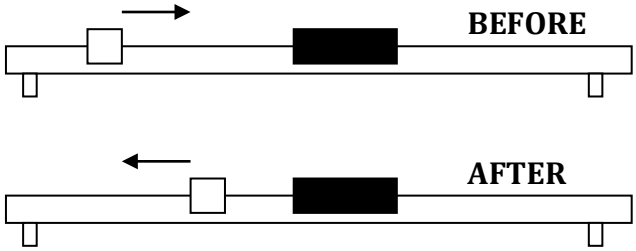
SQ1: A 0.05-kg tennis ball moving to the right with a speed of 10 m/s is struck by a tennis racket, causing it to move to the left with a speed of 10 m/s. If the ball remains in contact with the racquet for 0.010 s, what is the magnitude of the average force exerted on the ball?

A. 50 N
B. 100 N
C. 20 N
D. 0 N
E. 500 N

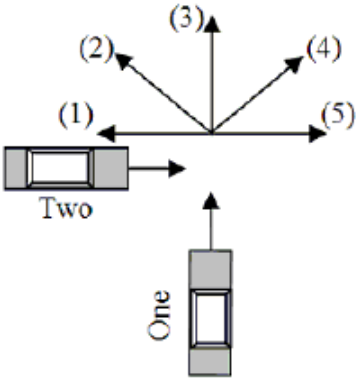
SQ2: A small glider is gliding along an air track at some initial speed, hits a much larger glider, and is observed to bounce back with a final speed nearly equal to its initial speed.



The speed and the magnitude of the momentum of the large glider (compared to the initial speed and magnitude of momentum of the small glider) after the collision are…

A. Both less than the initial values for the small glider.
B. Both greater than the initial values for the small glider.
C. Speed less, magnitude of momentum greater
D. Both zero
E. Speed greater, magnitude of momentum less

SQ3: Car One is traveling due north and Car Two is traveling due east. After the collision shown, Car One rebounds in the due south direction. Which of the numbered arrows is the only one that can represent the final direction of Car Two?



A. 1
B. 3
C. 5
D. 2
E. 4

SQ4: Bob, a 30 kg boy, is running at 4.0 m/s when he jumps onto a 10 kg sled, initially at rest on a frozen lake. What is the velocity of Bob and the sled, after he jumps on?

A. 1.5 m/s
B. 4.0 m/s
C. 2.0 m/s
D. 1.3333 m/s
E. 3.0 m/s

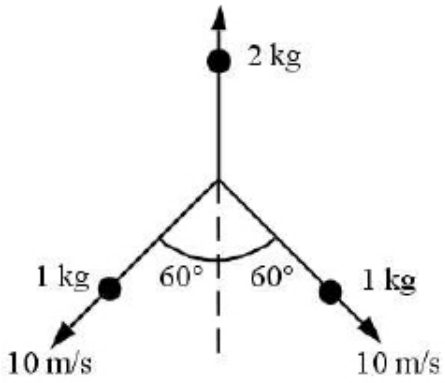
SQ5: A tennis ball has a velocity of 12 m/s downward just before it strikes the ground and bounces up with a velocity of 12 m/s upward. Which statement is true concerning this situation?

A. Neither the momentum of the ball nor the momentum of the earth changes.
B. The momentum of the ball and the momentum of the earth both change.
C. The momentum of the ball is changed; and the momentum of the earth is not changed.
D. The momentum of the ball is unchanged; and the momentum of the earth is changed.
E. Both the momentum and the kinetic energy of the ball change because of the collision.

SQ6: A stationary 4-kg shell explodes into three pieces. Two of the fragments have a mass of 1 kg each and move along the paths shown with a speed of 10 m/s. The third fragment moves upward as shown.

What is the speed of the third fragment immediately after the explosion?

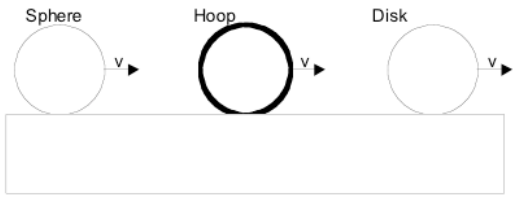
A. zero m/s
B. 1 m/s
C. 10 m/s
D. 5 m/s
E. 20 m/s



SQ7: A bicycle wheel of radius 0.70 m is rolling without slipping on a horizontal surface with an angular speed of 2.0 rad/s when the cyclist begins to uniformly apply the brakes. The bicycle stops in 5.0 s. Through how many radians did the wheel rotate during the 5.0 seconds of braking?

A. 5.0 rad
B. 0.4 rev
C. 9.6 rad
D. 10 rad
E. 2.0 rad

SQ8: A sphere, a hoop, and a cylinder, all with the same mass M and the same radius R, are rolling along, all with the same translational speed v. Which object has the most kinetic energy?



A. The sphere
B. The hoop
C. The disk
D. All four have the same kinetic energy

SQ9: A horizontal, 10-m plank weighs 100 N. It rests on two supports that are placed 1.0 m from each end as shown in the figure. How close to one end can an 800-N person stand without causing the plank to tip?

A. 0.5 m
B. 0.7 m
C. 0.9 m
D. 0 m
E. 0.3 m

SQ10: A bicycle with wheels of radius 0.4 m travels on a level road at a speed of 8 m/s. What is the angular speed of the wheels?

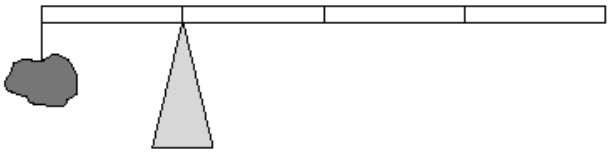
A. 10 rad/s
B. 20 rad/s
C. π /10 rad/s
D. 10 π rad/s
E. 20/ π rad/s

SQ11: A sculptor is sharpening a chisel on grindstone of radius 1.0 m that is spinning with a constant angular speed of 2.0 rad/s.
What is the magnitude of the centripetal acceleration of a point on the rim of the grindstone?

A. 4.0 m/s^2
B. zero m/s^2
C. 0.5 m/s^2
D. 1.0 m/s^2
E. 2.0 m/s^2

SQ12: A 1-kg rock is suspended by a massless string from one end of a 1-m measuring stick. What is the weight of the measuring stick if it is balanced on a pivot at the 0.25-m mark?

A: 0.25 kg
B: 0.5 kg
C: 1 kg
D: 2 kg
E: impossible to determine



SQ13: To double the total energy of a mass-spring system oscillating in simple harmonic motion, the amplitude of the harmonic motion must increase by a factor of:

A. 4
B. $2\sqrt{2}$
C. 2
D. $\sqrt{2}$
E. $2^{1/4}$

SQ14: A simple pendulum consists of a ball of mass m suspended from the ceiling using a string of length L. The ball is displaced from its equilibrium position by a small angle θ. What is the exact magnitude of the restoring force that moves the ball toward its equilibrium position and produces simple harmonic motion?

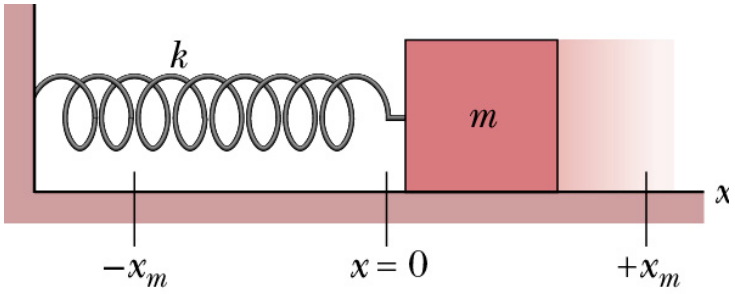
A. $mg \sin(\theta)$
B. mg
C. $mgL \sin(\theta)$
D. kx
E. $mg \cos(\theta)$

SQ15: A 10-kg box is at rest at the end of an un-stretched spring with constant k = 4000 N/m. The mass is struck with a hammer giving it an initial velocity of 10 m/s to the right across a frictionless surface. What is the amplitude of the resulting oscillation of this system?

A. 2 m
B. 0.4 m
C. 0.6 m
D. 0.5 m
E. 0.3 m

SQ16: In the figure below, the block has a kinetic energy of 3 J and the spring has an elastic potential energy of 2 J when the block is at x = +2.0 cm. What is the elastic potential energy when the block is at $x = -x_m$?

A. –5.0 J
B. 0 J
C. 2 J
D. 3 J
E. 5 J



SQ17: A balloon is released from a tall building. The total mass of the balloon including the enclosed gas is 2.0 kg. Its volume is 5.0 m^3. The density of air is 1.3 kg/m^3. Assume g = 10 m/s^2. Will the balloon rise, fall, or remain stationary?

A. The balloon will rise because the upward buoyant force is greater than its weight.
B. The balloon will fall because the upward buoyant force is less than its weight.
C. The balloon will remain stationary because its density is less than that of air.
D. The balloon will fall because the downward buoyant force exceeds the upward buoyant force.
E. The balloon will fall because its density is greater than that of air.

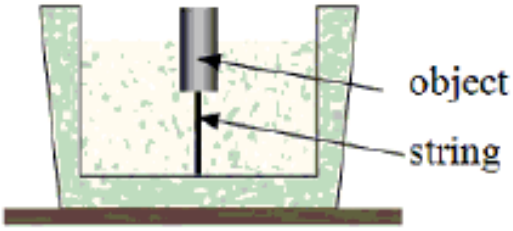
SQ18: A force of 50 N is applied to a hydraulic jack piston that is 0.1 m in diameter. If the piston that supports the load has a diameter of 1 m, approximately how much mass can be lifted by the jack? Ignore any difference in height between the pistons. Assume g = 10 m/s^2.

A. 1400 kg
B. 50 kg
C. 250 kg
D. 500 kg
E. 2500 kg

SQ19: Dale boards a submarine with a total surface area of 100 m^2 and submerges it to a depth of 10 km (=10,000 m) below the surface of the ocean. How much total force is exerted on the entire exterior of the submarine at the 10 km depth? Assume g = 10 m/s^2 and a density of 1000 kg/m^3 for water.

A. 10^8 N
B. 10^{10} N
C. 10 N
D. 100 N
E. 1000 N

SQ20: A 2-kg block displaces 10 kg of water when it is held fully immersed. The object is then tied down as shown in the figure; and it displaces 5 kg of water. What is the tension in the string? Assume g = 10 m/s^2.



A. 10 N
B. 20 N
C. 30 N
D. 100 N
E. 70 N

SQ21: A balloon inflated with helium gas (density = 0.2 kg/m^3) has a volume of 6×10^{-3} m^3. If the density of air is 1.3 kg/m^3, what is the buoyant force exerted on the balloon?

A. 0.01 N
B. 0.8 N
C. 0.08 N
D. 1.3 N
E. 7.8 N

SQ22: Selena uses a garden hose to fill a bucket of water. The water enters the hose through a faucet with a 6.0-cm diameter. The speed of the water at the faucet is 5 m/s. If the faucet and the nozzle are at the same height, and the water leaves the nozzle with a speed of 20 m/s, what is the diameter of the nozzle?

A. 6.0 cm
B. 1.5 cm
C. 4.0 cm
D. 2.0 cm
E. 3.0 cm