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PHYSICS DEPARTMENT

PHY 2053 Final Exam April 24, 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.
(6) **Hand in the answer sheet separately.**

Constants

$g = 9.80$ m/s^2 $G = 6.67 \times 10^{-11}$ N·m^2/kg^2 density of water = 1000 kg/m^3

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1. A truck carries a package with mass 20 kg on an inclined uphill road at an angle of 10 degrees to the horizontal. The truck travels along this road for 1 minute with a constant velocity of 4 m/s. What is the work done by gravity on the package during this interval?

(1) −8200 J (2) −46000 J (3) 784 J (4) 46000 J (5) 8200 J

2. An object with mass 0.30 kg is placed on a frictionless table. The object is then attached to a horizontal spring with spring constant 140 N/m. The object oscillates about the equilibrium position, moving horizontally back and forth over a total distance of 5.0 cm. Find the maximum acceleration of the object.

(1) 12 m/s^2 (2) 23 m/s^2 (3) 3.5 m/s^2 (4) 0.0075 m/s^2 (5) 0.58 m/s^2

3. The period of oscillation of a 2.0-kg mass on spring with spring constant 90 N/m is 3.0 s when the amplitude is 1.0 cm. What is the period of oscillation when the amplitude is increased to 2.0 cm?

(1) 3.0 s (2) 6.0 s (3) 1.5 s (4) 4.2 s (5) 2.1 s

4. Airplane A and airplane B travel along the same straight line in the same direction, with airplane A in front of airplane B. The velocity of airplane A is 25 m/s and the velocity of airplane B is 60 m/s. Airplane A emits sound at frequency of 400 Hz. Given that the velocity of sound in air is 340 m/s, what is the frequency of this sound as heard by a person on airplane B?

(1) 440 Hz (2) 360 Hz (3) 300 Hz (4) 500 Hz (5) 380 Hz

5. A simple pendulum consists of a small sphere attached to a string. The period of small oscillations is found to be 1.5 seconds. The mass of the sphere is increased from 100g to 400g. What is the new oscillation period?

(1) 1.5 s (2) 3.0 s (3) 6.0 s (4) 12.0 s (5) 5.0 s

6. A transverse wave travels at a speed of 6 m/s. Four crests of the wave pass a given point along the direction of travel every 9 seconds. What is the distance between two successive maxima?

(1) 13.5 m (2) 2.7 m (3) 4.6 m (4) 1.7 m (5) 9.5 m

7. In a perfectly elastic one-dimensional collision between two masses m_1 and m_2, the velocity of m_1 changes from +5.0 m/s to −2.0 m/s. If m_2 is initially at rest, what is the final velocity of m_2?

   (1) 3.0 m/s (2) 7.0 m/s (3) 4.5 m/s (4) 9.0 m/s (5) 6.4 m/s

8. A 200-kg crate is placed on an incline that is an angle of 20 degrees with the horizontal. The crate slides down the plane with an acceleration of 0.5 m/s^2. What is the coefficient of kinetic friction between the ramp and the crate?

   (1) 0.31 (2) 0.25 (3) 0.37 (4) 0.95 (5) 0.51

9. A 20 kg child on a 1.5 m long swing is released from rest when the ropes of the swing make an angle of 30 degrees with the vertical. If the speed of the child at the lowest position is 1.2 m/s, what is the mechanical energy lost due to friction?

   (1) 25 J (2) 280 J (3) 96 J (4) 14 J (5) 148 J

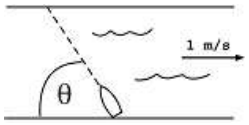
10. A dart player stands 2.0 m horizontally away from a target that is at a vertical distance y lower than the position at which he releases the dart. In order to hit the center of the target, he needs to release the dart at a velocity of 5.9 m/s at an angle of 5.0 degrees below horizontal. Find the vertical distance y.

    (1) 74 cm (2) 39 cm (3) 26 cm (4) 53 cm (5) 18 cm

11. A merry-go-round rotates without friction about its axis. It can be assumed to be solid disc of mass 30 kg and radius of 2.5 m. A person is originally standing at a point 1.0 m from the axis of rotation. It takes 6.0 seconds for the merry-go-round to complete one revolution. The mass of the person is 50 kg. If the person walks to a point 2.0 m from the center, what is the new angular speed? (Hint: the moment of inertia of a solid disc is $\frac{1}{2}MR^2$)

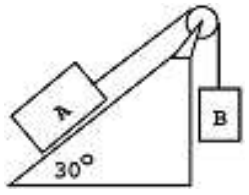
    (1) 0.51 rad/s (2) 0.26 rad/s (3) 2.9 rad/s (4) 0.75 rad/s (5) 1.3 rad/s

12. A man wishes to row across a river in the shortest possible time. He can row at 2 m/s in still water, and the river is flowing at 1 m/s. At what angle should he point the bow (front) of the boat?



    (1) 90° (2) 45° (3) 60 ° (4) 64° (5) 30°

13. Block A, with a mass of 10 kg, initially rests on a 30° incline. The coefficient of kinetic friction is 0.20. The attached string is parallel to the incline and passes over a massless, frictionless pulley at the top. Block B, with a mass of 8.0 kg, is attached to the dangling end of the string. After the blocks start moving, what is the acceleration of B?



    (1) 0.69 m/s^2, down (2) 0.69 m/s^2, up (3) 2.6 m/s^2, up (4) 2.6 m/s^2, down (5) 0

14. A ball of mass 2.0 kg is swung in a vertical circle at the end of a 1.0-m string. How slowly can the ball pass through its highest position without having the string go slack?

    (1) 3.1 m/s (2) 2.1 m/s (3) 4.1 m/s (4) 5.9 m/s (5) 7.0 m/s

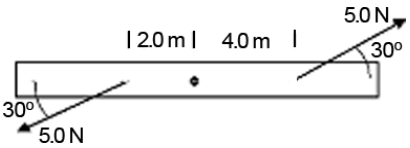
15. Three cylinders of the same mass and radius race from the top to the bottom of an inclined plane. Two of the cylinders, A and B, roll down without slipping while the third cylinder, C, slides down the plane without rolling. Cylinder A is hollow, while cylinder B is solid. Ignore frictional effects, even though we know friction must be present for rolling without slipping. What is the order of the finish?

(1) CBA (2) ABC (3) BCA (4) ACB (5) CAB

16. The driver of a 1000 kg car driving at a constant speed of 10 m/s tries to turn through a circle of radius 100 m on an unbanked, level curve. The coefficient of static friction between the car and the slippery road is $\mu_s = 0.092$. The car will:

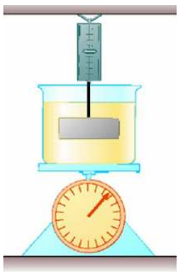
(1) slide off to the outside of the curve.
(2) slide into the inside of the curve.
(3) go around the curve successfully.
(4) slow down due to the friction.
(5) go around the curve successfully only if it speeds up.

17. A rod is able to rotate about its center. Two 5 N forces are applied, one 4 m from the center and a second 2 m from the center, as shown in the diagram. The magnitude of the total torque about the center is



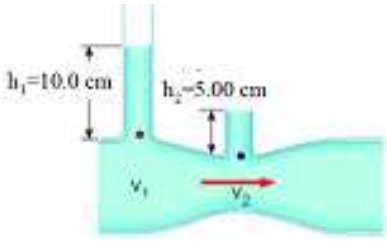
(1) 15 N-m (2) 0 (3) 8.7 N-m (4) 5.0 N-m (5) 26 N-m

18. A 3.00-kg beaker containing 2.00 kg of oil (density = 916 kg/m^3) rests on a scale that measures weight. A 2.00-kg block of iron (density = 7.86×10^3 kg/m^3) is suspended from a spring scale and is completely submerged in the oil. Find the equilibrium reading of the bottom scale.



(1) 51.3 N
(2) 31.7 N
(3) 17.3 N
(4) 132 N
(5) 4.9 N

19. The inside diameters of the larger portions of the horizontal pipe depicted in the figure are 2.50 cm. Water flows to the right at a rate of 1.80×10^{-4} m^3/s. Determine the velocity v_2.



(1) 1.06 m/s
(2) 2.43 m/s
(3) 3.71 m/s
(4) 5.71 m/s
(5) 8.23 m/s

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.