

Exam 4411

**Physics 1710
Fall 2003
Final Examination**

Name: _____

SS#: _____

Professor/Section: Krokhin/3
(circle one) Holland/4
Weathers/5

DIRECTIONS for Bubble Sheet

Bubble in your name (last, first, MI),
SS# (A through I of identification number)
Course section # (L of special codes),
Exam # (MNOP of special codes)

This test consists of 8 multiple-choice questions and 4 problems. To receive credit for the 4 problems, you must show all of your work on the pages provided. Don't hand in any extra sheets or other paper. We strongly recommend that you also show your work for the multiple choice questions.

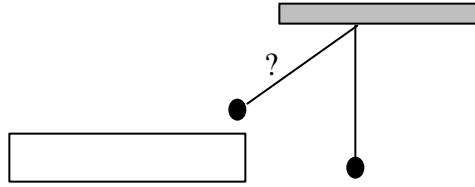
We suggest that you use the following procedure to solve the problems:

- 1. Read each problem carefully and make sure you know what is being asked before starting the problem.**
- 2. Draw a figure for the problem.**
- 3. List the parameters given.**
- 4. Write down the equations to be used.**
- 5. Solve for the answer algebraically.**
- 6. Substitute numbers into your final equation and circle your answer.**
- 7. Mark your scantron for the multiple choice questions.**

WORK THE EASY PROBLEMS FIRST!!!

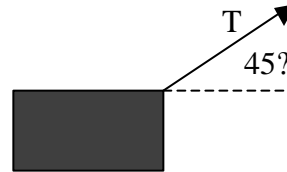
1. A man with a mass of $m = 80$ kg is holding on to the free end of a rope of length $l = 12$ m, the other end of which is fixed to a tree limb above. He gets the rope to swing and eventually reaches a ledge when the rope makes an angle of $\theta = 60^\circ$ with the horizontal. How much work is done by the force due to gravity during this maneuver?

- (a) 4.7 kJ
- (b) -1.3 kJ
- (c) 1.3 kJ
- (d) -4.7 kJ
- (e) -8.1 kJ



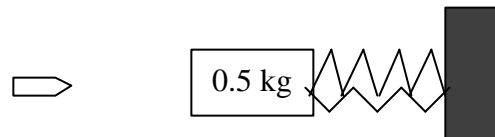
2. A block of mass $m = 30$ kg is pulled on a surface with coefficient of kinetic friction $\mu_k = 0.1$ by a rope with tension T at an angle of $\theta = 45^\circ$ with the direction of motion. After $t = 10$ s the block has moved $s = 5$ m. What amount of work W is done on the block by the rope, assuming that it started from rest?

- (a) 15 J
- (b) -15 J
- (c) 39 J
- (d) 147 J
- (e) 156 J



3. A bullet of mass $m = 9.5$ g traveling east at $v = 600$ m/s collides with block of wood of mass $M = 0.5$ kg attached to two equal parallel springs with spring constants of $k = 400$ N/m. Assuming that the bullet remains embedded in the block, what will be the maximum amount of compression x of the springs from the equilibrium position?

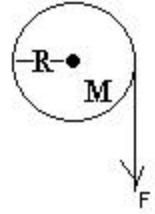
- (a) 0.25 m
- (b) 0.30 m
- (c) 1.34 m
- (d) 0.28 m
- (e) 1.54 m



4. A ball of mass $m = 1$ kg and radius $R = 0.5$ m rolls horizontally without sliding with angular velocity $\omega = 2$ rad/s. It rolls off a ledge and falls $h = 5$ m to the ground. At what angle θ (measured with respect to the horizontal) does the ball hit?

- (a) 84°
- (b) 90°
- (c) 107°
- (d) 36°
- (e) 88°

5. A uniform disk of radius $R = 0.250$ m and mass $M = 75.0$ kg is free to pivot about a horizontal axis passing through its center as shown. A massless cord is wrapped around the circumference of the disk, and a force $F = 67.3$ N is applied to the cord's free end. What is the angular momentum of the disk after the cord end has been pulled through a distance $h = 3.00$ m if the disk starts from rest?

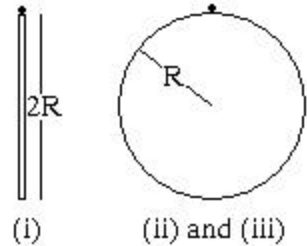


- (a) $42.3 \text{ kg}\cdot\text{m}^2/\text{s}$
- (b) $29.9 \text{ kg}\cdot\text{m}^2/\text{s}$
- (c) $30.8 \text{ kg}\cdot\text{m}^2/\text{s}$
- (d) $27.6 \text{ kg}\cdot\text{m}^2/\text{s}$
- (e) $25 \text{ kg}\cdot\text{m}^2/\text{s}$

6. A spherical ball has a diameter of $d = 3.80$ cm and an average density of $\rho_s = 2 \text{ g/cm}^3$. What force would be required to hold it stationary completely submerged under water? ($\rho_{\text{water}} = 1.00 \text{ g/cm}^3$)

- (a) $2.81 \times 10^{-4} \text{ N}$
- (b) 0.282 N
- (c) $2.37 \times 10^{-5} \text{ N}$
- (d) 2.63 N
- (e) $2.06 \times 10^{-2} \text{ N}$

7. Consider the following objects: (i) a uniform rod of length $2R$, suspended by a pivot at one end; (ii) a hollow spherical shell of radius R suspended by a pivot on its surface; and (iii) a uniform hoop of radius R suspended by a pivot on its surface. These three objects undergo small oscillations about their equilibrium positions. Rank them according to their periods of oscillation, least to greatest.

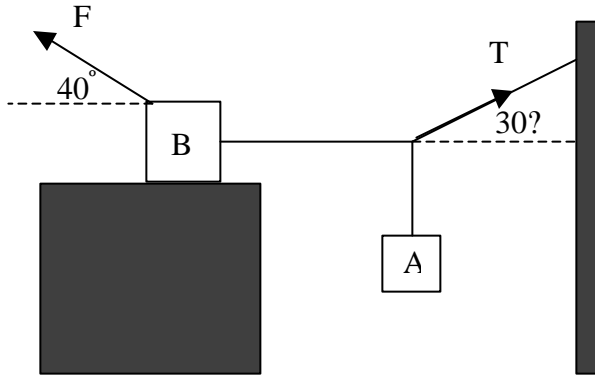


- (a) (ii), (iii), (i)
- (b) (i), (ii), (iii)
- (c) (iii), (i), (ii)
- (d) (iii), (ii), (i)
- (e) (i), (iii), (ii)

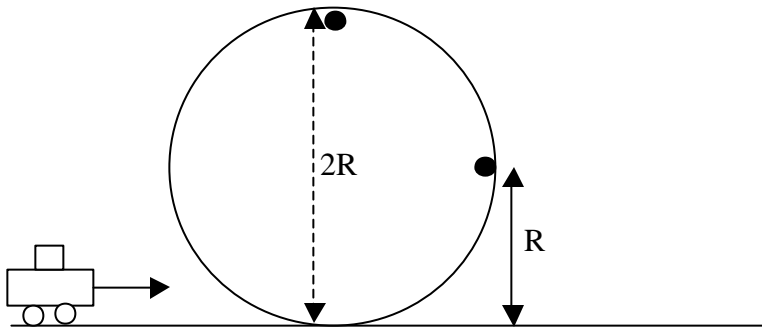
8. A stretched string of length $L = 2.00$ m and mass $m = 15.0$ g is excited in a resonant mode with four nodes and three antinodes (the third harmonic, $n = 3$). What tension T is the string under if the frequency of this resonance is $f = 44.0$ Hz?

- (a) 25.8 N
- (b) 14.5 N
- (c) 51.6 N
- (d) $2.58 \times 10^4 \text{ N}$
- (e) 0.440 N

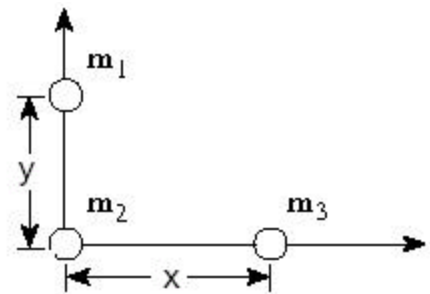
9. Block A weighs $W_A = 250 \text{ N}$ and block B weighs $W_B = 711 \text{ N}$. The coefficient of static friction between the block and table is $\mu_s = 0.25$; assume that the cord between B and the knot is horizontal. Find the minimal magnitude of the force F for which the system will be stationary.



10. A stunt car of mass $m = 800 \text{ kg}$ traveling at a speed of $v_1 = 40 \text{ m/s}$ enters a vertical loop of track of radius $R = 30 \text{ m}$. The racetrack exerts a variable force on the car depending upon the car's location along the track. What is the ratio of the normal force exerted by the track on the car at the highest point of the track ($2R$ above the ground) to that when the car has moved halfway up the loop (R above the ground) if the speed halfway up the loop is v_1 and the speed at the highest point is $v_2 = 0.5 v_1$?



11. Three uniform spheres of masses $m_1 = 2.00 \text{ kg}$, $m_2 = 4.00 \text{ kg}$, and $m_3 = 6.00 \text{ kg}$ are placed at the corners of a right triangle as shown, where $x = 3.00 \text{ m}$ and $y = 2.00 \text{ m}$. Calculate the position of a sphere of mass $m_4 = 1.00 \text{ kg}$ such that the net force acting on mass m_2 is zero.



12. Ice of mass $m_{ice} = 200$ g at initial temperature $T_1 = 250$ K is placed in a vessel with perfect thermal insulation. Hot water at $T_2 = 90^\circ\text{C}$ is then added to the vessel, and the contents are allowed to come to equilibrium. What is the mass m_w of the hot water added if the resulting equilibrium temperature is $T_f = 0^\circ\text{C}$ and 50% of the ice is melted?
($c_{ice} = 2220 \text{ J}\cdot\text{kg}^{-1}\cdot\text{K}^{-1}$, $c_{water} = 4190 \text{ J}\cdot\text{kg}^{-1}\cdot\text{K}^{-1}$, $c_{steam} = 2010 \text{ J}\cdot\text{kg}^{-1}\cdot\text{K}^{-1}$, $L_{F\ water} = 333 \text{ kJ}\cdot\text{kg}^{-1}$, $L_{V\ water} = 2260 \text{ kJ}\cdot\text{kg}^{-1}$)