

Physics 2314, Homework #8 (due 4/4)

Multiple choice questions

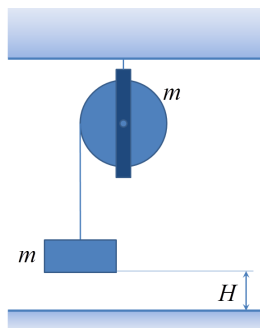
M1 If vectors \mathbf{A} and \mathbf{B} are perpendicular then vector $(\mathbf{A} \times \mathbf{B}) \times \mathbf{A}$ is

- A. parallel to vector \mathbf{A} .
- B. parallel to vector \mathbf{B} .
- C. perpendicular to both vectors \mathbf{A} and \mathbf{B} .
- D. zero.

M2 A solid sphere and a hollow sphere have the same mass and radius. They are rotating with the same angular speed about axes passing through their centers. Which one has the higher angular momentum?

- A. The solid sphere.
- B. The hollow sphere.
- C. Their angular momenta are the same.
- D. It is impossible to determine.

M3 A system consists of a block of mass m attached to a cord that is wound around a pulley. The pulley is a solid disk of the same mass m as the block. The system is originally held at rest so that the block is at height H above the ground, and then released. When the block hits the ground, its final velocity is v_f .



(a) If H is increased by a factor of 4, the final velocity v_f

- A. increases by a factor of 4.
- B. increases by a factor of 2.
- C. increases by a factor of $\sqrt{2}$.
- D. remains the same.
- E. decreases by a factor of $\sqrt{2}$.
- F. decreases by a factor of 2.
- G. decreases by a factor of 4.

(b) If the mass of the block is decreased by a factor of 4, the final velocity v_f

- A. increases by a factor of 4.
- B. increases by a factor of 2.
- C. increases by a factor of $\sqrt{2}$.
- D. remains the same.
- E. decreases by a factor of $\sqrt{2}$.
- F. decreases by a factor of 2.
- G. decreases by a factor of 4.

Problems

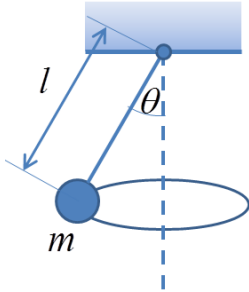
P1 Consider vectors $\mathbf{A} = \mathbf{i} + \mathbf{j}$ and $\mathbf{B} = \mathbf{i} + \mathbf{j} + \mathbf{k}$.

(a) Find $\mathbf{A} \cdot \mathbf{B}$ and $\mathbf{A} \times \mathbf{B}$.

(b) Show that $(\mathbf{A} \cdot \mathbf{B})^2 + |\mathbf{A} \times \mathbf{B}|^2 = |\mathbf{A}|^2 |\mathbf{B}|^2$

(c) Is (b) true for any vectors \mathbf{A} and \mathbf{B} ? Why?

P2 A conical pendulum consists of a ball of mass 0.05 kg suspended from a string of length 1.1 m. If the angle between the string and the vertical is 30° , find the angular momentum of the ball about the vertical dashed line.



P3 A particle with mass 1 kg is moving in the xy plane. Its velocity as a function of time is given by

$$\mathbf{v} = 6t^2\mathbf{i} + 2t\mathbf{j}$$

where \mathbf{v} is in meters per second and t is in seconds. Find the angular momentum of the particle at $t = 2$ s.

P4 A disk of radius 0.1 m and mass 0.2 kg rotates about a frictionless vertical axle with angular speed 1 rad/s. A second disk of radius 0.05 m and mass 0.05 kg, initially not rotating, drops onto the first disk. Because of the friction between the surfaces, the two eventually reach the same angular speed ω_f . Using the principle of conservation of angular momentum, calculate ω_f .

