Exam 1021

Physics 1710
Fall 2003
Examination 2

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!!!

Assume that all quantities are known to at least 2 significant figures.

Equations are on the back of the test.

1. A force of 8 N acts on an object on a frictionless horizontal surface. The force acts in a vertical plane at an angle of 30? with respect to the object's direction of motion. If the force displaces the object by a horizontal distance d = 4 m, how much work is done by the force?
   a. 16 J
   b. 28 J
   c. 32 J
   d. 12 J
   e. 2 J

2. An object of mass m = 3 kg has an initial kinetic energy of K = 20 J. What is its speed after work W = 8 J has been done on it?
   a. 12 m/s
   b. 2.8 m/s
   c. 8 m/s
   d. 4.3 m/s
   e. 18.7 m/s

3. An object has initial kinetic energy K = 5 J and initial potential energy U = 8 J. After work W = –9 J is done on the object by nonconservative forces, what is its final mechanical energy?
   a. 4 J
   b. 13 J
   c. 22 J
   d. 17 J
   e. Cannot be determined from the information given

4. An object of mass m = 15 kg falls from rest. At the moment it has fallen through a distance h = 3 m, what is the instantaneous power developed by the gravitational force acting on the mass?
   a. 440 W
   b. 115 W
   c. 560 W
   d. 8.64 kW
   e. 1.13 kW

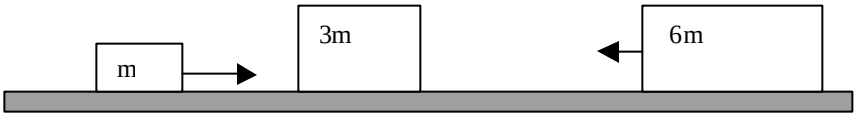
5. Given mass $m_1 = 25$ kg at position $(x_1, y_1) = (1\text{ m}, 3\text{ m})$, mass $m_2 = 15$ kg at position $(x_2, y_2) = (-2\text{ m}, 4\text{ m})$, and mass $m_3 = 35$ kg at position $(x_3, y_3) = (4\text{ m}, -1\text{ m})$, what is the x coordinate of the center of mass of this system?
   a. 1 m
   b. 135 m
   c. 2.2 m
   d. 1.8 m
   e. 1.3 m

6. Given mass $m_1 = 12$ kg with velocity $\mathbf{v}_1 = 45\text{ m/s}\ \boldsymbol{i} + 15\text{ m/s}\ \boldsymbol{j}$, and mass $m_2 = 18$ kg with velocity $\mathbf{v}_2 = -70\text{ m/s}\ \boldsymbol{i} + 20\text{ m/s}\ \boldsymbol{j}$, what is the speed of the center of mass of this system?
   a. 54 m/s
   b. 63 m/s
   c. 30 m/s
   d. 43 m/s
   e. 10 m/s

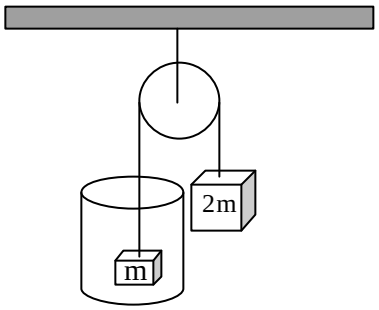
7. A ball of clay hits a wall and sticks to it. If the ball has mass m = 0.4 kg, initial velocity v = 25 m/s directed perpendicular to the wall, and the collision lasts for a time t = 0.0015 s, what is the average force exerted on the wall by the clay during the impact?
   a. 13.3 kN
   b. 6.67 kN
   c. 16.7 kN
   d. 3.9 N
   e. 670 N

8. Two rocket cars are lined up at the starting line ready for a race. Car 1 consumes fuel 20% faster than car 2 but exhausts the products with a speed (relative to the car) that is 30% slower. If the mass of car 1 is 20% less than the mass of car 2 at the start of the race, what will be the initial acceleration of car 1, relative to that of car 2?
   a. $a_1 = 1.05\ a_2$
   b. $a_1 = 0.95\ a_2$
   c. $a_1 = 0.3\ a_2$
   d. $a_1 = 0.84\ a_2$
   e. $a_1 = 1.8\ a_2$

9. There are three masses positioned on a frictionless surface. Initially, mass $m_1 = m$ moves with a velocity of 2 m/s towards the east, mass $m_2 = 3m$ is at rest, and mass $m_3 = 6m$ moves to the west with a velocity of 0.5 m/s. First, mass m_1 collides elastically with mass m_2 and recoils to the west. Afterwards, mass m_3 collides with mass m_2 and sticks. What is the speed of masses m_2 and m_3 after this collision?



10. An Atwood machine with block 1 of mass m = 2 kg and block 2 of mass $2m$ is initially configured so that block 2 is positioned 1 meter above the ground, and block 1 is positioned 0.2 meter from the ground and in a beaker of water. If block 2 is released from rest and falls towards the ground, what is its speed at the moment before it hits the ground? Assume that 1 J of energy is dissipated by the drag force of the water on block 1. (Additional assumptions: the pulley and cord are of negligible mass; the pulley rotates without friction; the cord does not stretch; and block 1 is very much denser than water.)



11. A block of mass m = 2 kg resting on a horizontal frictionless surface is initially held against a spring of constant k = 5000 N/m that is compressed by 0.1 m from its equilibrium length. After the block is released, it slides along the frictionless horizontal surface until it encounters a ramp that makes an angle ? = 20° to the horizontal. The coefficient of kinetic friction between the block and the ramp is $\mu_k = 0.15$. What distance will the block slide up the ramp before it comes to rest, measured parallel to the face of the ramp? (Assume that the block makes a smooth transition onto the ramp.)

12. A ball of mass *m* with an initial speed of 10 m/s collides with a larger ball of mass $M = 3m$ that is initially at rest. The collision is not perfectly elastic. After the collision, the smaller ball moves with a speed of 7 m/s in a direction that makes an angle ? = 30° to its initial direction. What is the angle f between the direction of the larger ball's motion after the collision and the direction of the smaller ball's motion before the collision?