



Université d'Ottawa • University of Ottawa

Faculté des sciences Faculty of Science
Physique Physics

PHY 1121

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Mid-Term Examination Two

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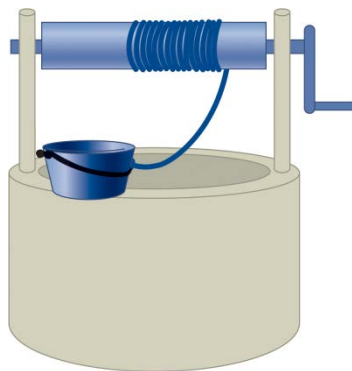
1. An automobile accelerates from rest at $t = 0$ s such that its tires undergo a constant rotational acceleration $\alpha = 5.8 \text{ rad/s}^2$. The radius of each tire is 0.33 m. At $t = 10$ s, compute the distance the automobile has traveled.

A) 33 m
B) 53 m
C) 96 m
D) 48 m
E) None of the above is correct.

2. A hollow cylinder, a solid cylinder, and a billiard ball are all released from the top of a ramp and roll to the bottom without slipping. Rank them, from least to greatest, according to the fraction of the kinetic energy that is rotational as they roll.

A) billiard ball < solid cylinder < hollow cylinder
B) hollow cylinder < solid cylinder < billiard ball
C) hollow cylinder < billiard ball < solid cylinder
D) billiard ball < hollow cylinder < solid cylinder
E) hollow cylinder = solid cylinder = billiard ball

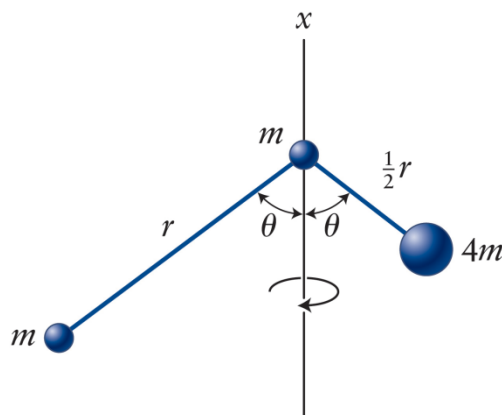
3.



You accidentally knock a full bucket of water off the side of the well shown in the figure above. The bucket plunges 15 m to the bottom of the well. Attached to the bucket is a light rope that is wrapped around the crank cylinder. How fast is the handle turning when the bucket hits bottom. The mass of the bucket plus water is 12 kg. The cylinder has a radius of 0.080 m and mass of 4.0 kg.

- A) 2.9×10^2 rad/s
- B) 2.7×10^2 rad/s
- C) 2.4×10^2 rad/s
- D) 2.2×10^2 rad/s
- E) 2.0×10^2 rad/s

4.

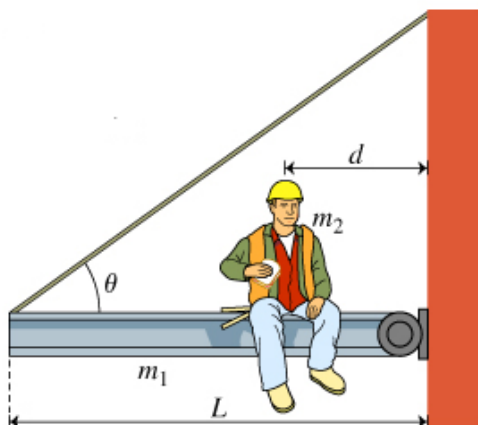


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 What is the moment of inertia about the x axis of the rigid object in the figure above? (Treat the balls as particles.)

- A) $mr^2 \sin^2 \theta$
- B) $2mr^2 \sin^2 \theta$
- C) $mr^2 \cos^2 \theta$
- D) $2mr^2 \cos^2 \theta$
- E) $mr^2 \tan^2 \theta$

5. Approximate the Sun as a uniform sphere of radius 6.96×10^8 m, rotating about its central axis with a period of 25.4 days. If, at the end of its life, the Sun collapses inward to form a uniform dwarf star that is approximately the same size as Earth (the Earth's radius is 6.38×10^6 m), what will the period of the dwarf's rotation be?
- A) 91 minutes
 - B) 52 minutes
 - C) 12 minutes
 - D) 3.1 minutes
 - E) 2.2 minutes
6. A gyroscope is precessing about a vertical axis. What happens to the precession angular speed if the total mass is doubled? (All other variables remaining the same.)
- A) It is doubled.
 - B) It is halved.
 - C) It remains unchanged.
 - D) It is quadrupled.
 - E) It decreases by a factor of four.
7. Suppose that a planet were discovered between the Sun and Mercury, with a circular orbit of radius equal to $\frac{2}{3}$ of the average orbit radius of Mercury. The orbital period of Mercury is 88.0 days. What would be the orbital period of such a planet?
- A) 61.2 days
 - B) 47.9 days
 - C) 41.3 days
 - D) 34.5 days
 - E) 28.1 days

8.



A uniform steel beam of length L and mass m_1 is attached via a hinge to the side of a building. The beam is supported by a steel cable attached to the end of the beam at an angle θ , as shown. Through the hinge, the wall exerts an unknown force, F , on the beam. A workman of mass m_2 sits eating lunch a distance d from the building. Find T , the tension in the cable.

A) $\frac{g\left(\frac{m_1 L}{2} + m_2 d\right)}{L \sin \theta}$

B) $\frac{g\left(\frac{m_1 L}{2} + m_2 d\right)}{2L \sin \theta}$

C) $\frac{2g\left(\frac{m_1 L}{2} + m_2 d\right)}{L \sin \theta}$

D) $\frac{g\left(\frac{m_1 L}{2} + 2m_2 d\right)}{L \sin \theta}$

E) $\frac{g\left(\frac{m_1 L}{2} + m_2 d\right)}{3L \sin \theta}$

9. A metal rod that is 4.20 m long and 0.45 cm^2 in cross-sectional area is found to stretch 0.21 cm under a tension of 5200 N. What is Young's modulus for this metal.

A) $2.9 \times 10^{11} \text{ Pa}$

B) $2.7 \times 10^{11} \text{ Pa}$

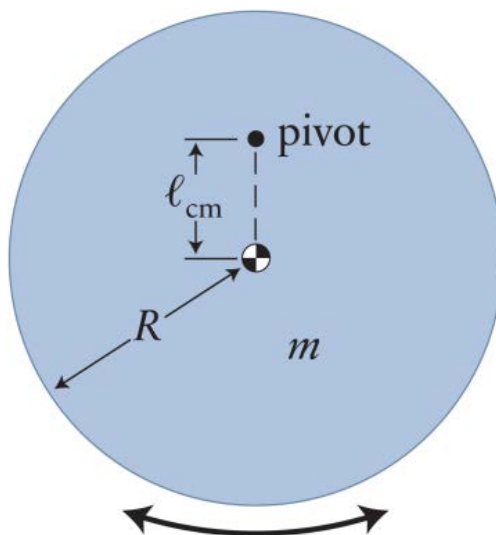
C) $2.5 \times 10^{11} \text{ Pa}$

D) $2.3 \times 10^{11} \text{ Pa}$

E) $2.0 \times 10^{11} \text{ Pa}$

10. A vertical spring on which is hung a block of mass m_1 oscillates with frequency f . With an additional block of mass $m_2 \neq m_1$ added to the spring, the frequency is $f/2$. What is the ratio m_1/m_2 ?
- A) $\frac{1}{2}$
 - B) $\frac{1}{3}$
 - C) $\frac{1}{4}$
 - D) 2
 - E) 3
11. A simple pendulum consists of a 1.00-kg bob on a string 1.00 m long. During a time interval of 27.0 s, the maximum angle this pendulum makes with the vertical is found to decrease from 6.00° to 5.40° . Determine the numerical value of the damping coefficient b .
- A) 6.21×10^{-3} kg/s
 - B) 6.82×10^{-3} kg/s
 - C) 7.05×10^{-3} kg/s
 - D) 7.47×10^{-3} kg/s
 - E) 7.80×10^{-3} kg/s

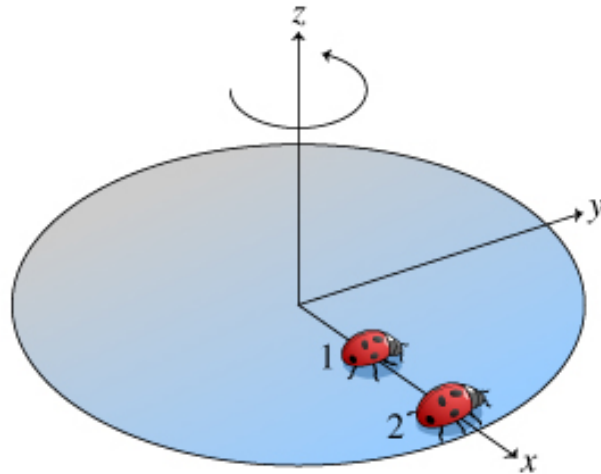
12.



A uniform disk of mass m and radius R lies in a vertical plane and is pivoted about a point a distance l_{cm} from its center of mass (see figure above). When given a small rotational displacement about the pivot, the disk undergoes simple harmonic motion. Determine the period of this motion.

- A) $2\pi \sqrt{\frac{\frac{1}{2}R^2 + l_{\text{cm}}^2}{2gl_{\text{cm}}}}$
- B) $2\pi \sqrt{\frac{\frac{1}{4}R^2 + l_{\text{cm}}^2}{gl_{\text{cm}}}}$
- C) $2\pi \sqrt{\frac{\frac{1}{2}R^2 + l_{\text{cm}}^2}{gl_{\text{cm}}}}$
- D) $2\pi \sqrt{\frac{\frac{1}{2}R^2 + l_{\text{cm}}^2}{3gl_{\text{cm}}}}$
- E) $2\pi \sqrt{\frac{\frac{1}{3}R^2 + l_{\text{cm}}^2}{gl_{\text{cm}}}}$

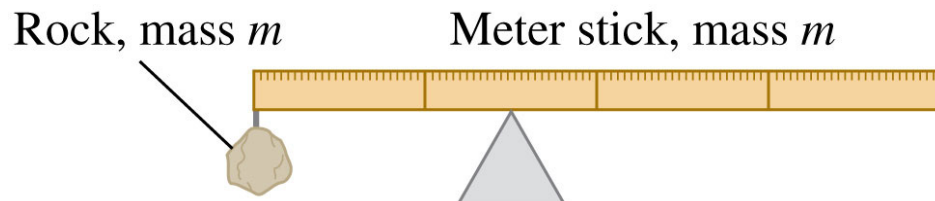
13.



Two ladybugs sit on a rotating disk, as shown in the figure (the ladybugs are at rest with respect to the surface of the disk and do not slip). Ladybug 1 is halfway between ladybug 2 and the axis of rotation. What is the angular speed of ladybug 1?

- A) One-half the angular speed of ladybug 2
- B) The same as the angular speed of ladybug 2
- C) Twice the angular speed of ladybug 2
- D) One-quarter the angular speed of ladybug 2
- E) None of the above is correct

14.



A rock is attached to the left end of a uniform meter stick that has the same mass as the rock. How far from the left end of the stick should the triangular object be placed so that the combination of meter stick and rock is in balance?

- A) Less than 0.25 m
- B) 0.25 m
- C) Between 0.25 m and 0.50 m
- D) 0.50 m
- E) More than 0.50 m