 77777

Instructor(s): *Rinzler/Qiu*

PHYSICS DEPARTMENT

PHY2053 Exam 2 March 30, 2011

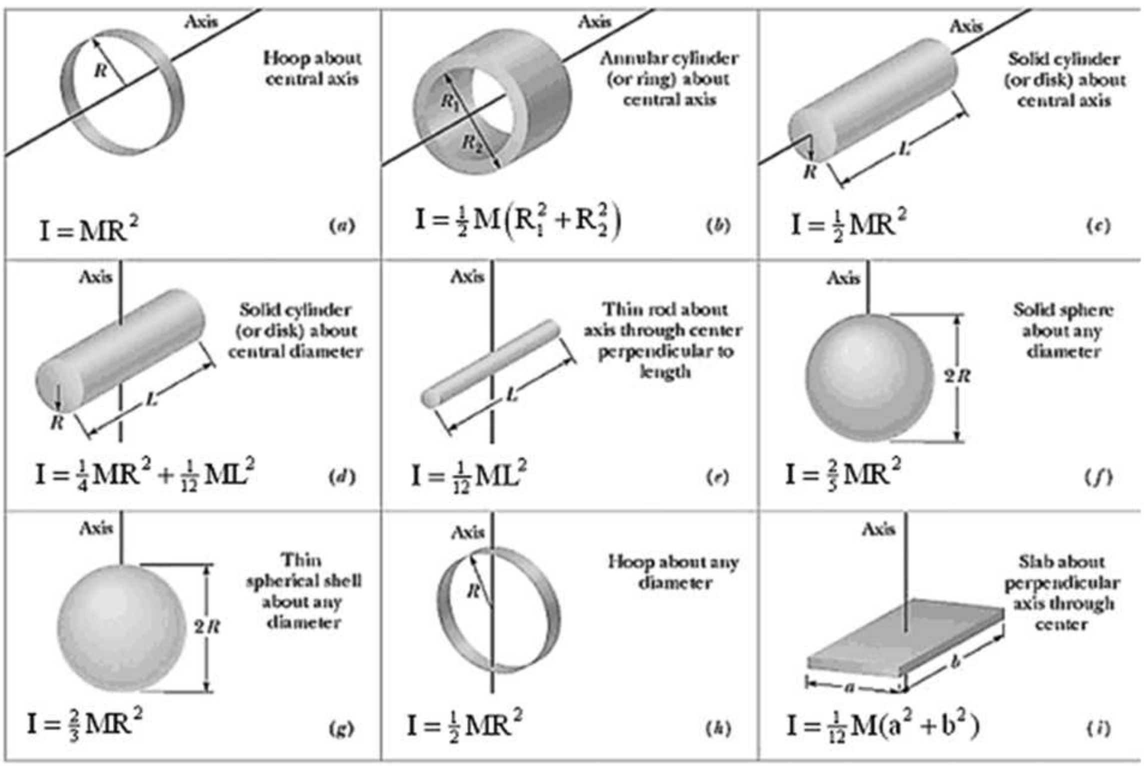
Name (print, last first): ______________________ Signature: ______________________

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. If you believe that no listed answer is correct, leave the form blank.**
(6) Hand in the answer sheet separately.

Use $g = 9.80$ m/s^2



1. If a wheel is turning at 6.28 rad/s, the time it takes to complete one revolution is:

(1) 1 s (2) 2 s (3) 0.5 s (4) 0.2 s (5) 3 s

2. 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 81 revolutions?

(1) 9 s (2) 16 s (3) 4 s (4) 8 s (5) 18 s

3. A race car accelerates uniformly from a speed of 40 m/s to a speed of 58 m/s in 6 seconds while traveling around a circular track of radius 625 m. When the car reaches a speed of 50 m/s, what is the magnitude of its total acceleration (in m/s^2)? (Remember: $\vec{a}_{tot} = \vec{a}_t + \vec{a}_c$, where $\vec{a}_t$ and $\vec{a}_c$ are tangential and centripetal accelerations, respectively.)

(1) 5 (2) 3 (3) 4 (4) 7 (5) 6

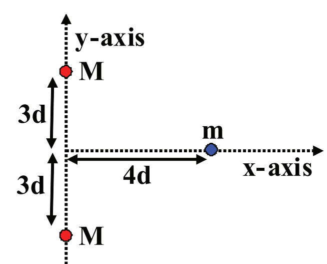
4. Near the surface of the Earth, a car is traveling at a constant speed v around a flat circular race track with a radius of 50 m. If the coefficients of kinetic and static friction between the car's tires and the road are $\mu_k = 0.1$, $\mu_s = 0.4$, respectively, what is the maximum speed the car can travel without slipping?

(1) 14 m/s (2) 28 m/s (3) 196 m/s (4) 22 m/s (5) 7 m/s

5. A 0.70-kg object is swung in a circular path and in a vertical plane on a string with length $L = 0.5$ m. If the angular speed at the bottom is 6.50 rad/s, what is the tension in the string (in N) when the object is at the bottom of the circle?

(1) 21.6 (2) 13.5 (3) 16.7 (4) 6.70 (5) 24.3

6. Two point masses each with mass M are located on the y-axis at $y = \pm 3d$ as shown in the figure. A third point mass with mass $m = 5M$ is on the x-axis a distance $x = 4d$ from the origin. What is the magnitude of the *net* gravitational force on the mass m due to the other two masses M?



(1) $0.32GM^2/d^2$ (2) $0.20GM^2/d^2$ (3) $0.40GM^2/d^2$ (4) $0.50GM^2/d^2$ (5) $5.0GM^2/d^2$

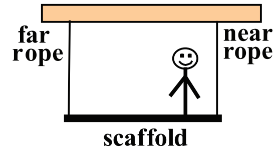
7. The center of gravity of an object coincides with the center of mass:

(1) if the acceleration due to gravity is uniform over the body
(2) always
(3) never
(4) if the center of mass is at the geometrical center of the body
(5) if the body has a uniform distribution of mass

8. If v_{esc} is the escape speed from the Earth, what is the escape speed from a planet with twice the mass of Earth and one-half the radius of the Earth?

(1) $2v_{esc}$ (2) $4v_{esc}$ (3) v_{esc} (4) $v_{esc}/2$ (5) $v_{esc}/4$

9. A billboard worker with a weight of 700 N stands on a uniform scaffold with length $L = 5$ m. The scaffold is supported by vertical ropes at each end as shown in the figure. If the scaffold weighs 500 N and the worker stands 1.0 m from one end, what is the tension (in N) in the rope nearest the worker?



(1) 810 (2) 730 (3) 1150 (4) 920 (5) 870

10. The newton·second is a unit of:

(1) linear momentum (2) work (3) angular momentum (4) power (5) none of these

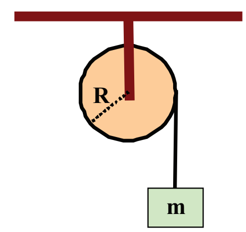
11. The second hand of a clock is a long thin rod of length 20 cm having a mass of 10 g. What is the magnitude of its angular momentum (in kg·m^2/s)?

(1) 1.4×10^{-5} (2) 2.4×10^{-5} (3) 3.4×10^{-5} (4) 4.4×10^{-5} (5) 5.4×10^{-5}

12. A uniform plank with length L weighs 80 N. It is balanced on a sawhorse at its center. An additional 160 N weight is now placed on the left end of the plank. To keep the plank balanced, the sawhorse must be moved what distance to the left?

(1) $L/3$ (2) $L/2$ (3) $L/6$ (4) $L/4$ (5) $2L/3$

13. A block of mass m is attached to a cord that is wrapped around the rim of a non-uniform flywheel of radius R and hangs vertically, as shown. The moment of inertia of the flywheel is $I = MR^2/3$. If, when the block is released and the cord unwinds, the acceleration of the block is equal to $g/2$, what is the mass m of the block?



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

14. A mouse of mass m lies on the rim of a non-uniform disk of mass M and radius R that can rotate freely about its center like a merry-go-round. Initially the mouse and disk rotate together with an angular velocity of ω. If the mouse walks to a new position that is at the center of the disk, the new angular velocity of the mouse-disk system is 2ω. If the moment of inertia of the solid disk is $MR^2/3$, what is the mass of the mouse?

(1) $M/3$ (2) $M/2$ (3) $M/6$ (4) M (5) $M/4$

15. A cylinder with mass M and radius R rolls without sliding along the floor. If its translational kinetic energy is four times greater than it 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) $MR^2/4$ (2) $MR^2/2$ (3) $2MR^2/5$ (4) $MR^2/3$ (5) $2MR^2/3$

16. A tin can has a volume of 1,000 cm^3 and a mass of 100 g. Of the following possibilities, what maximum mass of lead beads can be put into it without the can sinking to the bottom of a water tank (assume the water density = 1,000 kg/m^3)?

(1) 900 g (2) 99.0 g (3) 1000 g (4) 1100 g (5) 980 g

17. An airtight box, having a lid of area 80 cm^2, is partially evacuated. The atmospheric pressure is 1.01×10^5 Pa. If a force of 600 N is required to pull the lid off of the box, what is the pressure in the box (in Pa)?

(1) 2.60×10^4 (2) 6.35×10^4 (3) 7.50×10^4 (4) 1.38×10^4 (5) 1.76×10^4

18. The atmospheric pressure at sea level is 1.01×10^5 Pa. What is the total pressure in Pa (water + atmosphere) 3 meters below the surface of the sea (assume the water density = 1,000 kg/m^3)?

(1) 1.30×10^5 (2) 1.70×10^5 (3) 2.10×10^5 (4) 2.40×10^5 (5) 2.70×10^5

19. A 1,000 kg wrecking ball is to be lifted by a crane with a steel cable having a diameter of 2 cm and an unstretched length of 16 m. The Young's modulus of steel is 20×10^{10} Pa. Ignoring the weight of the cable itself, when the ball is lifted and held at rest, the cable stretches by:

(1) 2.50×10^{-3}m (2) 2.55×10^{-4}m (3) 3.06×10^{-4}m (4) 4.75×10^{-4}m (5) 6.58×10^{-3}m

20. Suppose that you release a small ball from rest at the surface in a pool of water (with density ρ_{water}) near the surface of the Earth. The density of the ball is three times the density of water (*i.e.*, $\rho_{\text{ball}} = 3\rho_{\text{water}}$). Assuming that we could ignore hydrodynamic drag forces, if it took the ball 3 seconds to reach the bottom, how deep would the pool of water be (in m)?

(1) 29.4 (2) 19.6 (3) 9.8 (4) 42.5 (5) 53.2