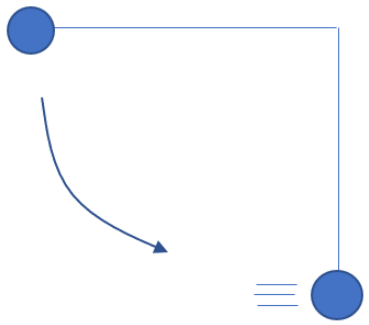
Practice Exam

1. A simple pendulum is made from a 0.205-kg metal ball attached to a massless string of length 75 cm. The pendulum is held horizontally and is then released from rest. Find the speed of the metal ball (in m/s) when the pendulum passes through the lowest point.

A) 2.3
B) 4.3
C) 3.8
D) 1.8
E) 5.0



2. A steel spring stores 18 J of potential energy when it is stretched by 2.40 cm. Determine the spring constant of the spring in N/m.

A) 62,500
B) 130,000
C) 6.25
D) 13.0
E) none of the above

3. A 2.3 kg object traveling at 6.1 m/s in the positive *x* direction catches up and collides with a 3.5 kg object traveling in the same direction at 4.2 m/s. The two objects stick together in a totally inelastic collision. What is the final velocity in m/s of the combined object?

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

4. A tennis ball of mass m = 0.25 kg, moving horizontally with speed 15.0 m/s, makes a perfectly elastic collision with a wall and after the collision recoils with velocity -15.0 m/s in the opposite direction. The ball and the wall are in contact for 0.15 s. The magnitude of the average force exerted on the ball by the wall is closest to

A) 10 N.
B) 20 N.
C) 30 N.
D) 40 N.
E) 50 N.

5. In a bike repair shop a wheel is given an initial angular velocity of 628 rad/s. After that, the wheel makes 224 full revolutions and stops. What is the magnitude of the angular acceleration of the wheel in rad/s^2?

A) 110
B) 120
C) 130
D) 140
E) 150

6. A 3.5 kg block is attached to a spring with a spring constant k=350 N/m. The block is then displaced 20 cm from equilibrium and is released from rest. Find the maximum speed (in m/s) achieved by the block.

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

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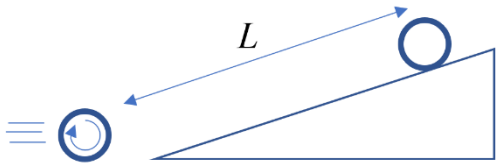
7. In order to find the speed of a 7.8 gram bullet it is fired into a 3.6 kg wooden block resting on a horizontal frictionless surface. After that, the block (with the bullet stuck in it) moves with speed of 2.2 m/s. Find the initial speed of the bullet.

A) 1017 m/s
B) 1250 m/s
C) 750 m/s
D) 500 m/s
E) 1531 m/s

8. A hoop is given an initial linear speed of 10.4 m/s and is sent rolling up a 30-degree incline without slipping. How far along the incline L (in meters) will the hoop roll before it stops? (Hint: use conservation of energy, including rotation; $I_{hoop} = MR^2$).

A) 22
B) 11
C) 33
D) 7.7
E) 44



9. A wheel rotating about a fixed axis has an angular position given by $\theta = 4.4 - 4.6\ t + 2.0t^3$, where θ is measured in radians and t in seconds. At $t = 1.0$ s, the magnitude of angular acceleration in rad/s^2 is

A) 5
B) 3
C) 12
D) 9
E) 6

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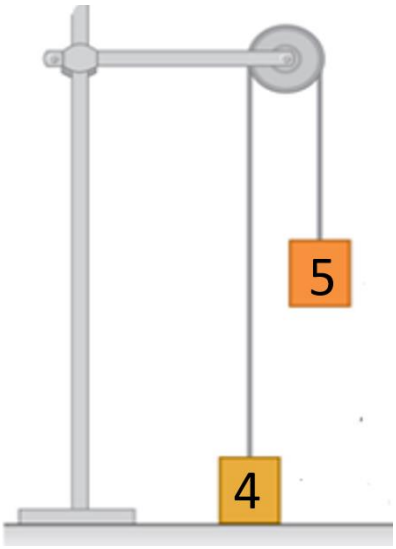
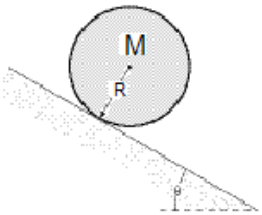
10. Two unequal blocks of mass 4.0 kg and 5.0 kg are suspended from either end of a light rope over a massless pulley as shown in the figure (not to scale). The blocks are released from rest. After the heavier block descends 0.50 m, what is the speed of the blocks in m/s? Select the closest answer.

A) 0.33
B) 1.04
C) 1.45
D) 0.63
E) 2.12



11. A ball (a spherical shell with $I = \frac{2}{3}MR^2$) of mass M =0.53 kg and radius R=13.3 cm rolls without slipping a distance of 4.0 meters down an incline which makes an angle of 20^0 with horizontal. If the sphere starts from rest, what is its speed at the bottom of the incline?

A) 1.4 m/s
B) 2.5 m/s
C) 5.2 m/s
D) 4.0 m/s
E) 3.1 m/s

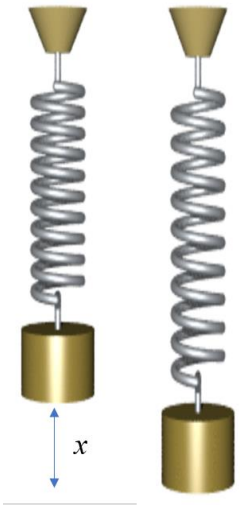


12. A bowling ball of mass M=30.0 kg and radius R=12 cm is rolling without slipping along a horizontal surface with speed of 6.9 m/s. Find the total kinetic energy (in Joules) due to the rotational and the translational motion of the ball. The bowling ball can be treated as a solid sphere, with $I = \frac{2}{5}MR^2$.

A) 200
B) 500
C) 1000
D) 400
E) 300

13. A mass 1.7 kg is attached to a vertical spring with a spring constant k=121 N/m. Originally, the spring is unstretched and the mass is released from rest. How far down (relative to initial position) will the mass fall?

A) 1.2 m
B) 0.19 m
C) 0.45 m
D) 0.66 m
E) 0.28 m



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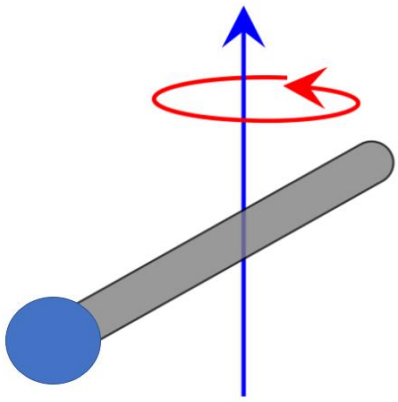
14. A small metal sphere with mass 1.8 kg and negligible radius is fixed at the end of 1.2 meter rod. If mass of the rod is 3.4 kg, find the kinetic energy of the system (in kJ, kilo-Joules) if it spins at 105 rad/s about an axis which is perpendicular to the rod and passes through its center (the moment of inertia for a rod about an axis through its center is $I = \frac{1}{12}ML^2$).

A) 1.8
B) 2.8
C) 3.8
D) 4.8
E) 5.8



15. A firework rocket moving with velocity 100 m/s in the positive x-direction and with mass 1.0 kg explodes into two parts of equal mass. The first half of the rocket keeps moving in the positive x-direction with velocity 250 m/s. Find the velocity (in m/s) of the second half.

A) -250
B) -50
C) 0
D) 25
E) 100

16. The mass of Sun is 2.0 x 10^{30} kg and the mass of Earth is 6.0 x 10^{24} kg. If the distance between Sun and Earth is 1.50 x 10^{8} km, the center of mass of the Sun-Earth system is located at the following distance from the center of the Sun (use the system of coordinates with the origin at the center of the Sun, and the Earth lies on the x-axis):

A) 75 x 10^{6} km
B) 450 km
C) 750 km
D) 4,500 km
E) 7,500 km

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1. C
2. A
3. E
4. E
5. D
6. B
7. A
8. A
9. C
10. B
11. D
12. C
13. E
14. E
15. B
16. B