

Q1.

A ball is thrown vertically upward into the air from the ground and returns to the ground. What happens to its speed?

- A) decreases then increases
- B) increases then decreases
- C) always increases
- D) always decreases
- E) remains the same

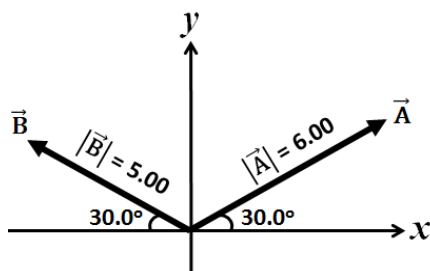
Q2.

Two cars (A and B) start from rest from the same point at the same instant and move along the same straight line in the same direction, with accelerations $a_A = 3.5 \text{ m/s}^2$ and $a_B = 4.9 \text{ m/s}^2$. What is the distance between them after 2.0 s?

- A) 2.8 m
- B) 1.7 m
- C) 8.4 m
- D) 5.4 m
- E) 1.5 m

Q3.

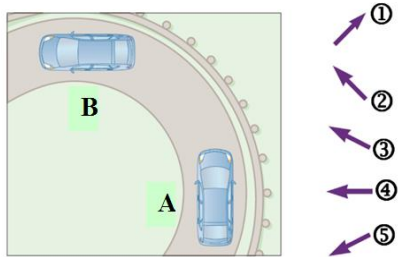
Two vectors (\vec{A} and \vec{B}) are shown in **FIGURE 1**. The vector $\vec{A} - \vec{B}$ is



- A) $9.53\hat{i} + 0.50\hat{j}$
- B) $0.87\hat{i} + 5.50\hat{j}$
- C) $-9.53\hat{i} - 0.50\hat{j}$
- D) $1.70\hat{i} + 0.50\hat{j}$
- E) $1.70\hat{i} + 5.50\hat{j}$

Q4.

FIGURE 2 shows a top view of a car moving in uniform circular motion. As the car moves from point A to point B, which of the vectors (1 through 5) shows the direction of the car's average acceleration between these two points?



- A) 5
- B) 1
- C) 3
- D) 4
- E) 2

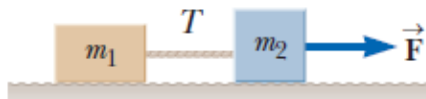
Q5.

A car starts from rest at the origin and accelerates at the rate of $3.0\hat{i} - 2.0\hat{j}$ (m/s^2). How far is the car from the origin after 5.0 s?

- A) 45 m
- B) 37 m
- C) 25 m
- D) 57 m
- E) 41 m

Q6.

Two blocks, connected by a massless string, are pulled on a frictionless surface by a horizontal force \vec{F} , as shown in **FIGURE 3**. Take $m_1 = 10$ kg, $m_2 = 15$ kg, and $F = 65$ N. What is the magnitude of the tension T in the string?



- A) 26 N
- B) 39 N
- C) 32 N
- D) 17 N
- E) 29 N

Q7.

A person pushes horizontally with a force of 16.0 N on a 4.00-kg block to move it across a horizontal floor. The coefficient of kinetic friction between the block and the floor is 0.250. What is the magnitude of the acceleration of the block?

- A) 1.55 m/s^2
- B) 4.00 m/s^2
- C) 2.45 m/s^2
- D) 6.45 m/s^2
- E) 3.65 m/s^2

Q8.

The force acting on a particle is $F_x = (8.0x - 16)$, where F is in Newtons and x is in meters. Find the work done by this force on the particle as it moves from $x = 0$ to $x = 3.0$ m.

- A) - 12 J
- B) + 12 J
- C) - 20 J
- D) + 20 J
- E) + 36 J

Q9.

A 5.0-kg block is sent up a plane inclined at 30° with an initial speed of 6.0 m/s. The block comes to rest after travelling 2.0 m along the plane. What is the change in the mechanical energy of the block during its motion on the plane?

- A) - 41 J
- B) + 140 J
- C) + 49 J
- D) - 90 J
- E) + 14 J

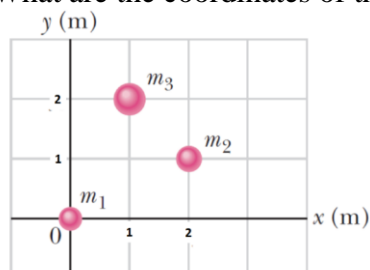
Q10.

An object of mass m moves along the positive x -axis with kinetic energy K . It collides with an object of mass $2m$ that is initially at rest. The collision is completely inelastic, and the objects move along the positive x -axis after the collision. What is the kinetic energy of the composite system just after the collision?

- A) $K/3$
- B) K
- C) $K/2$
- D) $K/4$
- E) $K/9$

Q11.

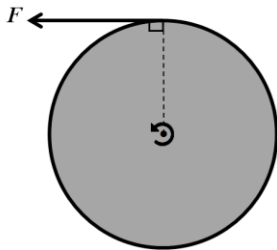
In **FIGURE 4**, the three particles have masses $m_1 = 3.0$ kg, $m_2 = 2.0$ kg, and $m_3 = 5.0$ kg. What are the coordinates of the center of mass of the system?



- A) (0.90, 1.2) m
- B) (1.2, 0.90) m
- C) (1.2, 1.2) m
- D) (0.90, 0.90) m
- E) (1.0, 1.0) m

Q12.

A uniform disk, of radius 20 cm and mass 350 g, rotates about an axis through its center and perpendicular to its plane. Starting from rest, a force F , applied as shown in **FIGURE 5**, brings the disk to an angular speed of 315 rad/s in 15 s. What is the magnitude of force F ?



- A) 0.74 N
- B) 0.85 N
- C) 0.64 N
- D) 0.37 N
- E) 1.3 N

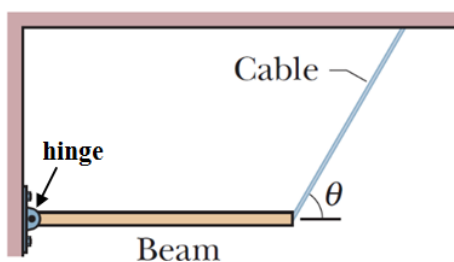
Q13.

A uniform disk rolls smoothly down a 30° incline. What is the magnitude of the linear acceleration of the center of mass of the disk?

- A) 3.3 m/s^2
- B) 9.8 m/s^2
- C) 4.9 m/s^2
- D) 2.4 m/s^2
- E) 5.1 m/s^2

Q14.

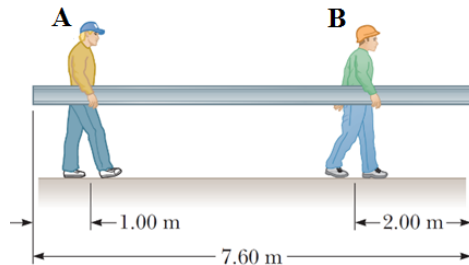
A uniform beam is 5.00 m long and has a mass of 60.0 kg. The beam is supported in a horizontal position by a hinge and a cable, as shown in **FIGURE 6**, with angle $\theta = 30.0^\circ$. What is the magnitude of the horizontal component of the force of the hinge on the beam?



- A) 509 N
- B) 588 N
- C) 339 N
- D) 170 N
- E) 402 N

Q15.

A uniform beam, of length 7.60 m and weight 375 N, is carried by two persons (A and B), as shown in **FIGURE 7**. Determine the magnitude of the force that each person exerts on the beam.



- A) $F_A = 147 \text{ N}, F_B = 228 \text{ N}$
- B) $F_A = 241 \text{ N}, F_B = 134 \text{ N}$
- C) $F_A = 134 \text{ N}, F_B = 241 \text{ N}$
- D) $F_A = 228 \text{ N}, F_B = 147 \text{ N}$
- E) $F_A = 188 \text{ N}, F_B = 188 \text{ N}$

Q16.

A rod, of length 1.5 m and radius 4.8 mm, is hung vertically to a ceiling. A box of mass 85 kg is attached to the free end of the rod, stretching it by 2.5 mm. What is Young's modulus of the rod?

- A) $6.9 \times 10^9 \text{ N/m}^2$
- B) $2.9 \times 10^9 \text{ N/m}^2$
- C) $3.7 \times 10^9 \text{ N/m}^2$
- D) $1.5 \times 10^9 \text{ N/m}^2$
- E) $4.3 \times 10^9 \text{ N/m}^2$

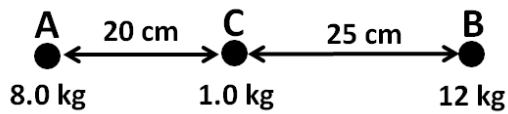
Q17.

In deep space, two particles, each of mass m , are held at rest a distance d apart. They are released and start to move toward each other. What is the speed of each particle when they are separated by $d/2$?

- A) $v = \sqrt{Gm/d}$
- B) $v = \sqrt{2Gm/d}$
- C) $v = \sqrt{Gm/2d}$
- D) $v = Gm/d$
- E) $v = Gm/2d$

Q18.

Three particles are held at rest, as shown in **FIGURE 8**. Find the net gravitational force on particle C due to particles A and B.



- A) 5.3×10^{-10} N, toward A
- B) 5.3×10^{-10} N, toward B
- C) 2.6×10^{-10} N, toward A
- D) 2.6×10^{-10} N, toward B
- E) Zero

Q19.

Two satellites are in circular orbits around a planet. One satellite has orbital radius 5.00×10^7 m, and orbital speed 5000 m/s. The second satellite has orbital radius 4.00×10^7 m. What is the orbital speed of the second satellite?

- A) 5590 m/s
- B) 6250 m/s
- C) 4470 m/s
- D) 4000 m/s
- E) 5920 m/s

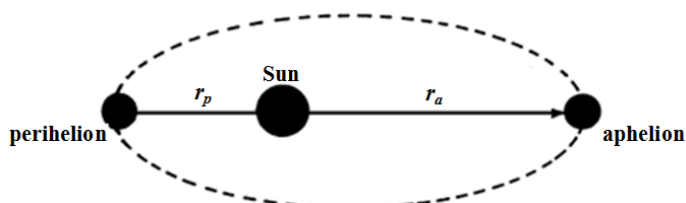
Q20.

On planet X, a stone thrown upward from the ground at 12.0 m/s returns to the ground in 3.00 s. If the radius of this planet is 3.18×10^8 m, what is its mass?

- A) 1.21×10^{28} kg
- B) 4.64×10^{28} kg
- C) 5.51×10^{28} kg
- D) 3.57×10^{28} kg
- E) 3.73×10^{28} kg

Q21.

In **FIGURE 9**, the maximum distance from the Earth to the Sun (at aphelion) is $r_a = 1.52 \times 10^{11}$ m, and the distance of closest approach (at perihelion) is $r_p = 1.47 \times 10^{11}$ m. The Earth's orbital speed at perihelion is 30.3 km/s. Determine the kinetic energy of the Earth at aphelion.



- A) 2.57×10^{33} J
 - B) 2.94×10^{33} J
 - C) 2.71×10^{33} J
 - D) 1.83×10^{33} J
 - E) 2.45×10^{33} J
-

Q22.

An ideal fluid flows through a horizontal pipe whose diameter varies along its length. As the pipe diameter increases

- A) the pressure increases
 - B) the kinetic energy per unit volume increases
 - C) the pressure decreases
 - D) neither the kinetic energy nor pressure are affected
 - E) both kinetic energy and pressure increase
-

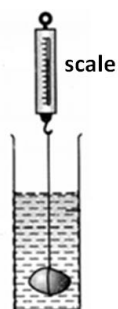
Q23.

The human ear has an area of $5.3 \times 10^{-5} \text{ m}^2$ and is damaged if the force on it increases by 1.5 N above the force from atmospheric pressure. If a person is diving in water, below what depth from the surface of the water could damage to his ear start to occur?

- A) 2.9 m
 - B) 1.3 m
 - C) 3.7 m
 - D) 4.2 m
 - E) 1.7 m
-

Q24.

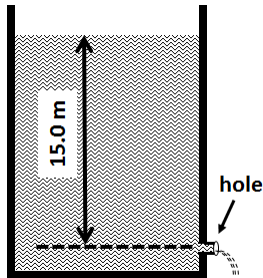
An object has a mass of 5.00 kg. Its weight is measured by a scale while it is completely submerged in a fluid of density 1020 kg/m^3 , as shown in **FIGURE 10**. If the scale reading is 25.0 N, what is the density of the object?



- A) $2.08 \times 10^3 \text{ kg/m}^3$
 - B) $2.49 \times 10^3 \text{ kg/m}^3$
 - C) $2.37 \times 10^3 \text{ kg/m}^3$
 - D) $2.01 \times 10^3 \text{ kg/m}^3$
 - E) $2.13 \times 10^3 \text{ kg/m}^3$
-

Q25.

A small hole is drilled in the side of a large water tank, 15.0 m below the top water level in the tank, as shown in **FIGURE 11**. The top of the tank is open to the atmosphere. Find the speed with which water flows out of the tank.



- A) 17.1 m/s
- B) 12.1 m/s
- C) 8.57 m/s
- D) 23.8 m/s
- E) 15.4 m/s

Q26.

At one point in a pipe, the water speed is 3.60 m/s and the pressure is 5.00×10^4 Pa. Find the pressure at a second point in the pipe that is 12.0 m lower than the first if the pipe diameter at the second point is twice that at the first.

- A) 1.74×10^5 Pa
- B) 8.27×10^5 Pa
- C) 6.76×10^5 Pa
- D) 5.61×10^5 Pa
- E) 4.39×10^5 Pa

Q27.

A particle is oscillating with simple harmonic motion with a period of 0.25 s and has a maximum speed of 3.5 m/s. What is the amplitude of the motion?

- A) 0.14 m
- B) 0.94 m
- C) 0.19 m
- D) 0.75 m
- E) 0.38 m

Q28.

A block ($m = 0.20$ kg) is attached to a spring ($k = 100$ N/m) and is moving in simple harmonic motion on a horizontal frictionless surface with an amplitude of 0.18 m. What is the speed of the block when its displacement from the equilibrium position is 0.15 m?

- A) 2.2 m/s
- B) 3.7 m/s
- C) 4.0 m/s
- D) 6.4 m/s
- E) 1.3 m/s

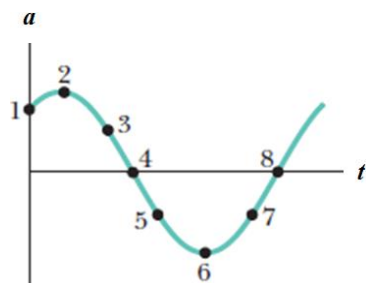
Q29.

A thin rod, of length 1.00 m, is pivoted from one end and is allowed to oscillate in a vertical plane like a pendulum. What is the period of oscillation of this system? Ignore air resistance and the friction at the pivot.

- A) 1.64 s
- B) 2.01 s
- C) 24.1 s
- D) 19.7 s
- E) 2.57 s

Q30.

The acceleration of a particle undergoing simple harmonic motion is graphed in **FIGURE 12**. At which point is the particle at $+x_m$, where x_m is the amplitude of the motion and $x = 0$ is the equilibrium position?



- A) 6
- B) 2
- C) 4
- D) 8
- E) 1