

Instructor(s): *Matcheva/Sabin*PHYSICS DEPARTMENT
Exam 2

March 16, 2010

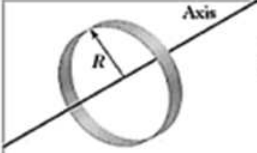
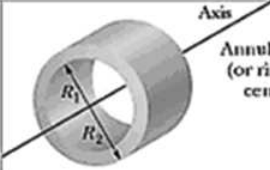
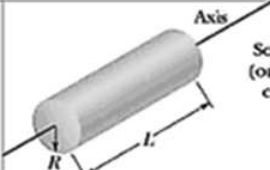
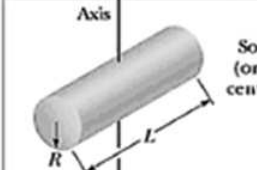
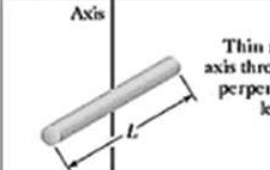
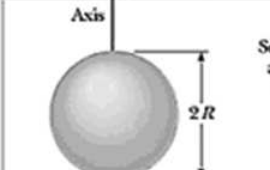
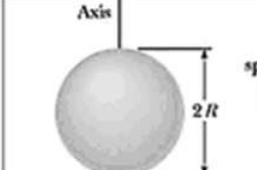
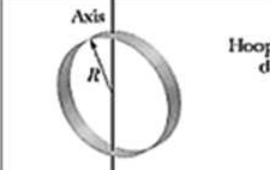
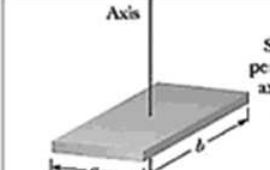
Name (print, last first): _____

Signature: _____

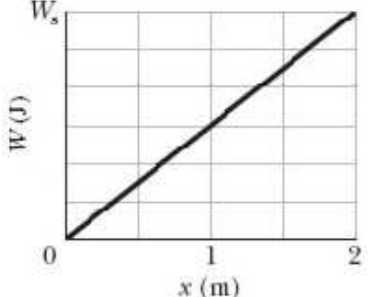
*On my honor, I have neither given nor received unauthorized aid on this examination.***YOUR TEST NUMBER IS THE 5-DIGIT NUMBER AT THE TOP OF EACH PAGE.**

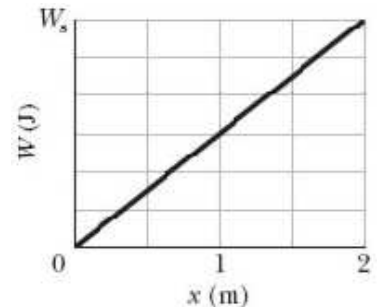
- (1) **Code your test number on your answer sheet (use lines 76–80 on the answer sheet for the 5-digit number).** Code your name on your answer sheet. **DARKEN CIRCLES COMPLETELY.** Code your UFID number on your answer sheet.
- (2) Print your name on this sheet and sign it also.
- (3) Do all scratch 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) The answers are rounded off. Choose the closest to exact. There is no penalty for guessing.
- (6) **Hand in the answer sheet separately.**

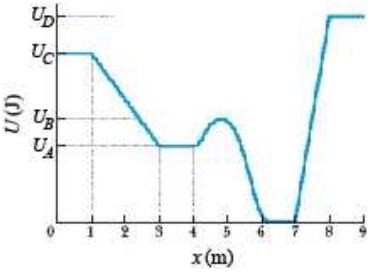
Where needed use $g = 9.80 \text{ m/s}^2$

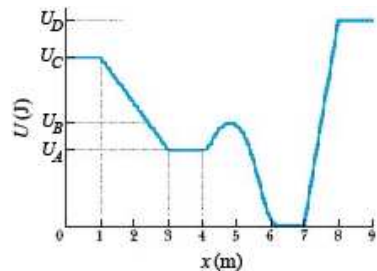
 <p>Hoop about central axis</p> <p>$I = MR^2$ (a)</p>	 <p>Annular cylinder (or ring) about central axis</p> <p>$I = \frac{1}{2} M (R_1^2 + R_2^2)$ (b)</p>	 <p>Solid cylinder (or disk) about central axis</p> <p>$I = \frac{1}{2} MR^2$ (c)</p>
 <p>Solid cylinder (or disk) about central diameter</p> <p>$I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

- If the momentum of an object is doubled, then its kinetic energy:
 - increases by a factor of 4
 - increases by a factor of 2
 - stays the same
 - decreases by a factor of 4
 - decreases by a factor of 2
- A 0.5 kg football is travelling at a speed of 15 m/s when it is caught and brought to rest in 0.02 s by a stationary receiver. What is the magnitude of the impulse delivered to the ball?
 - 7.5 J·s
 - 0.3 J·s
 - 0.15 J·s
 - 0.75 J·s
 - zero
- A particle starts from rest at time $t = 0$ and moves along the x axis. If the net force on it is proportional to \sqrt{t} , its kinetic energy is proportional to:
 - t^3
 - t
 - t^2
 - $\frac{1}{\sqrt{t}}$
 - none of these answers


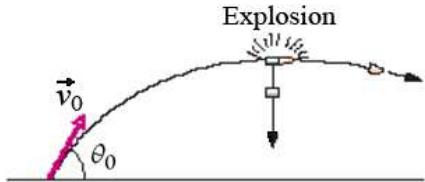
- A can of bolts and nuts is pushed 2 m along an x axis by a broom along the greasy (frictionless) floor of a car repair shop in a version of shuffleboard. The figure gives the work W done on the can by the constant horizontal force from the broom, versus the can's position x . The scale of the figure's vertical axis is set by $W_s = 10\text{J}$. What is the magnitude of that force?
 



- 5 N
 - 10 N
 - 20 N
 - 2 N
 - 15 N
- A Marine in the jungle finds herself in the middle of a swamp. She estimated the force she must exert in the horizontal direction to get out is $F_x = (1000 - 50x)$, where x is in meters and F is in Newtons. If she travels 20 m from her position along the x direction to get out of the swamp, how much work must she do (in kJ)?
 - 10
 - 0
 - 20
 - 1,000
 - 5
 - The figure shows a plot of potential energy U versus position x of a 0.5 kg particle that can travel only along an x -axis under the influence of a conservative force. The graph has these values: $U_A = 9\text{J}$, $U_C = 20\text{J}$ and $U_D = 24\text{J}$. The particle is released at the point where U forms a "potential hill" of "height" $U_B = 12\text{J}$, with kinetic energy 4 J. What is the speed of the particle at $x = 6.5\text{m}$?
 

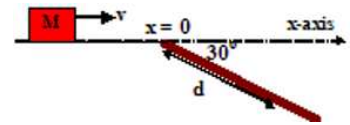


- 8 m/s
- 4 m/s
- 6 m/s
- 2 m/s
- 16 m/s

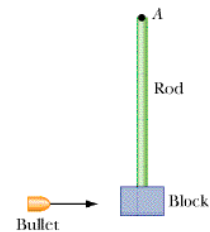
7. A 4 kg particle moves along the x-axis under the influence of a conservative force. The potential energy is given by $U(x) = ax^2 + b$, where $a = 6\text{J/m}^2$ and $b = 2\text{J}$. What is the x-component of the acceleration of the particle when it is at $x = 1\text{ m}$?
- (1) -3 m/s^2 (2) 3 m/s^2 (3) -1.5 m/s^2 (4) 1.5 m/s^2 (5) 2 m/s^2
8. A 16 kg block slides down a 30 degree frictionless incline where it is stopped by a strong Hook's Law spring at the bottom. The spring constant is $k = 9.8 \times 10^4\text{N/m}$. If the block slides 9 m from the point where it was released (from rest) to the point where it comes to rest against the spring, how far (in mm) has the spring been compressed?
- (1) 120 (2) 80 (3) 40 (4) 20 (5) 98
9. A 4 kg particle-like object moves in the xy plane with velocity components $v_x = 5\text{ m/s}$ and $v_y = 2\text{ m/s}$ as it passes through the point with (x, y) coordinates of (8 m, -4 m). At that moment, what is the magnitude of its angular momentum relative the point $P = (8\text{ m}, 4\text{ m})$?
- (1) 160 J·s (2) 144 J·s (3) 16 J·s (4) 80 J·s (5) 40 J·s
10. Near the surface of the Earth, a block of cheese with mass m lies on the floor of a elevator cab with mass $M = 1,000m$ (*i.e.*, the mass of the cab is 1,000 times the mass of the cheese) that is being pulled upward by a cable. If through the distance $d = 2\text{m}$, the normal force on the block from the floor has constant magnitude $F_N = 3\text{N}$, how much work is done on the cab by the force from the cable?
- 
- (1) 6,001 J (2) 3,001 J (3) $-6,001\text{ J}$ (4) $-3,001\text{ J}$ (5) 6 J
11. Near the surface of the Earth, a shell with mass M is shot with an initial velocity \vec{v}_0 , at an angle of θ_0 with the horizontal as shown in the figure. At the top of the trajectory, the shell explodes into two fragments with mass m_1 and m_2 ($M = m_1 + m_2$). One fragment (mass m_1), whose speed immediately after the explosion is zero, falls vertically and lands a horizontal distance d from the gun. Assuming that the terrain is level and that air drag is negligible, if the mass m_2 lands a horizontal distance of $5d$ from the gun, what is the mass m_1 ?
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- (1) $3M/4$ (2) $M/2$ (3) $2M/3$ (4) $M/4$ (5) $M/3$
12. An object is constrained by a cord to move in a circular path of radius R on a horizontal frictionless surface. The work done on the object by the force from the cord is zero because:
- (1) the force is perpendicular to the velocity
 (2) the displacement for each revolution is zero
 (3) the speed is constant
 (4) there is no friction
 (5) the acceleration points to the center of the circle
13. If an object has a rotational kinetic energy of 4 J and a moment of inertia of $0.5\text{ kg}\cdot\text{m}^2$ about its axis of rotation, then the magnitude of its angular momentum about its axis of rotation is:
- (1) 2 J·s (2) 1 J·s (3) 4 J·s (4) 8 J·s (5) $\sqrt{2}\text{ J}\cdot\text{s}$

14. An angular speed of 1 rad/s corresponds to about:
- (1) 9.55 rev/min (2) 60 rev/min (3) 30 rev/min (4) 19.1 rev/min (5) 0.159 rev/min
15. A cylinder with mass M and radius R rolls without sliding along the floor. If its translational kinetic energy is three times greater than its rotational kinetic energy about the rotation axis through its center of mass (*i.e.*, the central axis of the cylinder), what is its moment of inertia about the central axis?
- (1) $MR^2/3$ (2) $MR^2/2$ (3) $2MR^2/5$ (4) MR^2 (5) $2MR^2/3$
16. 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 negative x direction. The force must be:
- (1) in the negative z direction (2) in the positive z direction (3) in the positive x direction (4) in the negative x direction (5) in the positive y direction
17. A disk rotates about its central axis starting from rest at $t = 0$ and accelerates with constant angular acceleration. At one time it is rotating at 4 rev/s; 60 revolutions later, its angular speed is 16 rev/s. Starting at $t = 0$, what is the time required to complete 64 revolutions?
- (1) 8 s (2) 16 s (3) 4 s (4) 32 s (5) 24 s

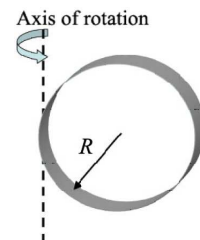
18. Near the surface of the Earth a block of mass M and initial velocity 4.9 m/s is sliding to the right along the x -axis as shown in the figure. The surface is frictionless for $x < 0$. At $x = 0$ the block encounters a 30° decline with a kinetic coefficient of friction $\mu_k = 0.7217$. How far along the 30° decline, d , will the block travel before coming to rest?



- (1) 9.8 m (2) 4.9 m (3) 19.6 m (4) 39.2 m (5) the block will not stop on the decline
19. An 10 g bullet is fired into a 1 kg block attached to the end of a 0.5 m non-uniform rod of mass 0.2 kg. The block-rod-bullet system then rotates in the plane of the figure, about a fixed axis at A as shown in the figure. The rotational inertia of the rod alone about A is $0.08 \text{ kg}\cdot\text{m}^2$. Treat the block as a particle. If the angular speed of the system about A just after impact is 2.0 rad/s, what is the bullet's speed just before impact?



- (1) 133 m/s (2) 256 m/s (3) 1,250 m/s (4) 826 m/s (5) 533 m/s
20. A uniform hoop with mass M and radius R is rotating around a fixed axis as shown in the figure. What is the rotational inertia of the hoop about the axis of rotation?



- (1) $\frac{3}{2}MR^2$ (2) $2MR^2$ (3) $\frac{1}{2}MR^2$ (4) MR^2 (5) $\frac{2}{3}MR^2$