Instructor(s): *Field/Hirschfeld*

PHYSICS DEPARTMENT
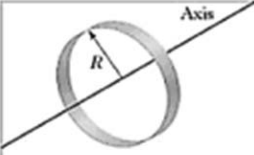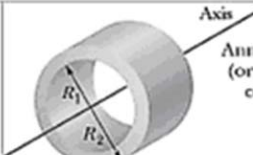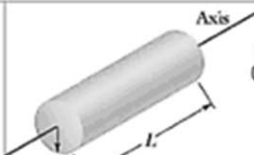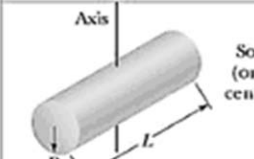PHY 2048　　　　　　　　　　　　　　　　　　Exam 2　　　　　　　　　　　　　　March 19, 2008
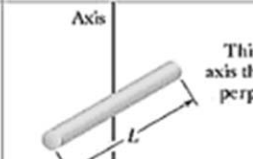
Name (print, last first): _____　　Signature: _____

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.
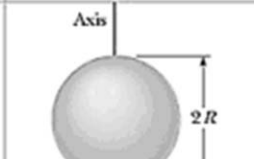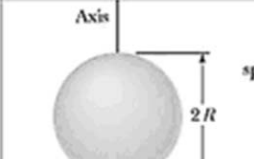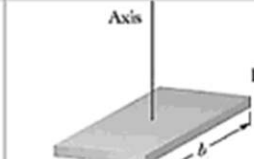(3) Do all scratch work anywhere on this exam that you like. **Circle your answers on the test form.** At the end of the test, this exam printout is to be turned in. No credit will be given without both answer sheet and printout.
(4) **Blacken the circle of your intended answer completely, using a #2 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.
(6) **Hand in the answer sheet separately.**

Where needed use $g = 9.80$ m/s^2

1. A 8000-N car is traveling at 12 m/s along a horizontal road when the brakes are applied. The car skids to a stop in 4.0 s. How much kinetic energy does the car lose in this time?

    (1) 5.9×10^4 J   (2) 4.8×10^4 J   (3) 1.2×10^5 J   (4) 5.8×10^5 J   (5) 4.8×10^6 J

2. An object is constrained by a cord to move in a circular path of radius 0.5m on a horizontal frictionless surface. The cord will break if its tension exceeds 16N. The maximum kinetic energy of the object can have is:

    (1) 4 J   (2) 8 J   (3) 16 J   (4) 32 J   (5) 64 J

3. A 0.50-kg object moves in a horizontal circular track with a radius of 2.5 m. An external force of 3.0 N, always tangent to the track, causes the object to speed up as it goes around. The work done by the external force as the mass makes one revolution is:

    (1) 47 J   (2) 24 J   (3) 59 J   (4) 94 J   (5) 120 J

4. At time $t = 0$ a 2-kg particle has a velocity in m/s of $(4 \text{ m/s})\hat{i}-(3 \text{ m/s})\hat{j}$. At $t = 3$ s its velocity is $(2 \text{ m/s})\hat{i} + (3 \text{ m/s})\hat{j}$. During this time the work done on it was:

    (1) -12 J   (2) 12 J   (3) 4 J   (4) -4 J   (5) $(4 \text{ J})\hat{i} + (36 \text{ J})\hat{j}$

5. A 0.20-kg particle moves along the x axis under the influence of a conservative force. The potential energy is given by

$$U(x) = (8.0\text{J/m}^2)x^2 + (2.0\text{J/m}^4)x^4,$$

    where x is the coordinate of the particle (in meters). If the particle has a speed of 5.0 m/s when it is at $x = 1.0$ m, its speed when it is at the origin is:

    (1) 11 m/s   (2) 0   (3) 2.9 m/s   (4) 5.7 m/s   (5) 7.9 m/s

6. A ball is held at a height H above a floor. It is then released and falls to the floor. If air resistance can be ignored, which of the five graphs below correctly gives the mechanical energy E of the Earth-ball system as a function of the altitude y of the ball?

    (1) V
    (2) I
    (3) II
    (4) III
    (5) IV

7. The potential energy of a body of mass m is given by $U = -mgx + 1/2kx^2$. The corresponding force is:

    (1) $mg - kx$ (2) $-mg + kx$ (3) $-mg + kx/2$ (4) $mgx^2/2 - kx^3/6$ (5) $-mgx^2/2 + kx^3/6$

8. A 25-g ball is released from rest 80 m above the surface of the Earth. During the fall the total thermal energy of the ball and air increases by15 J. Just before it hits the surface its speed is

    (1) 19 m/s   (2) 36 m/s   (3) 40 m/s   (4) 45 m/s   (5) 53 m/s

9. Block A, with a mass of 4 kg, is moving with a speed of 2.0 m/s while block B, with a mass of 8 kg, is moving in the opposite direction with a speed of 3 m/s. The center of mass of the two block-system is moving with the velocity of:

   (1) 1.3 m/s in the same direction as B
   (2) 1.3 m/s in the same direction as A
   (3) 2.7 m/s in the same direction as A
   (4) 2.7 m/s in the same direction as B
   (5) 2.7 m/s in the same direction as A

10. Two 4.0-kg blocks are tied together with a compressed spring between them. They are thrown from the ground with an initial velocity of 35 m/s, 45° above the horizontal. At the highest point of the trajectory they become untied and spring apart. About how far below the highest point is the center of mass of the two-block system 2.0 s later, before either fragment has hit the ground?

   (1) 20 m
   (2) 12 m
   (3) 31 m
   (4) Can't tell because the velocities of the fragments are not given.
   (5) Can't tell because the coordinates of the highest point is not given.

11. A 0.2 kg rubber ball is dropped from the window of a building. It strikes the sidewalk below at 30 m/s and rebounds up at 20 m/s. The magnitude of the impulse due to the collision with the sidewalk is:

   (1) 10 N·s   (2) 6 N·s   (3) 2 N·s   (4) 19.6 N·s   (5) 9 N·s

12. A 75-kg man is riding in a 30-kg cart at 2.0 m/s. He jumps off in such a way as to land on the ground with no horizontal velocity. The resulting *change* in speed of the cart is:

   (1) 5 m/s   (2) 7 m/s   (3) zero   (4) 2 m/s   (5) 3 m/s

13. The angular speed of the minute hand of a watch is

   (1) $(\pi/1800)$ rad/s   (2) $(\pi/1800)$ m/s   (3) (1800π) rad/s   (4) (1800π) m/s   (5) $(\pi/60)$ m/s

14. A flywheel is initially rotating at 20 rad/s and has a constant angular acceleration. After 9.0 s it has rotated through 450 rad. Its angular acceleration is:

   (1) 6.7 rad/s^2 (2) 3.3 rad/s^2 (3) 4.4 rad/s^2 (4) 5.6 rad/s^2 (5) 11 rad/s^2

15. The rotational inertia of a solid uniform sphere about a diameter is $(2/5)MR^2$, where M is its mass and R is its radius. If the sphere is pivoted about an axis that is tangent to its surface, its rotational inertia is:

   (1) $(7/5)MR^2$ (2) $(2/5)MR^2$ (3) $(3/5)$MR2   (4) $(5/2)MR^2$ (5) MR^2

16. A rod is pivoted about its center. A 5-N force is applied 4 m from the pivot and another 5-N force is applied 2 m from the pivot, as shown. The magnitude of the total torque about the pivot (in N·m) is:
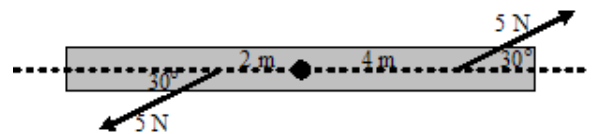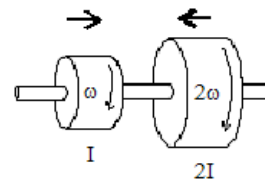

   (1) 15 N   (2) 5 N   (3) 8.7 N   (4) 26 N   (5) 0

17. A thin-walled hollow tube rolls without sliding along the floor. The ratio of its translational kinetic energy to its rotational kinetic energy (about an axis through its center of mass) is:

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

18. A sphere and cylinder of equal mass and radius are simultaneously released from the same height, from rest, on the same inclined plane, rolling down the incline without slipping. On an adjacent incline of the same angle a cube of the same mass is simultaneously released from rest, from the same height, to slide without friction down the incline. Then:

(1) The sphere reaches the bottom 2nd
(2) the cylinder reaches the bottom 2nd
(3) the cube reaches the bottom 2nd
(4) the cube and sphere tie for 2nd
(5) the cube and cylinder tie for 2nd

19. A 2.0-kg block travels around a 0.50-m radius circle with an angular velocity of 12 rad/s. The magnitude of its angular momentum about the center of the circle is:

(1) 6.0 kg·m^2/s   (2) 12 kg·m^2/s   (3) 24 kg·m^2/s   (4) 48 kg·m^2/s   (5) 64 kg·m^2/s

20. Two disks are mounted on low-friction bearings on a common shaft. The first disc has rotational inertia I and is spinning with angular velocity ω. The second disc has rotational inertia $2I$ and is spinning in the same direction as the first disc with angular velocity 2ω as shown. The two disks are slowly forced toward each other along the shaft until they couple and have a final common angular velocity of:

(1) $5\omega/3$ (2) 3ω (3) $7\omega/3$ (4) $3\omega/5$ (5) $3\omega/7$