

Instructor(s): *Mueller/Saab*PHYSICS DEPARTMENT  
Exam 2

October 26, 2009

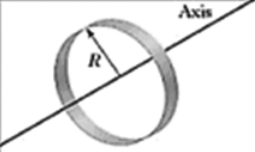
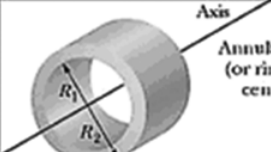
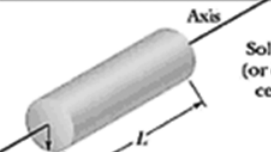
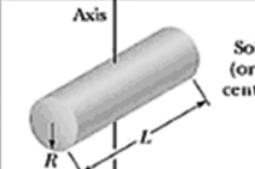
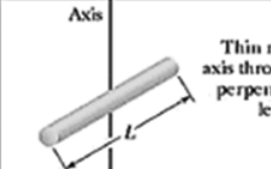
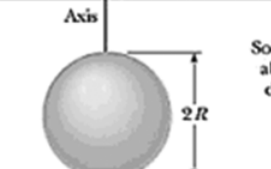
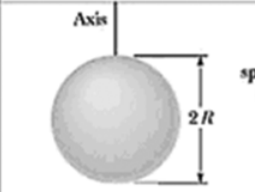
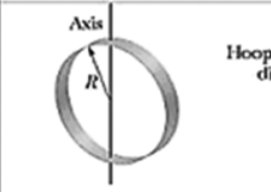
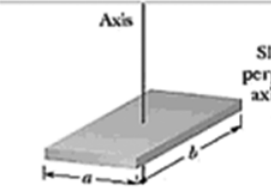
Name (print, last first): \_\_\_\_\_

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.**

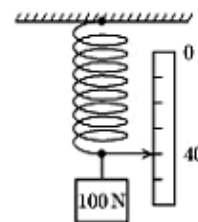
- (1) **Code your test number on your answer sheet (use lines 76–80 on the answer sheet for the 5-digit number).** Code your name on your answer sheet. **DARKEN CIRCLES COMPLETELY.** Code your UFID number on your answer sheet.
- (2) Print your name on this sheet and sign it also.
- (3) Do all scratch 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 blue or black ink.** Do not make any stray marks or some answers may be counted as incorrect.
- (5) **Hand in the answer sheet separately.**

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

 <p>Hoop about central axis</p> <p><math>I = MR^2</math> (a)</p>	 <p>Annular cylinder (or ring) about central axis</p> <p><math>I = \frac{1}{2}M(R_1^2 + R_2^2)</math> (b)</p>	 <p>Solid cylinder (or disk) about central axis</p> <p><math>I = \frac{1}{2}MR^2</math> (c)</p>
 <p>Solid cylinder (or disk) about central diameter</p> <p><math>I = \frac{1}{4}MR^2 + \frac{1}{12}ML^2</math> (d)</p>	 <p>Thin rod about axis through center perpendicular to length</p> <p><math>I = \frac{1}{12}ML^2</math> (e)</p>	 <p>Solid sphere about any diameter</p> <p><math>I = \frac{2}{5}MR^2</math> (f)</p>
 <p>Thin spherical shell about any diameter</p> <p><math>I = \frac{2}{3}MR^2</math> (g)</p>	 <p>Hoop about any diameter</p> <p><math>I = \frac{1}{2}MR^2</math> (h)</p>	 <p>Slab about perpendicular axis through center</p> <p><math>I = \frac{1}{12}M(a^2 + b^2)</math> (i)</p>

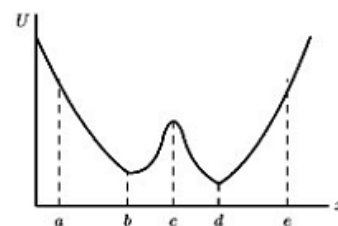
1. The weight of an object on the moon is one-sixth of its weight on Earth. The ratio of the kinetic energy of a body on Earth moving with speed  $V$  to that of the same body moving with speed  $V$  on the moon is:
- (1) 1:1                      (2) 6:1                      (3) 36:1                      (4) 1:6                      (5) 1:36
2. An object of mass 1 g is whirled in a horizontal circle of radius 0.5 m at a constant speed of 2 m/s. The work done on the object during one revolution is:
- (1) 0                      (2) 1 J                      (3) 2 J                      (4) 4 J                      (5) 16 J
3. At time  $t = 0$  a particle starts moving along the  $x$  axis. If its kinetic energy increases uniformly with time,  $t$ , the net force acting on it must be:
- (1) proportional to  $1/\sqrt{t}$    (2) constant   (3) proportional to  $t$    (4) inversely proportional to  $t$    (5) proportional to  $\sqrt{t}$

4. An ideal spring, with a pointer attached to its end, hangs next to a linear scale. With a 100-N weight attached, the pointer indicates "40" on the scale as shown. Using a 200-N weight instead results in "60" on the scale. Using an unknown weight  $W$  instead results in "30" on the scale. The weight of  $W$  is

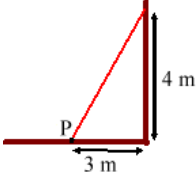


- (1) 50 N                      (2) 75 N                      (3) 60 N                      (4) 40 N                      (5) 25 N
5. A 0.50-kg block attached to an ideal spring with a spring constant of 80 N/m oscillates on a horizontal frictionless surface. When the spring is 4 cm longer than its equilibrium length, the speed of the block is 0.50 m/s. The greatest speed of the block is:
- (1) 0.71 m/s                      (2) 0.23 m/s                      (3) 0.32 m/s                      (4) 0.55 m/s                      (5) 0.93 m/s
6. A 0.5-kg particle moves along the  $x$  axis under the influence of a conservative force. The potential energy is given by  $U(x) = (8J/m^2)x^2 + (2J/m^4)x^4$ , where  $x$  is the coordinate of the particle in meters. If the particle has a kinetic energy of 6 J when it is at  $x = 1$  m, its speed when it is at the origin is:
- (1) 8 m/s                      (2) 0 m/s                      (3) 5 m/s                      (4) 6 m/s                      (5) 16 m/s

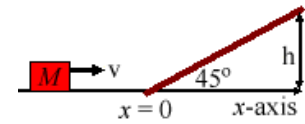
7. A particle is released from rest at the point  $x = a$  and moves along the  $x$  axis subject to the potential energy function  $U(x)$  as shown in the figure. The particle



- (1) moves to a point  $x = e$ , then moves to the left  
 (2) moves to a point  $x = e$ , stops, and remains at rest  
 (3) moves to infinity at varying speed  
 (4) moves to  $x = b$ , where it remains at rest  
 (5) moves to  $x = e$  and then to  $x = d$ , where it remains at rest
8. A particle moves along the  $x$ -axis under the influence of a conservative force. The potential energy is given by  $U(x) = (6J/m^2)x^2 - (24J/m)x$ , where  $x$  is the coordinate of the particle. At what value of the position  $x$  is the force on the particle equal to zero?
- (1)  $x = 2m$                       (2)  $x = 4m$                       (3)  $x = 6m$                       (4)  $x = 0$                       (5) The force is not zero at any value of  $x$

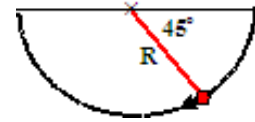
9. At the same instant that a 0.50-kg ball is dropped from 25 m above Earth, a second ball, with a mass of 0.25 kg, is thrown straight upward from Earth's surface with an initial speed of 15 m/s. They move along nearby lines and pass without colliding. What is the velocity of the center-of-mass of the two-ball system 2 seconds after the balls are released?
- (1) 14.6 m/s, downward (2) 14.6 m/s, upward (3) 19.6 m/s, downward (4) 19.6 m/s, upward (5) 5.0 m/s, upward
10. A mouse of mass  $M$  lies on the rim of a uniform disk of mass  $6M$  that can rotate freely about its center like a merry-go-round. Initially the mouse and disk rotate together with an angular velocity of  $\omega$ . If the mouse walks to a new position that is at the center of the disk what is the new angular velocity of the mouse-disk system?
- (1)  $4\omega/3$  (2)  $\omega$  (3)  $\omega/2$  (4)  $2\omega$  (5)  $3\omega/2$
11. A 100-N uniform plank leans against a frictionless wall as shown. The magnitude of the torque (about the point P) applied to the plank by the wall is:
- 
- (1) 150 N·m (2) 100 N·m (3) 500 N·m (4) 200 N·m (5) 75 N·m
12. A 0.5-kg rubber ball is dropped from rest a height of 19.6 m above the surface of the Earth. It strikes the sidewalk below and rebounds up to a maximum height of 4.9 m. The magnitude of the impulse due to the collision with the sidewalk is:
- (1) 14.7 N·s (2) 4.9 N·s (3) 19.6 N·s (4) 8.3 N·m (5) 16.6 N·m
13. A wheel initially ( $t = 0$ ) has an angular velocity of 18 rad/s. It has a constant angular acceleration with a magnitude  $2 \text{ rad/s}^2$  and at  $t = 0$  the angular velocity is decreasing. At what time  $t$  is the angular velocity equal to 18 rad/s in the direction opposite to the initial angular velocity?
- (1) 18 s (2) 3 s (3) 6 s (4) 9 s (5) 36 s
14. An astronaut is being tested in a centrifuge. The centrifuge has a radius  $R$  and, in starting from rest at  $t = 0$ , rotates according to  $\theta(t) = (0.5 \text{ rad/s}^2)t^2$ . At what time  $t > 0$  is the magnitude of the tangential acceleration equal to the magnitude of the radial acceleration (*i.e.*, centripetal acceleration)?
- (1)  $t = 1 \text{ s}$  (2)  $t = 2 \text{ s}$  (3)  $t = 0.5 \text{ s}$  (4) never (5) need to know the radius  $R$
15. A single force acts on a particle located on the positive  $y$ -axis a distance  $d$  from the origin (*i.e.*, at the point  $P = (x, y, z) = (0, d, 0)$ ). The torque about the origin is non-zero and points in the positive  $x$  direction. The force must be:
- (1) in the positive  $z$  direction  
 (2) in the negative  $z$  direction  
 (3) in the positive  $x$  direction  
 (4) in the negative  $x$  direction  
 (5) in the positive  $y$  direction
16. A 0.5-kg particle-like object moves in a plane with velocity  $\vec{v} = (30 \text{ m/s})\hat{i} + (60 \text{ m/s})\hat{j}$ . What is the magnitude of its angular momentum relative to the origin when it passes through the point with  $(x, y, z)$  coordinates of (2m, 4m, 0)?
- (1) zero (2) 6.0 J·s (3) 12.0 J·s (4) 150 J·s (5) 164.3 J·s

17. Near the surface of the Earth a block of mass  $M$  and initial velocity  $16.97 \text{ m/s}$  is sliding to the right along the  $x$ -axis as shown. The surface is frictionless for  $x < 0$ . At  $x = 0$  the block encounters a  $45^\circ$  incline ramp. If the block stops at a height  $h = 9.8 \text{ m}$ , what is the kinetic coefficient of friction of the ramp?



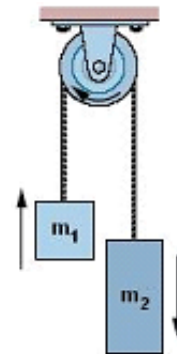
- (1) 0.50                      (2) 0.25                      (3) 0.75                      (4) 0.35                      (5) 0.20

18. Near the surface of the Earth a small object of mass  $m = 0.5 \text{ kg}$ , on the end of a light cord, is held at an angle of  $45^\circ$  from the horizontal and a distance  $R$  from a fixed support as shown in the figure. The object is then released from rest. What is the tension force of the cord when the object is at the lowest point of its swing?



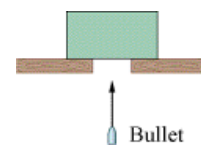
- (1) 7.8 N                      (2) 4.9 N                      (3) 14.7 N                      (4) 7.4 N                      (5) need to know R

19. The figure shows two blocks attached by a massless rope around a pulley. The pulley has radius  $R$  and rotates on a frictionless horizontal axis through its center. If  $m_2 = 2m_1$  and if when released from rest  $m_2$  moves downward with an acceleration of  $g/4$  (without the cord slipping on the pulley), what is the rotational moment of inertia of the pulley about its axis of rotation?



- (1)  $m_1 R^2$   
 (2)  $2m_1 R^2$   
 (3)  $3m_1 R^2$   
 (4)  $m_1 R^2 / 2$   
 (5)  $m_1 R^2 / 3$

20. Near the surface of the Earth, a bullet moving directly upward at  $1,000 \text{ m/s}$  strikes and passes through the center of mass of a block initially at rest as shown in the figure. The bullet then emerges from the block moving directly upward at  $500 \text{ m/s}$ . If the mass of the block is 250 times the mass of the bullet, to what maximum height does the block then rise above its initial position?



- (1) 20.4 cm                      (2) 10.2 cm                      (3) 30.6 cm                      (4) 5.1 cm                      (5) 9.8 cm