Instructor(s): *Mueller/Qiu*

PHYSICS DEPARTMENT

PHY 2053 Final Exam December 11, 2010

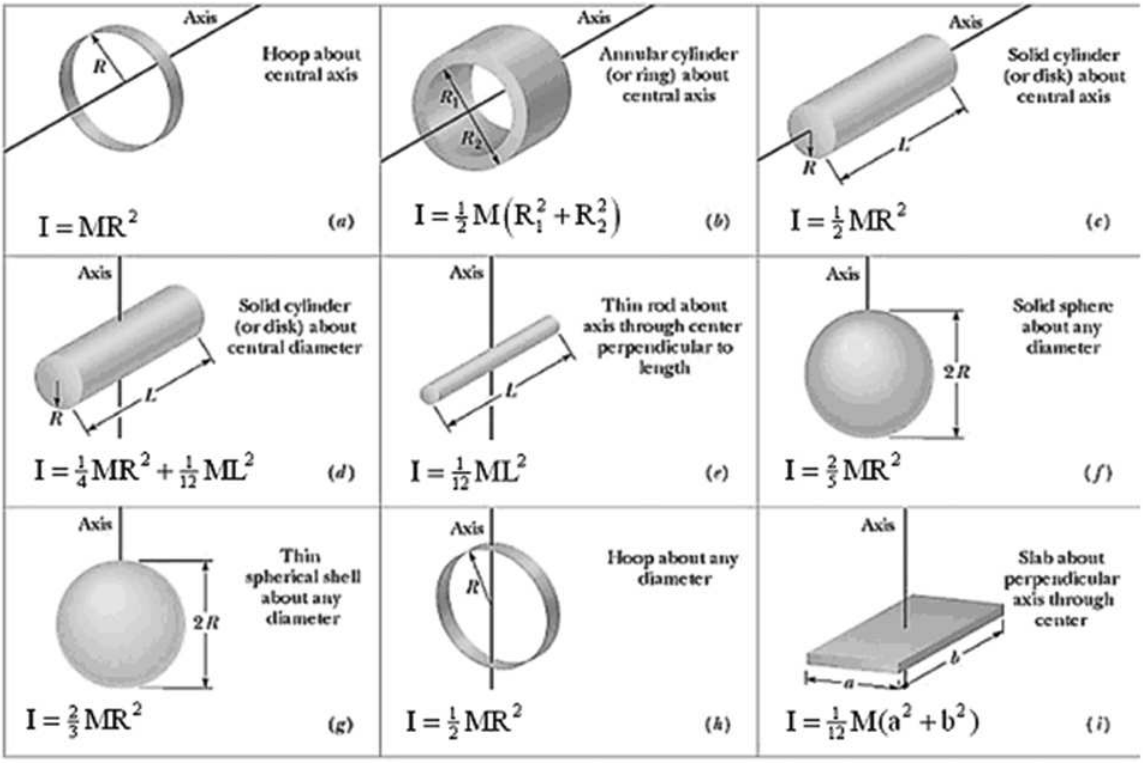
Name (print, last first): _____ Signature: _____

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

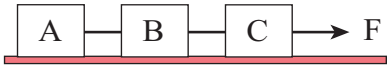
YOUR TEST NUMBER IS THE 5-DIGIT NUMBER AT THE TOP OF EACH PAGE.

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

Use $g = 9.80\ \text{m/s}^2$

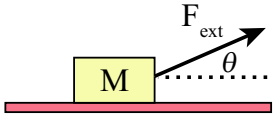


1. Three blocks (A,B,C), each having mass M, are connected by strings on a horizontal frictionless surface as shown in the figure. Block C is pulled to the right by a horizontal force of magnitude F that causes the entire system to accelerate. What is the magnitude of the net horizontal force acting on block B due to the strings?



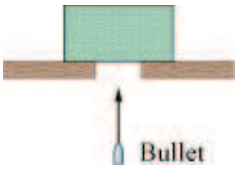
(1) F/3 (2) F/2 (3) 2F/3 (4) zero (5) F

2. Near the surface of the Earth, a block of mass M = 2 kg slides along the floor while an external force F_{ext} = 12 N is applied at an upward angle $\theta = 26°$? If the coefficient of kinetic friction between the block and the floor is 0.488, what is the magnitude of the acceleration of the block?



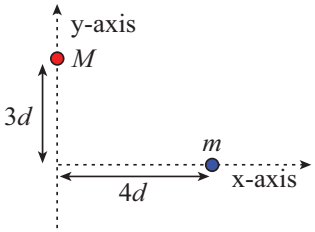
(1) 1.89 m/s^2 (2) 4.78 m/s^2 (3) 11.46 m/s^2 (4) 3.78 m/s^2 (5) 0.95 m/s^2

3. Near the surface of the Earth, a bullet with mass M moving directly upward at 1,000 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 m/s. If the block rises to a maximum height of 20.4 cm, what is the mass of the block?



(1) 250M (2) 200M (3) 150M (4) 100M (5) 10M

4. One point mass M is located on the y-axis a distance $3d$ from the origin (at $y = 3d$) as shown in the figure. A second 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 mass M?



(1) $0.2GM^2/d^2$ (2) GM^2/d^2 (3) $4GM^2/d^2$ (4) $0.5GM^2/d^2$ (5) $2GM^2/d^2$

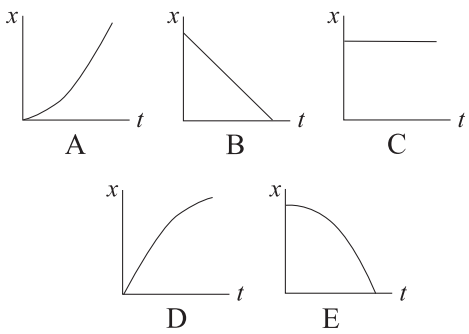
5. Suppose that you release a small ball from rest at the surface in a pool of water (with density ρ_{water}) near the surface of the Earth. The density of the ball is four times the density of water (*i.e.*, $\rho_{ball} = 4\rho_{water}$). If it takes the ball 2 seconds to reach the bottom, how deep is the pool of water (in m)?

(1) 14.7 (2) 19.6 (3) 9.8 (4) 42.5 (5) 39.2

6. A mouse of mass M/4 lies on the rim of a uniform disk of mass M 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, what is the new angular velocity of the mouse-disk system?

(1) $3\omega/2$ (2) ω (3) $\omega/2$ (4) 2ω (5) $4\omega/3$

7. Which of the above five graphs of position, x, versus time, t, represents the motion of an object moving with a constant nonzero speed?



(1) B
(2) A
(3) C
(4) D
(5) E

8. A motorist is driving along a straight road at a constant speed of 60 m/s. At time $t = 0$ she passes a parked motorcycle police officer and begins to accelerate at a constant acceleration $a_{\text{car}} = a$. The officer takes off after her at $t = 0$ and accelerates at a constant acceleration of $a_{\text{cop}} = 2a$. What is the speed of the police officer when he reaches the motorist?

(1) 240 m/s (2) 180 m/s (3) 160 m/s (4) 120 m/s (5) need to know a

9. Near the surface of the Earth a startled armadillo leaps vertically upward at time $t = 0$; at time $t = 0.5$ s it is a height of 0.98 m above the ground. At what time does it land back on the ground?

(1) 0.9 s (2) 1.2 s (3) 0.7 s (4) 1.5 s (5) 1.0 s

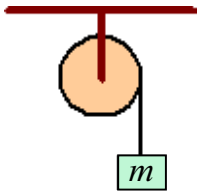
10. Near the surface of the Earth, a car is traveling at a constant speed v around a flat circular race track with a radius of 50 m. If the coefficients of kinetic and static friction between the car's tires and the road are $\mu_k = 0.1$ and $\mu_s = 0.4$, respectively, what is the maximum speed the 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??

11. Near the surface of the Earth a stone of mass $M = 2$ kg sits at rest on an elastic spring (*i.e.,* Hooke's Law spring) which is compressed a distance $d = 2$ cm by the stone. What is the spring constant k (in N/m)?

(1) 980 (2) 490 (3) 1,960 (4) 2,940 (5) 98

12. 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, 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) $M/2$ (2) M (3) $2M$ (4) $M/3$ (5) $M/4$

13. A block of wood has a mass of 4 kg and density of 600 kg/m^3. It is loaded on top with lead (density = 11400 kg/m^3) so that the block of wood will float in water with 90% of its volume submerged. What is the mass of the lead if the water density is 1000 kg/m^3?

(1) 2 kg (2) 4 kg (3) 1 kg (4) 0.5 kg (5) 6 kg

14. A simple harmonic oscillator consists of a block of mass 2 kg attached to a spring of spring constant 200 N/m. If the speed of the block is 40 m/s when the displacement from equilibrium is 3 m, what is the amplitude of the oscillations?

(1) 5 m (2) 4 m (3) 3 m (4) 6 m (5) 10 m

15. In simple harmonic motion, the kinetic energy is greatest when:
A. the potential energy is zero **B.** the displacement is zero
C. the speed is maximum **D.** the force is zero

(1) all of these answers (2) only A and C (3) only A, B, and C (4) only C (5) only A, B, and D

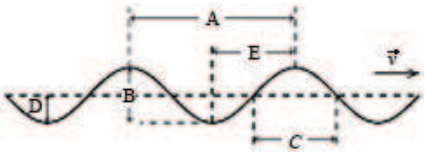
16. A force of 10 N holds an ideal spring with a 20 N/m spring constant in compression. The potential energy stored in the spring is:

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

17. A simple pendulum has a length L. If its period is T when it is on the surface of the Earth (gravitational acceleration g), what is its period when it is on the surface of a planet with gravitational acceleration equal to $g/4$?

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

18. A sinusoidal wave is traveling toward the right as shown in the figure. Which letter correctly labels the wavelength of the wave?



(1) A (2) E (3) C (4) B (5) D

19. The sound intensity 5.0 m from an isotropically radiating point source is 0.50 W/m^2. What is the sound intensity 2.5 m from the same point source?

(1) 2 W/m^2 (2) 1 W/m^2 (3) 4 W/m^2 (4) 3 W/m^2 (5) 8 W/m^2

20. A low flying aircraft skims the ground at a speed of 200 m/s as it approaches a stationary observer. A loud horn whose wavelength at rest is 86 cm is carried on the plane. What frequency does the ground observer hear if the speed of sound is 340 m/s?

(1) 960 Hz (2) 635 Hz (3) 680 Hz (4) 252 Hz (5) 971 Hz