Instructor(s): *Mueller/Rinzler*

PHYSICS DEPARTMENT

PHY 2048 Final Exam December 13, 2008

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

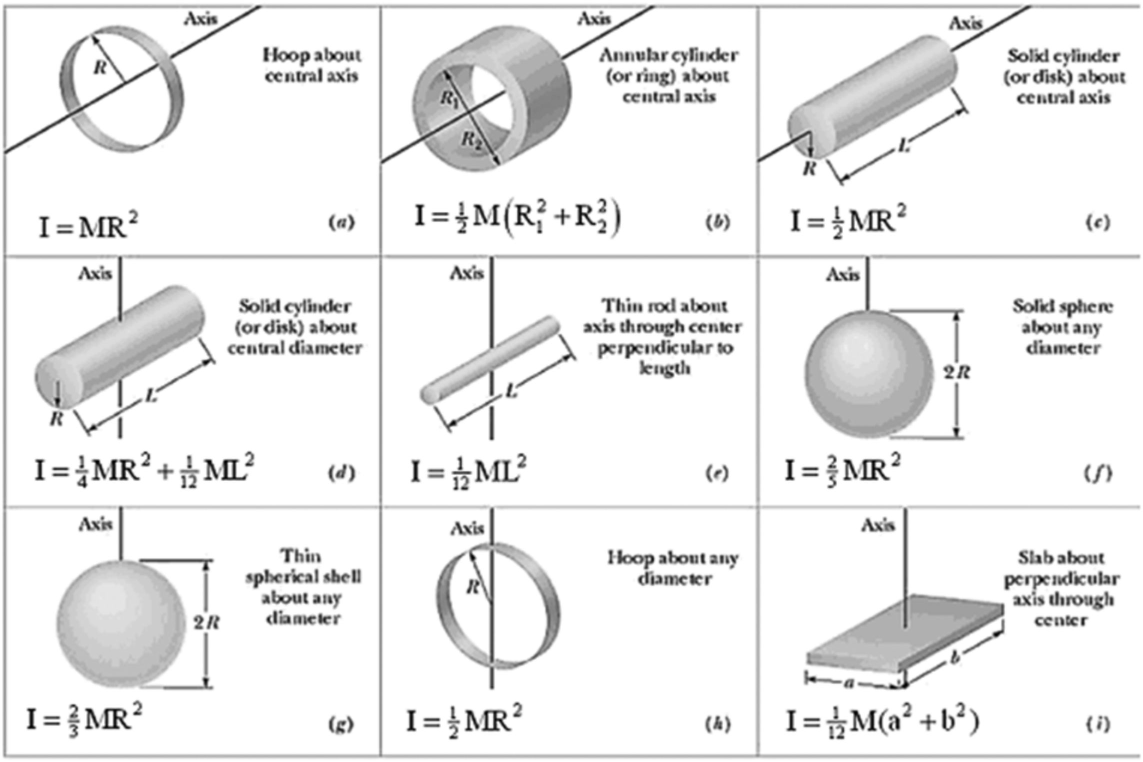
On my honor, I have neither given nor received unauthorized aid on this examination.

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 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.**

Useful information:

$g = 9.80$ m/s^2	$G = 6.67 \times 10^{-11}$Nm^2/kg^2	$M_{\rm Earth} = 5.98 \times 10^{24}$kg
$R_{\rm Earth} = 6.37 \times 10^6$m	$M_{\rm Sun} = 1.99 \times 10^{30}$kg	$d_{\rm Earth-Sun} = 1.5 \times 10^{11}$m



1. A race car traveling with constant acceleration increases its speed from 10 m/s to 50 m/s over a distance of 60 m. What is its acceleration?

(1) 20 m/s^2 (2) 8 m/s^2 (3) 12 m/s^2 (4) 16 m/s^2 (5) 40 m/s^2

2. If the y-component of a vector $\vec{A}$, in the xy plane, is half as large as the magnitude of the vector, the angle between the vector and the x-axis is:

(1) 30° (2) 60° (3) 45° (4) 90° (5) 20°

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

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

4. A force of 10 N holds an ideal spring with a 20 N/m spring constant in compression. The potential energy stored in the spring is:

(1) 2.5 J (2) 0.5 J (3) 5 J (4) 10 J (5) 200 J

5. One revolution per minute is about:

(1) 0.105 rad/s (2) 0.0524 rad/s (3) 0.95 rad/s (4) 1.57 rad/s (5) 6.28 rad/s

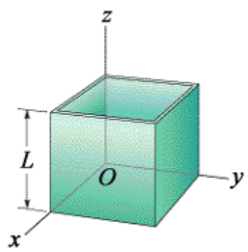
6. A solid wheel with mass M, radius R, and rotational inertia $MR^2/2$, rolls without sliding on a horizontal surface. A horizontal force F is applied to the axle and the center of mass has an acceleration a. The frictional force f that the floor exerts on the wheel is horizontal and opposite to the direction of F. What is the magnitude of the applied force F?

(1) $F = 3Ma/2$ (2) $F = Ma/2$ (3) $F = Ma$ (4) $F = 2Ma$ (5) $F = 3Ma$

7. A student in a physics lab is measuring the acceleration of an object that is sliding down an incline having an of angle 30 degrees with the horizontal. She finds that the object accelerates at one-third of what is calculated under the assumption of no friction. What is the value of the coefficient of kinetic friction?

(1) 0.385 (2) 0.192 (3) 0.289 (4) 0.577 (5) 0.866

8. The figure shows a cubical box with each side consisting of a uniform metal plate of negligible thickness. Each of the four sides have mass, M, and the bottom has mass m. The box is open at the top (*i.e.*, $z = L$) and has edge length L and a total mass of $4M + m$. If the z-coordinate of the center- of-mass of the box is $z_{cm} = L/4$, what is the mass, m, of the bottom side?

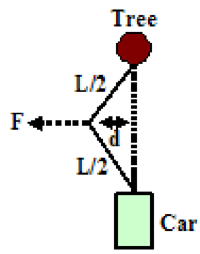


(1) $4M$ (2) M (3) $2M$ (4) $5M$ (5) $3M$

9. A motorist drives along a straight road at a constant speed of 60 m/s. Just as she passes a parked motorcycle police officer, the officer starts to accelerate at 3 m/s^2 to overtake her. If the officer maintains this constant value of acceleration, how long will it take the police officer to reach the motorist?

(1) 40 s (2) 120 s (3) 20s (4) 60 s (5) 180 s

10. One end of a rope with length $L = 30$ m is tied to a tree, the other end is tied to a car stuck in the mud. The motorist pulls sideways on the midpoint of the rope, displacing it a distance $d = 2$ m as shown in the figure. If the rope does not stretch and if the motorist exerts a force $F = 40$ N under these conditions, what is the magnitude of the force exerted on the car by the rope? (Assume that the rope is in static equilibrium.)



(1) 150 N (2) 40 N (3) 80 N (4) 300 N (5) 75 N

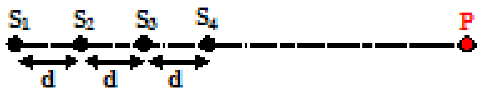
11. A 5.0 g bullet moving at 600 m/s strikes a 400 g wooden block at rest on a frictionless surface. The bullet emerges, traveling in the same direction with its speed reduced to 200 m/s. What is the resulting speed, V, of the block?

(1) 5.0 m/s (2) 7.5 m/s (3) 2.5 m/s (4) 10 m/s (5) 400 m/s

12. The sound intensity 5.0 m from an isotropically radiating point source is 0.50 W/m^2. The power output of the source is:

(1) 157 W (2) 39 W (3) 266 W (4) 320 W (5) 628 W

13. The figure shows four isotropic point sources of sound that are uniformly spaced on the x-axis. The sources emit sound at the same wavelength λ and the same amplitude s_m, and they emit in phase. A point P is shown on the x-axis. Assume that as the sound waves travel to the point P, the decrease in their amplitude is negligible. What is the amplitude of the net wave at P if $d = \lambda/4$?



(1) zero (2) s_m (3) $2s_m$ (4) $3s_m$ (5) $4s_m$

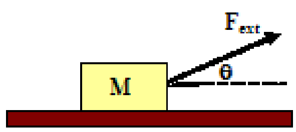
14. A stationary motion detector sends sound waves of frequency of 400 Hz toward an approaching truck. If the frequency of the waves reflected back to the detector is 500 Hz, what is the speed of the truck? (Take the speed of sound to be 343 m/s.)

(1) 38.1 m/s (2) 19.1 m/s (3) 68.6 m/s (4) 85.8 m/s (5) 3.4 m/s

15. A particle's position is given by $x(t) = 27 - 18t + 3t^2$, in which x is in meters and t is in seconds. Where is the particle when it momentarily stops (*i.e.*, when the speed is zero)?

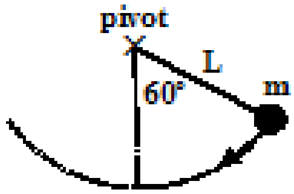
(1) $x = 0$ (2) $x = -11$ m (3) $x = 11$ m (4) $x = 16$ m (5) $x = -3$ m

16. A block of mass M slides along the floor while an external force F_{ext} is applied at an upward angle θ. If the coefficient of kinetic friction between the block and the floor is 0.364, what angle θ gives the maximum value of the blocks acceleration (while still keeping the block on the table)?



(1) 20° (2) 45° (3) 30° (4) 10° (5) 0°

17. A pendulum consists of a rod of length L with negligible mass connected to a ball of mass m as shown in the figure. If the pendulum is released from rest at an angle of 60° with the vertical, what is the tension force of the rod on the ball when the ball is at the lowest point of its swing?

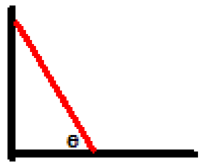


(1) 2mg (2) mg (3) 3mg (4) mg/2 (5) 4mg

18. Assume the Earth has a uniform mass density. An object at the surface of Earth (at a distance R from the center of Earth) weighs 80 N. It the object is in a cave a distance of $3R/4$ from the center of Earth its weight is:

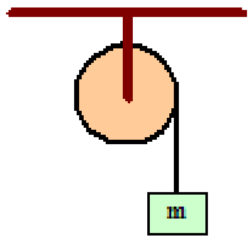
(1) 60 N (2) 40 N (3) 107 N (4) 80 N (5) 20 N

19. A window washer attempts to lean a uniform ladder against a frictionless vertical wall. He finds that the ladder slips on the ground when it is placed at an angle, θ, less than 45° to the ground but remains in place when the angle is greater than 45°. The coefficient of static friction between the ladder and the ground is:



(1) 0.5 (2) 0.13 (3) 0.27 (4) 0.33 (5) 0.75

20. A block of mass m is attached to a cord that is wrapped around the rim of a flywheel of radius R and hangs vertically, as shown. The rotational inertia of the flywheel is $I = MR^2/2$. If $m = M$, when the block is released and the cord unwinds, the acceleration of the block is:



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