 77777

Instructor(s): *Mueller/Rinzler*

PHYSICS DEPARTMENT

PHY 2048 — Exam 3 — December 9, 2008

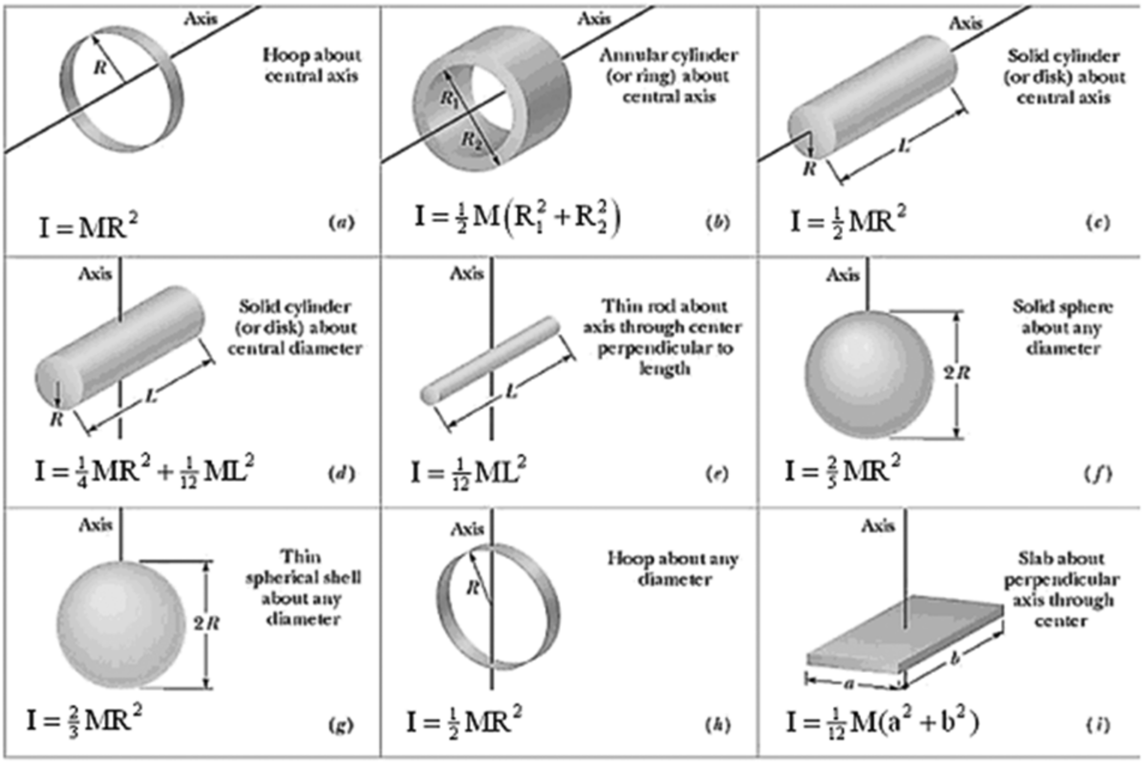
Name (print, last first): ____________________ Signature: ____________________

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



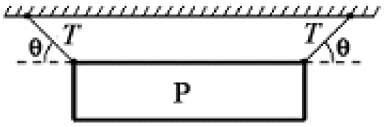
1. Three identical, uniform rods have forces acting in directions and at locations indicated in the figure. The forces all have the same magnitude. Which of the rods could be in static equilibrium if an additional force of the same magnitude were applied at the center of mass of the uniform rod?

(1) Only 3 (2) Only 1 (3) Only 2 (4) Only 1 and 2 (5) All three

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

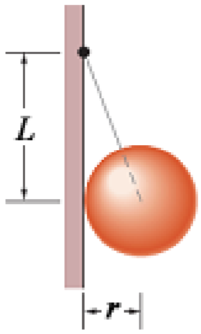
(1) if the acceleration due to gravity is uniform over the body
(2) always
(3) never
(4) if the center of mass is at the geometrical center of the body
(5) if the body has a uniform distribution of mass

3. A picture P of weight W is hung by two strings as shown. The magnitude of the tension force of each string is T and the angle of each string with the horizontal is θ. The total upward pull of the strings on the picture is:



(1) $2T\sin\theta$ (2) $2W\cos\theta$? (3) $T\sin\theta$ (4) $T\cos\theta$ (5) $2T\cos\theta$

4. A uniform sphere of mass $m = 2.0$ kg and radius $r = 0.50$ m is held in place by a massless rope attached to a frictionless vertical wall a distance $L = 3.0$ m above the center of the sphere. What is the force on the sphere from the wall?

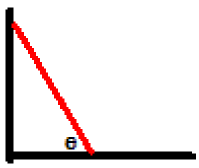


(1) 3.3 N (2) 6.5 N (3) 19.4 N (4) 9.8 N (5) 1.2 N

5. A certain elastic wire stretches 0.90 cm when outward forces with magnitude F are applied to each end. The same forces are applied to an elastic wire of the same material but with three times the diameter and twice the length. The second wire stretches:

(1) 0.20 cm (2) 0.30 cm (3) 0.10 cm (4) 0.90 cm (5) 0.60 cm

6. 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 75° to the ground but remains in place when the angle is greater than 75°The coefficient of static friction between the ladder and the ground is:



(1) 0.13 (2) 0.27 (3) 1.0 (4) 0.33 (5) 0.75

7. The mass of a hypothetical planet is 1/100 that of Earth and its radius is 1/4 that of Earth. If a person weighs 600 N on Earth, what would he weigh on this planet?

(1) 96 N (2) 24 N (3) 48 N (4) 192 N (5) 600 N

8. 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. If the object is in a cave a distance of R/2 from the center of Earth its weight is:

(1) 40 N (2) 10 N (3) 80 N (4) 320 N (5) 20 N

9. Two point masses are located on the x-axis. Mass m_1 is at the origin (*i.e.* $x = 0$) and mass m_2 is at $x = d$. If $m_1 = 4m_2$, at what point on the x-axis is the *net* gravitational force from the two masses equal to zero?

(1) $x = 2d/3$ (2) $x = 2d$ (3) $x = 3d/4$ (4) $x = 4d/5$ (5) $x = d/2$

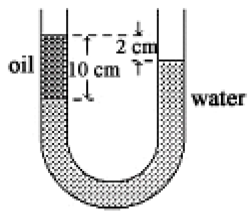
10. A projectile is fired straight upward from Earth's surface with a speed that is half the escape speed. If R is the radius of Earth, the highest altitude reached, measured from the surface, is:

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

11. To measure the mass of a planet with the same radius as Earth, an astronaut drops an object from rest (relative to the planet) from an altitude of one radius above the surface. When the object hits the surface of the planet (neglecting air resistance), its speed is 4 times what it would be if the same experiment were carried out for Earth. If M_E is the mass of the Earth, the mass of the planet is:

(1) $16M_E$ (2) $2M_E$ (3) $4M_E$ (4) $8M_E$ (5) $32M_E$

12. The density of water is 1.0 g/cm^3 and oil does not mix with water. The density of the oil in the left column of the U-tube shown in the figure is:



(1) 0.80 g/cm^3 (2) 0.20 g/cm^3 (3) 1.0 g/cm^3 (4) 1.3 g/cm^3 (5) 5.0 g/cm^3

13. An object hangs from a spring balance. The balance indicates 30 N in air and 20 N when the object is submerged in water. What does the balance indicate when the object is submerged in a liquid with a density that is half that of water?

(1) 25 N (2) 20 N (3) 30 N (4) 35 N (5) 40 N

14. Water flows through a horizontal cylindrical pipe of varying cross section. The velocity is 3.0 m/s at a point where the pipe diameter is 1.0 cm. At a point where the pipe diameter is 3.0 cm, the velocity is:

(1) 0.33 m/s (2) 9 m/s (3) 3m/s (4) 1.0 m/s (5) 0.11 m/s

15. A large water tank, open at the top, has a small hole in the bottom. Assume that the area of the hole is much much smaller than the area of the top of the tank. When the water level is 40 m above the bottom of the tank, what is the speed of the water leaking from the hole?

(1) 28.0 m/s (2) 19.8 m/s (3) 39.6 m/s (4) 12.7 m/s (5) 784 m/s

16. In simple harmonic motion, the magnitude of the acceleration is greatest when:

(1) the displacement is maximum
(2) the displacement is zero
(3) the speed is maximum
(4) the force is zero
(5) the speed is between zero and its maximum

17. The displacement of an object oscillating on a spring is given by $x(t) = x_m \cos(\omega t + \phi)$. If the initial displacement is zero and the initial velocity is in the negative x direction, then the phase constant ϕ is:

(1) $\pi/2$ rad (2) 0 rad (3) π rad (4) $3\pi/2$ rad (5) 2π rad

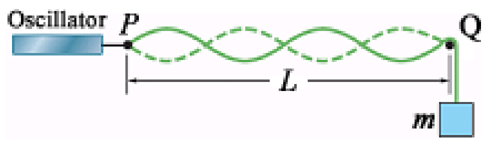
18. A particle is in simple harmonic motion with period T and with position as a function of time given by $x(t) = A\cos(\omega t + \phi)$. At time $t = 0$ the particle is at $x = A/2$ with positive velocity. The next time it is at the same position is:

(1) $t = T/3$ (2) $t = T$ (3) $t = T/2$ (4) $t = T/4$ (5) $t = T/8$

19. The function $y(x,t) = (15.0cm)\cos(\pi x 15\pi t)$, with x in meters and t in seconds, describes a wave on a taut string with the x-axis parallel to the string. The transverse velocity of the string is $u(x,t) = dy/dt$. What is the maximum transverse speed a particle in the string?

(1) 7.1 m/s (2) 0.5 m/s (3) 2.2 m/s (4) 0.15 m/s (5) 15.0 m/s

20. A string, which is tied to a sinusoidal oscillator at P and which runs over a support Q, is stretched by a block of mass m. The distance $L = 2.0$ m, the linear density of the string $\mu = 4.9$ g/m, and the oscillator frequency $f = 100$ Hz. The motion at P is in the vertical direction, and its amplitude is small enough for that point to be considered a node. A node also exists at Q. What mass allows the oscillator to set up the fourth harmonic on the string?



(1) 5 kg (2) 20 kg (3) 10 kg (4) 40 kg (5) 80 kg