

Practice Exam

**Physics 1710
Fall 2003
Examination 3**

Name: _____

SS#: _____

Professor/Section: Krokhin/3
(circle one) Holland4
Weathers/5

Answers appear at the end of the test for personal assessment of performance.

This test consists of 8 multiple-choice questions and 4 problems. To receive credit for the 4 problems, you must show all of your work on the pages provided. Don't hand in any extra sheets or other paper. We strongly recommend that you also show your work for the multiple-choice questions.

We suggest that you use the following procedure to solve the problems.

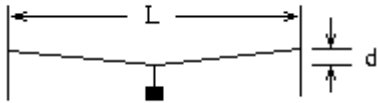
- 1. Read each problem carefully and make sure you know what is being asked before starting the problem.**
- 2. Draw a figure for the problem.**
- 3. List the parameters given.**
- 4. Write down the equations to be used.**
- 5. Solve for the answer algebraically**
- 6. Substitute numbers into you final equation and circle your answer.**
- 7. Mark your scantron for the multiple-choice questions.**

WORK THE EASY PROBLEMS FIRST!!!

1. A bowling ball (which may be modeled as a solid sphere with $I = \frac{2}{5}MR^2$ about an axis through its center) is placed on an inclined plane and is released from rest. There is friction between the inclined surface and the ball, so that the ball rolls without slipping down the plane. How fast is the ball's center of mass moving after the ball has rolled to a position 2.0 m below its starting height?

- (a) 10m/s
- (b) 5.3m/s
- (c) 6.3m/s
- (d) 4.5m/s
- (e) 10m/s

2. A wire of negligible mass is stretched horizontally between two vertical immovable surfaces that are $L = 3.0$ m apart. A mass of 10kg is suspended from the middle of the wire, causing the wire to move downward by $d = 5.0$ cm at its center as shown. What is the resulting tension in the wire?



- (a) 98 N
- (b) 150N
- (c) 2000N
- (d) 1470N
- (e) 1250N

3. What is the radius of the orbit of a geosynchronous satellite, i.e., a satellite that orbits in Earth's equatorial plane such that it is always directly above the same spot on the planet? Earth has a mass of $M = 5.98 \times 10^{24}$ kg and the gravitational constant, $G = 6.67 \times 10^{-11}$ N m²/kg².

- (a) 6400 km
- (b) 270000 km
- (c) 42000 km
- (d) 900 km
- (e) 50000 km

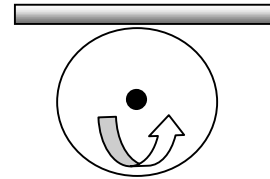
4. Several ice cubes are placed in a glass, and the glass is carefully filled with water until the ice floats and the water level reaches the rim of the glass. As the ice subsequently melts, what will happen and why?
- (a) the water overflows because the amount of water originally in the ice cube adds to the water originally in the glass causing it to spill.
 - (b) nothing; the level stays the same because the volume of the water from the melted cube matches the volume of the water displaced by the ice cube.
 - (c) indeterminate since you don't know the density of ice.
 - (d) the water level in the glass drops because as the ice melts its density increases.

5. A mass $m = 2$ kg, suspended by a spring of constant $k = 0.5$ N/m, can oscillate freely. What is the period of the mass's oscillation?
- (a) 12.6 s
 - (b) 6.3 s
 - (c) 5.0 s
 - (d) 1.0 s
 - (e) 2.2 s

6. A solid cylinder has a moment of inertia $I = \frac{1}{2}MR^2$ about an axis of rotation passing through its center. If the axis of rotation is moved from the center and the moment of inertia increases by a factor of 2, what is the location of the new axis (relative to the center of the cylinder)?
- (a) 0.50 R
 - (b) 0.62 R
 - (c) 0.65 R
 - (d) 0.25 R
 - (e) 0.71 R

7. A solid cylinder of radius $R = 0.2$ m and mass $M = 1$ kg is rotating about its center ($I = \frac{1}{2}MR^2$) with a frequency $f = 2$ revolutions/s. The position of the axis of rotation is fixed. A rough surface with a coefficient of friction $\mu_k = 0.1$ is then brought into contact with the cylinder. If the cylinder comes to rest in 10 s, what was the normal force exerted on the cylinder by the surface?

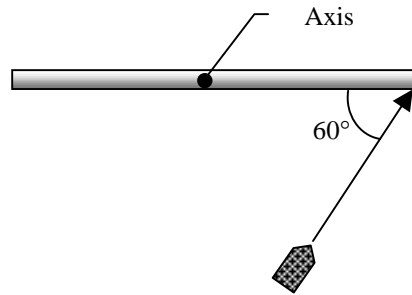
- (a) 0.72 N
- (b) 3.40 N
- (c) 4.56 N
- (d) 1.26 N
- (e) 2.00 N



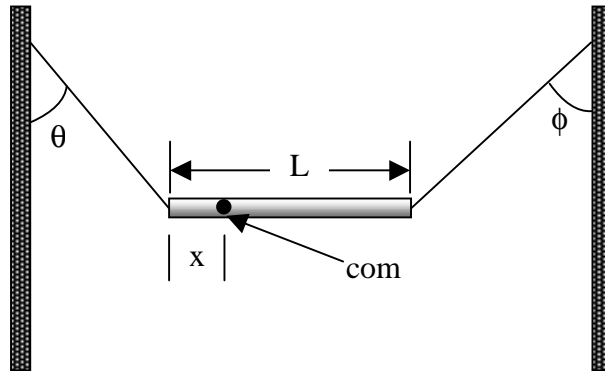
8. The units of Young's modulus in the MKS system are given as

- (a) $\text{N} \cdot \text{m}$
- (b) nothing; it's dimensionless
- (c) N/m^2
- (d) m^{-1}
- (e) m^2/s

9. A uniform thin rod of length $L = 0.5$ m and mass $M = 4.0$ kg can rotate in a horizontal plane about a vertical axis through its center ($I = ML^2/12$). The rod is at rest when a bullet of mass $m = 3.0$ g traveling in the horizontal plane of the rod is fired into one end of the rod. As viewed from above, the direction of the bullet's velocity makes an angle of $\theta = 60^\circ$ with the rod, as shown. If the bullet lodges in the rod and the angular velocity of the rod is $\omega = 10$ rad/s immediately after the collision, what is the bullet's speed just before impact?



10. A nonuniform bar is suspended at rest in a horizontal position by two massless cords as shown. One cord makes the angle $\theta = 36.9^\circ$ with the vertical; the other makes the angle $\phi = 53.1^\circ$ with the vertical. If the length L of the bar is 6.10 m, compute the distance x from the left-hand end of the bar to its center of mass.



11. If the speed of flow past the lower surface of an airplane wing is $V_0 = 110$ m/s, what speed of flow over the upper surface will give a pressure difference of $p = 900$ Pa between upper and lower surfaces? Take the density of air be $\rho = 1.30$ kg/m³, and assume that the vertical thickness of the wing is negligible.

12. Calculate the period of a pendulum of length $L = 2.5$ m on the surface of a planet of mass $M = 1.90 \times 10^{27}$ kg and radius $R = 7.15 \times 10^4$ m. The gravitational constant is $G = 6.67 \times 10^{-11}$ N m²/kg².

Answers:

1 b

2 d

3 c

4 b

5 a

6 e

7 d

8 c

9 1290. m/s

10 2.20 m

11 116. m/s

12 2.00 ms

