Q1.
The angular position of a point on the rim of a rotating wheel of radius R is given by:

$$\theta(t) = 6.0\,t + 3.0\,t^2 - 2.0\,t^3,$$

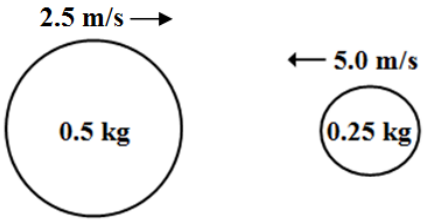
where θ is in radians and *t* is in seconds. What is the average angular acceleration for a point at R/2 for the time interval between t = 0 and t = 5 s?

A) – 24 rad/s^2
B) + 24 rad/s^2
C) 0
D) – 12 rad/s^2
E) + 12 rad/s^2

Q2.
An object of mass m = 15 kg initially at rest explodes into two pieces of masses 10 kg and 5.0 kg. The velocity of the 5.0 kg mass is 4.0 m/s along the positive x-axis. Find the kinetic energy of the 10 kg piece.

A) 20 J
B) 30 J
C) 40 J
D) 50 J
E) 60 J

Q3.
Figure 1 shows a 0.5 kg ball moving at 2.5 m/s collides head on with a 0.25 kg ball moving in the opposite direction at 5.0 m/s. Determine the final kinetic energy of the 0.5 kg ball if the collision is perfectly elastic.



A) 1.6 J
B) 2.3 J
C) 6.4 J
D) 11 J
E) 0.11 J

Q4.
A uniform disk starts from rest and rotates, about fixed central axis, with a constant angular acceleration. It reaches an angular velocity of 13.7 rad/s when it has completed 5.00 revolutions. What is the angular velocity when it has completed 9.00 revolutions?

A) 18.4 rad/s
B) 17.2 rad/s
C) 11.2 rad/s
D) 8.20 rad/s
E) 0

Q5.

A uniform disk is rotating with angular velocity ω about a fixed axis perpendicular to its plane and passing through a point on its edge. Find the ratio of its kinetic energy about this axis of rotation to its kinetic energy about a parallel axis passing through its center of mass and rotating with the same angular velocity ω.

A) 3
B) 9
C) $\sqrt{3}$
D) 4
E) 1

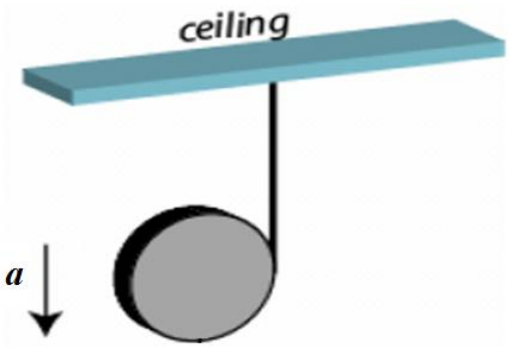
Q6.

A torque, of 2.0 N·m, is applied to a pulley rotating about fixed central axis. Starting from rest, the angular speed of the pulley after 4.0 s is 120 rev/min. What is the rotational inertia, in kg.m^2, of the pulley?

A) 0.64
B) 0.81
C) 0.22
D) 0.12
E) 1.00

Q7.

A string (one end attached to the ceiling) is wound around a uniform solid cylinder of mass M = 2.0 kg and radius R = 10 cm (see **Figure 2**). The cylinder starts falling from rest as the string unwinds. The linear acceleration, in m/s^2, of the cylinder is:

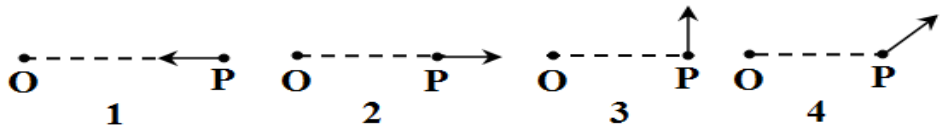


A) 6.5
B) 4.3
C) 8.5
D) 1.1
E) 2.2

Q8.
A hoop rolls without sliding on a horizontal floor. The ratio of its translational kinetic energy to its rotational kinetic energy (about its central axis) is

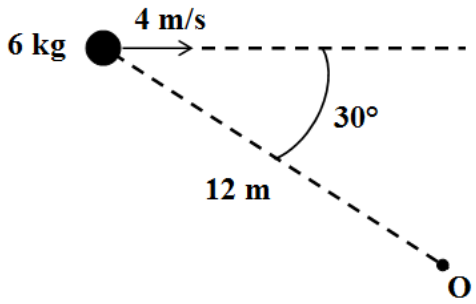
A) 1
B) 2
C) 3
D) 1/3
E) 1/2

Q9.
A single force acts on a particle P. Rank each of the orientations of the force shown in **Figure 3** according to the magnitude of the time rate of change of the particle's angular momentum about the point O, least to greatest.



A) 1 and 2 tie, then 4, then 3
B) 1, 2, 3, 4
C) 1 and 2 tie, then 3, then 4
D) 1 and 2 tie, then 3 and 4 tie
E) All are the same

Q10.
A 6.0 kg particle moves to the right at 4.0 m/s as shown in **Figure 4**. Its angular momentum, in kg.m^2/s, about point O is:



A) 144, into the page
B) 0
C) 249, into the page
D) 144, out of the page
E) 249, out of the page

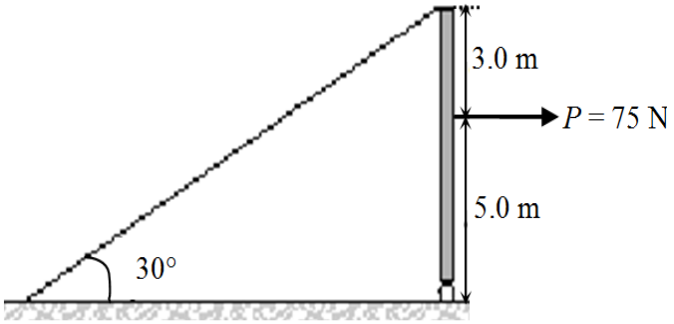
Q11.

A merry-go-round of radius 2.0 m is rotating about a frictionless pivot. It makes one revolution every 5.0 s. The moment of inertia of the merry-go-round (about an axis through its center) is 500 kg·m^2. A child of mass 25 kg, originally standing at the rim, walks radially in to the exact center. The child can be considered as a point mass. What is the new angular velocity, in rad/sec, of the merry-go-round?

A) 1.5
B) 1.3
C) 2.3
D) 1.9
E) 0.5

Q12.

A uniform 100 kg beam is held in a vertical position by a pin at its lower end, a cable at its upper end, and by applying a horizontal force P = 75 N as shown in **Figure 5**. Find the tension in the cable.



A) 54 N
B) 99 N
C) 14 N
D) 10 N
E) 76 N

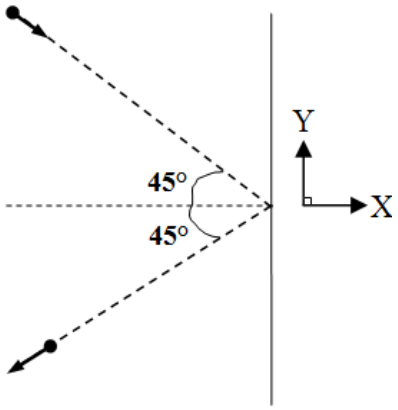
Q13.

A certain wire, hanging from a ceiling, stretches 0.9 cm when outward force with magnitude F is applied to the free end. The same force is applied to a wire of the same material but with three times the diameter and three times the length. The second wire stretches:

A) 0.3 cm
B) 0.1 cm
C) 0.9 cm
D) 2.7 cm
E) 8.1 cm

Q14.

As shown in **Figure 6**, a ball with a mass of 1.0 kg and a speed of 25 m/s hits a vertical wall at an angle of 45° and rebounds with the same speed with the same angle. Find the change in the linear momentum, in $\text{kg}\frac{\text{m}}{\text{s}}$, of the ball.



A) $-35\ \hat{\text{i}}$

B) $+35\ \hat{\text{i}}$

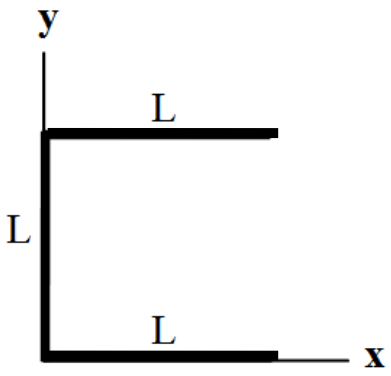
C) $-70\ \hat{\text{i}}$

D) $+70\ \hat{\text{i}}$

E) $-25\ \hat{\text{j}}$

Q15.

An object is formed by three identical uniform thin rods, each of length L and mass M, as shown in **Figure 7**. Determine the x and y coordinates, (x, y), of the center of mass of this object.



A) (L/3 , L/2)

B) (0 , L/2)

C) (L , L/2)

D) (L/2 , L)

E) (L/4 , L/4)
