0.50, 1.20 m
6-2a. 2.50, 5.00 m/s^2
6-2b. 40.0, 60.0 N
6-3a. 6.00, 8.00 m/s^2
6-3b. 19.0, 23.0 N
6-3c. 12.0, 16.0 N
6-4a. 110, 140 N
6-4b. 220, 250 N
7-1a. 0.20, 0.60
7-1b. 0.20, 0.60
7-2a. 10.0, 25.0 N
7-2b. 20.0, 30.0 N
7-3. 0.150, 0.500
7-4. 3.00, 4.00 m/s^2
7-5a. 1.00, 1.50 m/s^2
7-5b. 10.0, 30.0 N
7-5c. 0.10, 0.50 m/s^2
7-5d. 10.0, 25.0 N
8-1a. 50.0, 75.0 J
8-1b. −40.0, −50.0 J
8-1c. 0.0, 0.0 J
8-2. 0.40, 1.20 J
8-3a. 20.0, 60.0 J
8-3b. 0.0, 0.0 J
8-3c. 0.0, 0.0 J
8-3d. 20.0, 60.0 J
8-4a. 400, 800 J
8-4b. 0.80, 1.60 m
9-1a. 40.0, 90.0 J
9-1b. 5.0, 15.0 J
9-1c. 0.0, 0.0 J
9-2a. −80, −210 J
9-2b. −100, −260 J
9-2c. 450, 550 J
9-2d. 30, 350 J
9-2e. 2.50, 12.00 m/s
9-3a. 490, 650 N/m
9-3b. 40.0, 57.0
10-1a. 3.50, 7.50 m/s
10-1b. 6.00, 9.00 m/s
10-1c. 90, 200 J
10-2. 4.00, 6.20 m

10-3a. 19000, 27000 $\pm$100 J
10-3b. 0.60, 1.50 hp
10-4. 1.00, 6.00 m
10-5. 0.70, 4.00 m/s
10-6a. 300, 800
10-6b. 70.0, 150.0 W
11-10. 5.00, 8.00 kg·m/s
11-10. 2000, 3500 $\pm$ 10 N
11-2a. 30.0, 60.0 cm/s
11-2b. 1.80, 2.40 cm/s
11-3a. 900, 1500 $\pm$ 10 lbs
11-4a. 0.80, 0.150 s
11-4b. 2.00×10^5, 6.00×10^5 N
11-4c. 10.0, 40.0g
11-5. 400, 600 N
12-1a. 0.00, 2.00 m/s
12-1b. 0.00, 2.00 m/s
12-1c. 0.00, −2.00 m/s
12-1d. 0.00, 2.00 m/s
12-1e. 0.00, 2.00 m/s
12-1f. 0.00, 2.00 m/s
12-2a. 30.0, 35.0° north of east
12-2b. 2.50, 3.50 m/s
12-2c. 700, 1000 $\pm$ 10 J
12-3a. 2500, 4000 $\pm$ 10 N
13-1a. 2.50×10^8, 4.00×10^7 rad
13-1b. 4.50×10^8, 6.00×10^7 rev
13-2a. 1.5, 3.5 m
13-2b. 50, 200 $\pm$ 10 m
13-2c. 500, 1200 $\pm$ 10 m
13-3a. 0.100, 0.200 rad/s^2
13-3b. 6.00, 11.00 rad/s
13-4. 0.0300, 0.0800 rad/s^2
13-5. 2.50, 4.50 rad
13-6. 0.30, 1.30 m
14-1a. 0.20, 0.60 m/s^2
14-1b. 0.70, 1.50 m/s
14-1c. 0.20, 0.60 m/s^2
14-1d. 0.30, 2.50 m/s^2
14-1e. 0.30, 2.50 m/s^2
14-2a. 7.80, 9.40 N
14-2b. 7.80, 9.40 N
14-2c. 5.60, 6.20 m/s
14-3. 10.0, 15.0 m/s
14-4. 15.0, 25.0 m/s
15-1. 80, 160 N
15-2a. 0, −50 N·m
15-2b. 0, −50 N·m
15-2c. 0, −50 N·m
15-2d. 0, −50 N·m
15-3. 5, 70 N·m
15-4. 0.400, 0.800 N·m
15-5a. −150, 250 N·m
15-5b. −150, 250 N·m
15-5c. −50, 150 N·m
16-1a. 740, 770 N
16-1b. 600, 1000 N
16-1c. 500, 900 N
16-2a. 350, 450 N
16-2b. 600, 800 N
16-2c. 3.00, 5.00 m
16-3. 6.50, 7.50 m
16-4a. 120, 190 N
16-4b. 80, 130 N
16-5. 700, 900 N
17-1a. 80.0, 100.0 kg·m^2
17-1b. 30.0, 50.0 kg·m^2
17-1c. 120.0, 150.0 kg·m^2
17-2a. 25.0, 35.0 rev/s
17-3a. 400, 600 J
17-3b. 200, 300 J
17-3c. 600, 900 J
17-4. 10, 80 rad/s
17-5. 0.250, 0.400
17-6. 14.0, 16.0 rad/s
18-1a. 1.80, 2.20 rad/s
18-1b. 2.50, 3.40 J
18-1c. 6.50, 9.00 J
18-2. 6.50, 8.00 rev/min
18-3a. 3500, 4500 $\pm$ 10 kg·m^2/s
18-3b. 1.50, 2.50 kJ
18-3c. 3500, 4500 $\pm$ 10 kg·m^2/s
18-3d. 5.0, 15.0 m/s
18-3e. 7.00, 9.00 kJ

18-3f. 5.00, 7.00 kJ
19-2. 20, 50 N
19-3. 3.0, 7.0 mm
19-4. 1.00, 1.50 mm
19-5. 1.0×10^4, 4.0×10^4 N
19-7. 0.8×10^6, $1.4 \times 10^6 \pm 0.1 \times 10^6$ Pa
19-8a. 1.00×10^5, 3.00×10^5 Pa
19-8b. 2.00×10^5, 4.00×10^5 Pa
20-1. 1.25, 1.45 m
20-2. 3.70×10^6, 4.20×10^6 Pa
20-3. 8.00, 12.00 kN
20-4a. 500.0, 1100.0 N
20-4b. 500.0, 1100.0 N
20-4c. 5.0, 12.0 N
20-4d. 80.0, 100.0 N
20-5. 40, 100 kg
20-6. 0.300, 0.950 kg
20-7. 4300, 5100 ±10 m^3
21-1. 2.30, 3.20 m/s
21-2. −0.010, −0.040 Pa
21-3a. 13.0, 20.0 m/s
21-3b. 1.50, 2.00 mm
21-4. 10.0, 25.0 min
21-5. 10.0, 16.0 m/s
21-6a. 50, 99 g/s
21-6b. 0.15, 0.40 mm/s
23-1a. −150, 350°F
23-1b. 0, 100°C
23-1c. −100, −300°F
23-2. 1.0, 5.0 m
23-3a. 0.45, 1.00 mm
23-3b. 70.0, 85.0° below the horizontal
23-4a. 0.8×10^6, $2.5 \times 10^6 \pm 0.1 \times 10^6$ Pa
23-5a. −0.20, −1.50 mm
24-1a. 3.00, 3.50 mol
24-1b. 1.80×10^{24}, 2.10×10^{24}
24-2. 5.00, 9.00 m
24-3a. 320, 380 K
24-3b. 6.0, 20.0%
24-4. 100, 900 balloons
24-5. 5.00, 6.50 atm
24-6. 10.0, 25.0 cm^3
24-7a. 2.00×10^{19}, 5.00×10^{19} molecules
24-7b. 4.00×10^{-21}, 9.00×10^{-21} moles
24-8. 3.40, 4.00 m
25-1a. 10.0, 30.0 N
25-1b. 30.0, 60.0 m/s^2
25-2a. 350, 750 N/m
25-2b. 30.0, 65.0 J
25-3. 1500, 3000 ± 10 N/m
25-4a. 2.00, 4.00 m/s
25-4b. 2.00, 4.00 m/s
25-5. 1.00, 1.40 m
25-6a. 30.0, 60.0 J
25-6b. 30.0, 50.0 m/s
26-1. 1.90, 2.20 Hz
26-2a. 9.0×10^{-9}, $12.0 \times 10^{-9} \pm 0.1 \times 10^{-9}$ s
26-2b. 2.70, 3.40 m
26-3. 350, 600 N
26-4a. 0.250, 0.450 m/s
26-4b. 0.250, 0.450 m/s
26-4c. 0.250, 0.450 m/s
26-4d. 3.50, 5.50 cm
26-5a. 7.0, 13.0 N
26-5b. 0.80, 1.30
27-1. 2.00, 3.00 km
27-2a. 1.0, 5.0
27-2b. 2.0, 20.0
27-3a. 1.50×10^{-4}, 1.90×10^{-4} W/m^2
27-3b. 82.0, 84.0 dB
27-4a. 5.0, 70.0 mW/m^2
27-4b. 95.0, 110.0 dB
27-4c. 0.50, 3.00 m
27-5. 1.0×10^{-7}, 5.0×10^{-7} W/m^2
27-6. 10, 30 km
28-1. 0.20, 0.80 m/s
28-2. 640.0, 660.0 Hz
28-3a. 0.10, 0.60 m
28-3b. 0.50, 1.50 m
28-4. 9.0, 17.0 Hz
28-5a. 441.0, 445.0 Hz
28-5b. 435.0, 439.0 Hz
28-5c. 50.0, 60.0 dB