Instructor(s): *Korytov/Matcheva*

PHYSICS DEPARTMENT

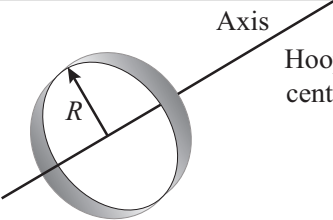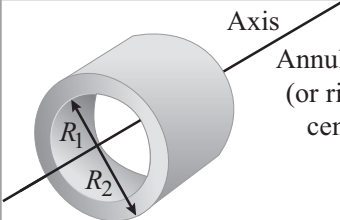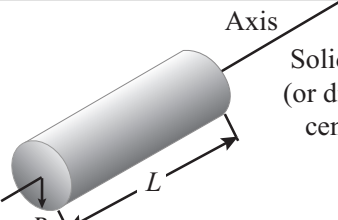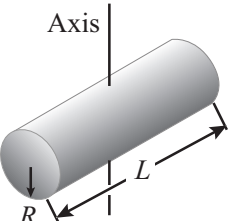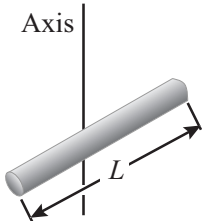PHY 2048   Final Exam   December 7, 2013

Name (print, last first): _____   Signature: _____

On my honor, I have neither given nor received unauthorized aid on this examination.

YOUR TEST NUMBER IS THE 5-DIGIT NUMBER AT THE TOP OF EACH PAGE.
(1) **Code your test number on your answer sheet (use lines 76–80 on the answer sheet for the 5-digit number).** Code your name on your answer sheet. **DARKEN CIRCLES COMPLETELY**. Code your UFID number on your answer sheet.
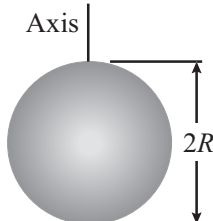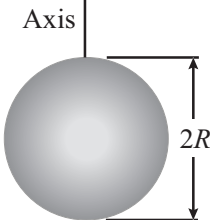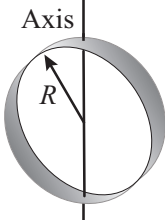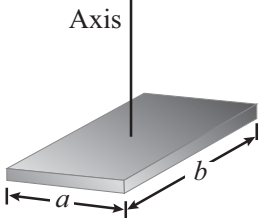(2) Print your name on this sheet and sign it also.
(3) Do all scratch work anywhere on this exam that you like. **Circle your answers on the test form.** At the end of the test, this exam printout is to be turned in. No credit will be given without both answer sheet and printout.
(4) **Blacken the circle of your intended answer completely, using a #2 pencil or <u>blue</u> or <u>black</u> ink**. Do not make any stray marks or some answers may be counted as incorrect.
(5) **The answers are rounded off. Choose the closest to exact. There is no penalty for guessing. If you believe that no listed answer is correct, leave the form blank.**
(6) Hand in the answer sheet separately.

Where needed use $g = 9.80 \text{ m/s}^2$

Hoop about central axis $I = MR^2$	Annular cylinder (or ring) about central axis $I = \frac{1}{2} M(R_1^2 + R_2^2)$	Solid cylinder (or disk) about central axis $I = \frac{1}{2} MR^2$
Solid cylinder (or disk) about central diameter $I = \frac{1}{4} MR^2 + \frac{1}{12} ML^2$	Thin rod about axis through center perpendicular to length $I = \frac{1}{12} ML^2$	Solid sphere about any diameter $I = \frac{2}{5} MR^2$
Thin spherical shell about any diameter $I = \frac{2}{3} MR^2$	Hoop about any diameter $I = \frac{1}{2} MR^2$	Slab about perpendicular axis through center $I = \frac{1}{12} M(a^2 + b^2)$

1. A desk rests on a rough horizontal surface ($\mu_s = 0.50$, $\mu_k = 0.45$). A constant horizontal force, just sufficient to start the desk in motion, is applied. The acceleration of the desk is:

   (1) 0.49 m/s² (2) 0 m/s² (3) 3.3 m/s² (4) 4.5 m/s² (5) 8.9 m/s²

2. A small coin rests on a table. The table turns around its center at a constant rate. The distance between the coin and the center of the table is 20 cm. The coefficient of static friction between the coin and the table is 0.5. What is the maximum angular velocity of the table for which the coin <u>does not</u> slide?

   (1) 4.9 rad/s
   (2) 14 rad/s
   (3) 49 rad/s
   (4) 0.7 rad/s
   (5) 1.4 rad/s
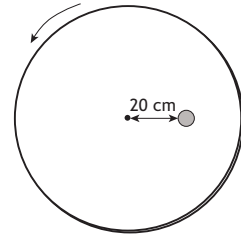
3. A stone of mass M rests on an elastic spring which is compressed a distance of 1 cm by the weight of the stone. The stone is pushed down an additional distance of 5 cm and then released. What is the maximum height reached by the stone relative to the release point?

   (1) 18 cm (2) 16 cm (3) 4 cm (4) 12 cm (5) need to know the spring constant k

4. A 4-kg block is attached to a cord that is wrapped around the rim of a flywheel of diameter 0.40 m and hangs vertically, as shown. The rotational inertia of the flywheel is 0.50 kg·m². When the block is released and the cord unwinds, the acceleration of the block is:

   (1) 2.4 m/s² (2) 1.5 m/s² (3) 5.5 m/s² (4) 9.8 m/s² (5) 12.7 m/s²
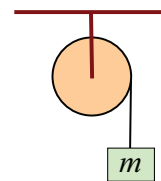
5. The coordinate of an automobile is given by $x(t) = 27t - 4.0t^3$, where t is in seconds and x is in meters. At $t = 1.0$ s, the acceleration of the auto is:

   (1) -24 m/s² (2) 15 m/s² (3) -4.0 m/s² (4) -12 m/s² (5) 23 m/s²

6. Identical guns fire identical bullets horizontally at the same speed from the same height above level planes, one on the Earth and one on the Moon. Ignore air resistance and assume that the speed of the bullet is much less than the escape velocity. Which of the following three statements is/are true?
   I. The horizontal distance traveled by the bullet is greater for the Moon.
   II. The flight time is less for the bullet on the Earth.
   III. The velocities of the bullets at impact are the same.

   (1) I and II only (2) III only (3) I and III only (4) II and III only (5) I, II, III

7. Two blocks, weighing 250 N and 350 N, respectively, are connected by a string that passes over a massless, frictionless pulley as shown. The tension in the string is:

   (1) 290 N (2) 210 N (3) 410 N (4) 500 N (5) 4900 N
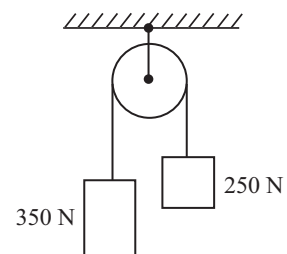
8. A small block of mass m starts from rest at the position shown and slides along the frictionless loop-the-loop track of radius R. What is the smallest value of y such that the object will slide without losing contact with the track?
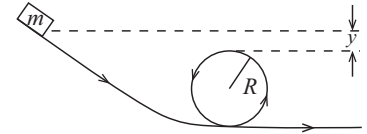
(1) $R/2$ (2) $R/4$ (3) R (4) $2R$ (5) zero

9. A playground merry-go-round has a radius R and rotational inertia I. When the merry-go-round is at rest, a child with mass m runs towards the merry-go-round with speed v along a line tangent to the rim and jumps on it. The angular velocity of the merry-go-round is then:

(1) $mRv/(mR^2+I)$ (2) v/R (3) mRv/I (4) $2mRvI$ (5) mv/I

10. A 5.0 g bullet moving at speed v strikes a 500 g wooden block at rest on a frictionless surface. The bullet emerges, traveling in the same direction with its speed reduced to $v/2$. What is the resulting speed of the block?

(1) $v/200$ (2) $v/100$ (3) $v/500$ (4) $v/2$ (5) $v/50$

11. Three particles, two with mass m and one with mass M, might be arranged in any of the four configurations shown on the right. Rank the configurations according to the magnitude of the gravitational force on M, least to greatest.
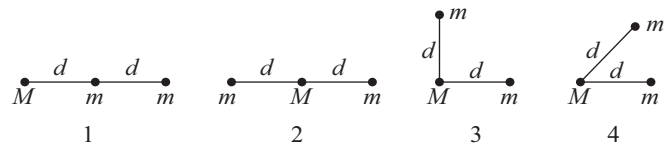
(1) 2, 1, 3, 4 (2) 1, 2, 3, 4 (3) 2, 1, 4, 3 (4) 2, 3, 4, 1 (5) 2, 3, 1, 4

12. To measure the mass of a planet with the same radius as that of the Earth, an astronaut drops an object from rest (relative to the planet) from an altitude of one radius above the surface. When the object hits the ground, its speed is 4 times what it would be if the same experiment were carried out on the Earth. In units of Earth masses, the mass of the planet is:

(1) 16 (2) 4 (3) 8 (4) 2 (5) 1/4

13. Two identical blocks of ice float in water as shown. Then:
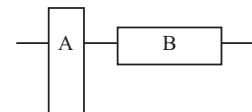
(1) the two blocks displace equal volumes of water since they have the same weight.
(2) block B displaces a greater volume of water since the pressure is less on its bottom.
(3) block A displaces a greater volume of water since the pressure acts on a smaller bottom area.
(4) block A displaces a greater volume of water since its submerged end is lower in the water.
(5) block B displaces a greater volume of water since its submerged end has a greater area.

14. A hydraulic press has one piston of diameter 2.0 cm and the other piston of diameter 8.0 cm. What force must be applied to the smaller piston to obtain a force of 1600N at the larger piston?

(1) 100N (2) 25N (3) 6.25N (4) 400N (5) 1600N

15. A block attached to a spring undergoes simple harmonic motion on a horizontal frictionless surface. Its total energy is 50.0 J. When the displacement is half the amplitude, the kinetic energy is:

(1) 37.5 J (2) 12.5 J (3) 25.0 J (4) zero (5) 50.0 J

16. A simple pendulum has length L and period T. As it passes through its equilibrium position, the string is suddenly clamped at its midpoint. The period then becomes:

    (1) none of these   (2) $2T$ (3) T (4) $T/2$ (5) $T/4$

17. A string carries a traveling sinusoidal wave with an amplitude of 2.0 cm and a frequency of 100Hz. The maximum transverse speed of any point on the string is:

    (1) 13 m/s   (2) 4.0 m/s   (3) 6.3 m/s   (4) 2.0 m/s   (5) unknown (not enough information is given)

18. An isotropically radiating point source of sound has a power output of 100 W. What is the sound intensity at a point 2 meters away (in W/m^2)?

    (1) 2   (2) 25   (3) 3   (4) 12.5   (5) 50

19. Two small identical speakers are connected (in phase) to the same source. The speakers are 3m apart and at ear level. An observer stands at X, 4m in front of one speaker as shown. If the amplitudes are not changed, the sound he hears will be least intense if the wavelength is:
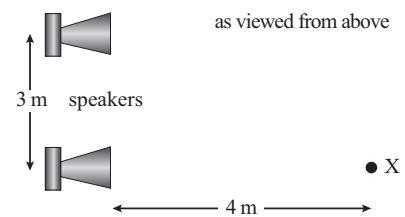
    (1) 2m   (2) 1m   (3) 3m   (4) 4m   (5) 5m

20. A source emits sound with a frequency of 1000 Hz. The source and an observer are moving toward each other, each with a speed of 100 m/s, with respect to the ground. If the speed of sound is 343 m/s, the observer hears sound with a frequency of:

    (1) 1823 Hz   (2) 708 Hz   (3) 1412 Hz   (4) 549 Hz   (5) 1224 Hz