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PHYSICS DEPARTMENT
PHY 2053   Exam 2   March 25, 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 <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.**

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Constants

$g = 9.80$ m/s^2 $G = 6.67 \times 10^{-11}$ N·m^2/kg^2

Moments of inertia about center of mass: $I_{\text{disc}} = \frac{1}{2}MR^2$, $I_{\text{hoop}} = MR^2$

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1. A car with mass 1200 kg was traveling at 5.0 m/s immediately before it hit a large tree. Given that the car came to
complete stop in 0.10 s, what was the average force on the car during the collision?

   (1) 60,000 N   (2) 5,000 N   (3) 15,000 N   (4) 700 N   (5) 145,000 N

2. Mass A (11 kg) travels towards the right at a velocity of 2.0 m/s. Mass B (2.0 kg) travels towards the left at a velocity
of 3.0 m/s. After they collide head-on, mass B travels to the right with velocity of 5 m/s. Find the speed of mass A
after the collision.

   (1) 0.55 m/s   (2) 6 m/s   (3) 2.4 m/s   (4) 1.6 m/s   (5) 3.4 m/s

3. A car with mass 900 kg collided with a motorcycle with mass 300 kg at an intersection. Right before the collision, the
car traveled at 4.0 m/s towards the east and the motorcycle traveled at 7.0 m/s towards the south. If the car and the
motorcycle were stuck together after the collision, what was their speed after the collision?

   (1) 3.5 m/s   (2) 8.1 m/s   (3) 3.0 m/s   (4) 4.6 m/s   (5) 1.7 m/s

4. A pitcher throws a baseball of mass 0.15 kg. The ball arrives at home plate with a speed of 35 m/s and is batted straight
back to the pitcher with a speed of 45 m/s. The bat is in contact with the ball for 0.20 s. Find the magnitude of the
impulse experienced by the ball.

   (1) 12 kg m/s   (2) 1.5 kg m/s   (3) 67. 5 kg m/s   (4) 23 kg m/s   (5) 60 kg m/s

5. A 310 g wooden block was initially at rest on a rough horizontal table. A bullet with mass 15 g was fired horizontally
into the block. After impact, the bullet remained stuck in the block and the block slid 5 m before coming to rest. Given
that the coefficient of kinetic friction between the block and the table was 0.45, find the speed of the bullet immediately
before impact.

   (1) 140 m/s   (2) 210 m/s   (3) 6.6 m/s   (4) 2100 m/s   (5) 512 m/s

6. A 2.0-kg mass initially sitting at rest is struck by a 3.0-kg mass in an elastic head-on collision. Immediately before the
collision, the 3.0-kg mass traveled at a velocity of 4.0 m/s. Find its speed after the collision.

   (1) 0.8 m/s   (2) 4.8 m/s   (3) 3.8 m/s   (4) 2.5 m/s   (5) 7.1 m/s

7. Two identical boats, each with mass of 110 kg, rest on a pool. A person with mass 60 kg sat in boat 1 while boat 2 was empty. After the person jumped from boat 1 to boat 2 and sat down, boat 1 traveled at a speed of 0.30 m/s. Find the speed of boat 2 after the person jumped, neglecting the resistance due to water.

(1) 0.19 m/s   (2) 0.30 m/s   (3) 0.55 m/s   (4) 0.15 m/s   (5) 0.65 m/s

8. A force F acts on a particle with mass 5 kg. F varies with time as shown in the figure. Find the final velocity of the particle if it is initially at rest.

(1) 0.9 m/s
(2) 4.5 m/s
(3) 9.0 m/s
(4) 1.8 m/s
(5) 7.2 m/s
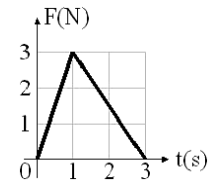
9. An object traveling at uniform velocity along a straight path collides with a stationary object of the same mass. After the collision, the two objects stick together. Which of the following statements is true?

(1) the total kinetic energy is not conserved but the total momentum is conserved.
(2) neither the total kinetic energy nor the total momentum is conserved.
(3) both the total kinetic energy and the total momentum are conserved.
(4) the relative velocity of the two object remain the same.
(5) the total kinetic energy is conserved but the total momentum is not conserved.

10. A 10 kg block is attached to a massless cord that is wrapped around the perimeter of a 0.1 m diameter pulley. The pulley is a 10 kg uniform disc rotating about a horizontal frictionless axle through its center as shown. As the block falls, what is its acceleration?

(1) 6.7 m/s^2
(2) 10 m/s^2
(3) 3.3 m/s^2
(4) 5.0 m/s^2
(5) 13.4 m/s^2
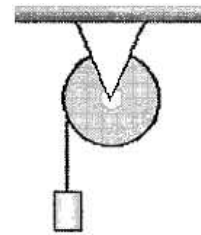
11. A 960-N block is suspended as shown. The beam AB is weightless and is hinged to the wall at A. The tension force of the cable BC has magnitude:

(1) 1600 N
(2) 720 N
(3) 1200 N
(4) 1280 N
(5) none of these
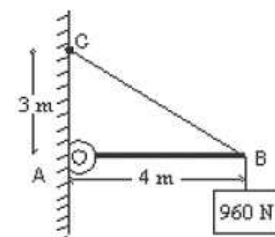
12. An object is dropped from an altitude of one Earth radius above the Earth's surface. If M is the mass of the Earth, and R is its radius, the speed of the object just before it hits Earth is given by:

(1) $\sqrt{GM/R}$ (2) $\sqrt{GM/2R}$ (3) $\sqrt{2GM/R}$ (4) $\sqrt{GM/R^2}$ (5) $\sqrt{GM/2R^2}$

13. Two bicycle wheels are mounted with their axles fixed, as shown in the diagram. Starting with the wheels at rest, forces are applied. Assume that the hubs and spokes are massless. In order to impart equal angular accelerations to the wheels, F_2 must be:
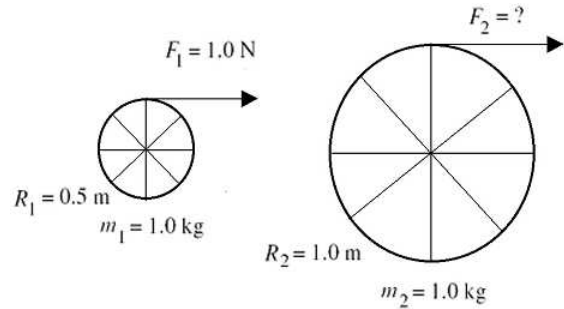
(1) 2 N
(2) 0.25 N
(3) 0.5 N
(4) 1 N
(5) 4 N

14. The escape velocity of a projectile fired from a cannon at the Earth's surface is 11.2 km/s. Astronomers discover a distant planet whose mass is twice that of Earth, but half its radius. The escape velocity from this planet would be

(1) 22.4 km/s   (2) 44.8 km/s   (3) 11.2 km/s   (4) 5.6 km/s   (5) 15.8 km/s

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

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

16. A 0.50-kg object moves in a horizontal circular track with a radius of 2.5 m. An external force of 3.0 N, always tangent to the track, causes the object to speed up as it goes around. The work done by the external force as the mass makes one revolution is:

(1) 47 J   (2) 24 J   (3) 59 J   (4) 94 J   (5) 120 J

17. A flywheel is initially rotating at 20 rad/s and has a constant angular acceleration. After 9.0 s it has rotated through 450 rad. Its angular acceleration is:

(1) 6.7 rad/s^2 (2) 3.3 rad/s^2 (3) 4.4 rad/s^2 (4) 5.6 rad/s^2 (5) 11 rad/s^2

18. A constant horizontal force F_{app} of magnitude 20 N is applied to a wheel of mass 20 kg and radius 0.5 m as shown in the figure. The wheel rolls without slipping on the horizontal surface, and the acceleration of its center of mass has magnitude 0.5 m/s^2. What is the rotational inertia of the wheel about the rotation axis through its center of mass?
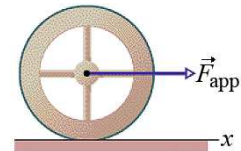
(1) 5 kg·m^2 (2) 10 kg·m^2 (3) 2.5 kg·m^2 (4) 25 kg·m^2 (5) 1.0 kg·m^2

19. Jupiter is 5.2 times farther from the Sun than the Earth is from the sun. What is the length of Jupiter's year (in Earth years)?

(1) 11.9   (2) 3.0   (3) 2.3   (4) 5.2   (5) not enough info

20. In order to receive credit for this problem, you must correctly code ("bubble in") your UFID and your 5-digit test number (located at the top left and right hand corners of this test) onto your scan sheet and also select the correct response below. Please check now that you have correctly coded your exam number on the scan sheet.

(1) I have correctly bubbled my UFID number and 5-digit test code.   (2) No   (3) No   (4) No   (5) No