

Q1.

A car with a mass of 1.20×10^3 kg travelling to the right at a speed of 15.0 m/s collides head-on with a truck of mass 2.00×10^3 kg travelling at a speed of 15.0 m/s to the left. The vehicles stick together when they collide. Find their kinetic energy after collision.

- A) 2.25×10^4 J
- B) 1.40×10^4 J
- C) 4.50×10^4 J
- D) 3.60×10^5 J
- E) 0

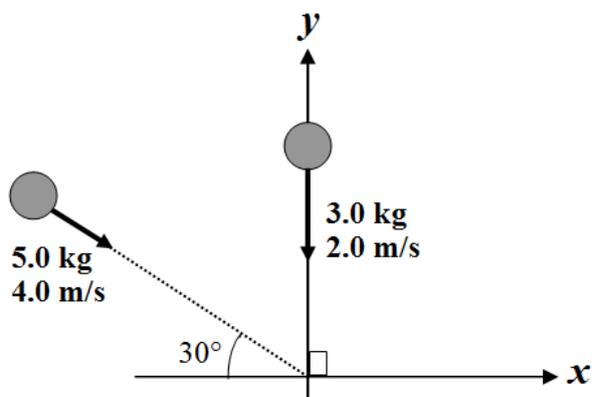
Q2.

The linear momentum of a system of colliding particles is conserved only if:

- A) There are no external forces acting on the system.
- B) The external forces equal to the internal forces.
- C) The kinetic energy is conserved.
- D) The collision is completely inelastic.
- E) The collision is elastic.

Q3.

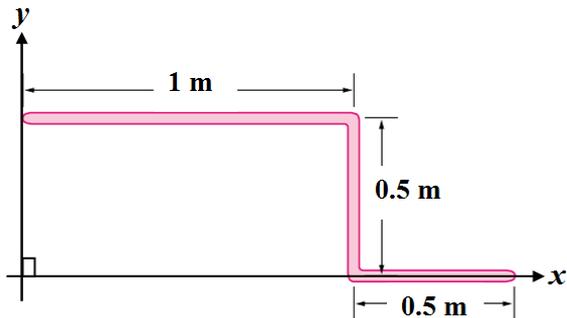
Figure 1 shows two masses; 3.0 kg and 5.0 kg moving with velocities 2.0 m/s and 4.0 m/s, respectively. The masses collide and stick together. Find the final velocity (in m/s) of the combined mass.



- A) $2.2\hat{i} - 2.0\hat{j}$
- B) $2.6\hat{i} + 4.8\hat{j}$
- C) $3.4\hat{i} - 3.1\hat{j}$
- D) $0.2\hat{i} - 0.2\hat{j}$
- E) $1.1\hat{i} - 1.2\hat{j}$

Q4.

A thin uniform wire of 2 m total length and 4 kg mass is bent into the shape shown in **Figure 2**. Find the coordinates (in m) of the center of mass of this shape.



- A) (0.8, 0.3)
- B) (0.8, 0.5)
- C) (0.5, 0.2)
- D) (0.5, 0.3)
- E) (0.5, 0.8)

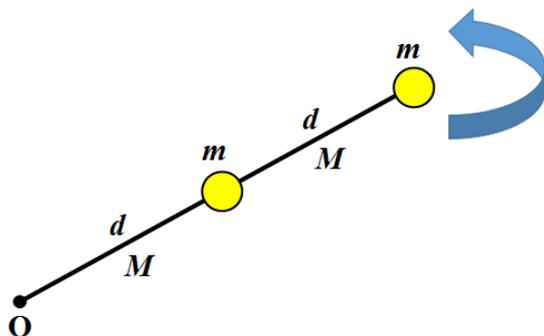
Q5.

Force $\vec{F} = (3\hat{i} + \hat{j})\text{N}$ is acting on a particle with position vector $\vec{r} = (2\hat{i} + 4\hat{j})\text{m}$. What is resulting torque on the particle about a point ($x = -1\text{ m}$, $y = 6\text{ m}$)?

- A) $9\hat{k}\text{ N}\cdot\text{m}$
- B) $-9\hat{k}\text{ N}\cdot\text{m}$
- C) $14\hat{k}\text{ N}\cdot\text{m}$
- D) $-14\hat{k}\text{ N}\cdot\text{m}$
- E) $5\hat{k}\text{ N}\cdot\text{m}$

Q6.

In **Figure 3**, two particles, each with mass $m = 0.85\text{ kg}$, are fastened to each other, and to a rotation axis at O, by two thin rods, each with length $d = 5.6\text{ cm}$ and mass $M = 1.2\text{ kg}$. The combination rotates around the axis at point O with an angular speed $\omega = 0.35\text{ rad/s}$. Find the total kinetic energy of the system.



- A) $1.4 \times 10^{-3}\text{ J}$
- B) $3.1 \times 10^{-3}\text{ J}$
- C) $5.5 \times 10^{-3}\text{ J}$
- D) $1.5 \times 10^{-2}\text{ J}$
- E) $1.9 \times 10^{-3}\text{ J}$

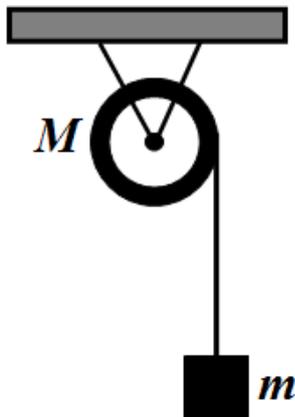
Q7.

A wheel is initially rotating at an angular speed of 18 rad/s . If the wheel is slowed down at a rate of 2.0 rad/s^2 , then find the angular displacement by time it stops.

- A) 81 rad
- B) 23 rad
- C) 87 rad
- D) 69 rad
- E) 65 rad

Q8.

In **Figure 4**, a block of mass $m = 1.00 \text{ kg}$ hangs from a massless cord that is wrapped around the rim of a disk of mass $M = 3.00 \text{ kg}$ and radius $R = 10.0 \text{ cm}$. Find the magnitude of the block's acceleration.



- A) 3.92 m/s^2
- B) 2.21 m/s^2
- C) 1.97 m/s^2
- D) 4.65 m/s^2
- E) 9.81 m/s^2

Q9.

Two cylinders of the same size and mass roll without slipping down an incline, starting from rest. Cylinder A has most of its mass concentrated at the rim, while cylinder B has most of its mass concentrated at the center. Find the correct statement.

- A) Cylinder B will reach the bottom of the incline first.
- B) Cylinder A will reach the bottom of the incline first.
- C) Both cylinders will reach the bottom at the same time.
- D) The incline is frictionless.
- E) Cylinder A will have higher acceleration than cylinder B .

Q10.

A disk has a rotational inertia of $6.0 \text{ kg}\cdot\text{m}^2$ and a constant angular acceleration of 2.0 rad/s^2 . If the disk starts from rest, then find the work done during the first 5.0 s by the net torque acting on it.

- A) 300 J
- B) 200 J
- C) 100 J
- D) 400 J
- E) 0

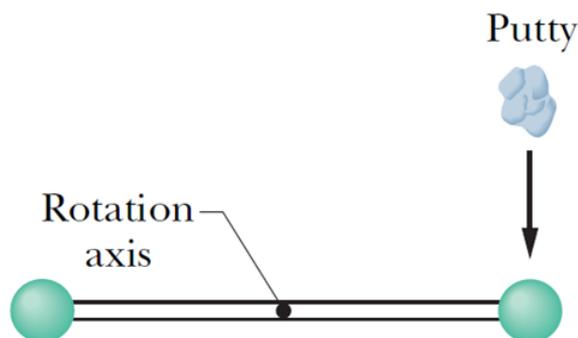
Q11.

A car of total mass 1000 kg has four wheels each of 10 kg mass and moves with speed v . What fraction of its total kinetic energy is due to the rotation of the wheels about their axles? [Assume that the wheels are uniform disks of the same mass and size].

- A) 0.02
- B) 0.03
- C) 0.04
- D) 0.05
- E) 0.06

Q12.

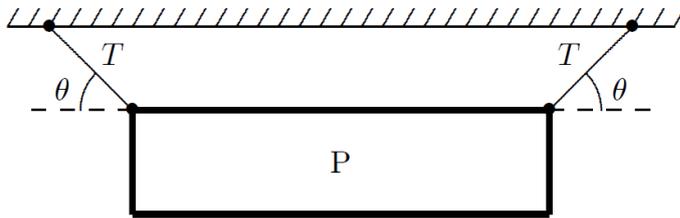
In **Figure 5**, two 2.00 kg balls are attached to the ends of a thin rod of length 50.0 cm and negligible mass. The rod is free to rotate in a vertical plane without friction about a horizontal axis through its center. With the rod initially horizontal, a 50.0 g piece of putty (wet mud) drops onto one of the balls, hitting it with speed of 3.00 m/s and sticking to it. Find the angular speed of the system just after the putty hits.



- A) 0.148 rad/s
- B) 0.296 rad/s
- C) 0.228 rad/s
- D) 0.318 rad/s
- E) 0.102 rad/s

Q13.

Figure 6 shows a picture P hanging by two strings making angle $\theta = 30^\circ$ with the dashed horizontal line. If the magnitude of the tension force T of each string is 20 N, then the weight of the picture is:



- A) 20 N
- B) 10 N
- C) 17 N
- D) 40 N
- E) 25 N

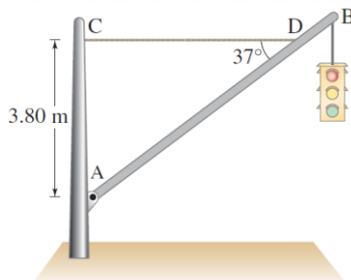
Q14.

A steel wire 2.3 mm in diameter with one end fixed to a ceiling stretches by 0.030% when an object is suspended from its other end. If the steel Young Modulus is $200 \times 10^9 \text{ N/m}^2$, then find the mass of the suspended object.

- A) 25 kg
- B) 21 kg
- C) 17 kg
- D) 29 kg
- E) 15 kg

Q15.

A traffic light hangs from a pole AB as shown in **Figure 7**. The uniform aluminum pole AB is 7.20 m long and has a mass of 12.0 kg. The mass of the traffic light is 21.5 kg. Find the tension in the horizontal massless cable CD



- A) 408 N
- B) 328 N
- C) 570 N
- D) 370 N
- E) 608