Last Name: First Name:

- Print your LAST and FIRST name on the front of your blue book, on this question sheet, the multiple-choice question sheet and the multiple-choice answer sheet.
- TIME ALLOWED 90 MINUTES
- The test consists of three free-response questions and ten multiple-choice questions.
- The test is graded on a scale of 100 points; the first free-response question accounts for 20 points, the second for 25 points, the third for 25 points, and the multiple-choice questions account for 30 points.
- Answer the three free-response questions in your blue book. Answer the multiple-choice questions by marking a dark X in the appropriate column and row in the table on the multiple-choice answer sheet.
- Consult no books or notes of any kind. You may use a hand-held calculator in non-graphing, non-programmed mode.
- Do NOT take test materials outside of the class at any time. Return this question sheet along with your blue book and multiple-choice question sheet.
- Write and sign the Pledge on the front of your blue book.

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*Show your work for the free-response problems, including neat and clearly labeled figures, in your blue book. It is possible that answers without explanation (**even correct answers**) will not be given credit.* **Take g = 9.8 m/s^2 or 32 ft/s^2.**

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1. (**20 pts**) A block of mass m hangs on the end of a light cord and connected to a block of mass M by the pulley arrangement shown in the figure below (Fig. 1). The pulleys have negligible mass and are friction free. Upon release from rest, m begins to accelerate downwards.

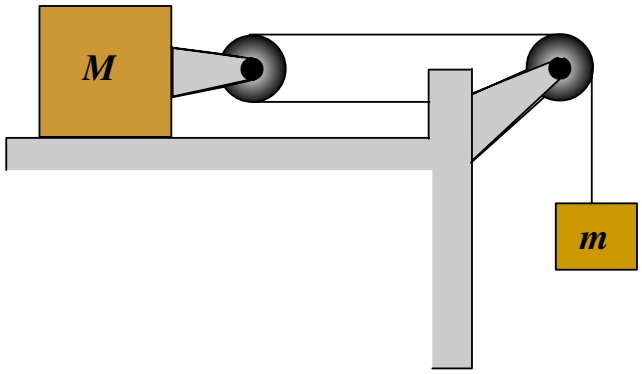


Figure 1: Problem 1

   (a) find an expression relating the acceleration of m to the acceleration of M.

   (b) Assuming initially that there is no friction between M and the table, use energy considerations to find an expression for the speed of m as a function of the distance h it has fallen. *(Leave your answer in terms of all or some of the following: m, M, g, and h.)*

   (c) Repeat (b) assuming that sliding friction is present between M and the table, the coefficient of sliding friction being μ_k. *(Leave your answer in terms of all or some of the following: m, M, g, μ_k, and h.)*

2. (**25 pts**) Two pendulum bobs of differing masses are suspended from strings of equal length as shown in the figure below (Fig. 2). The bob of mass $m_1 = 0.5$-kg is released from rest at a height h. It then hits the second bob of mass m_2 which is initially at rest. The two stick together after the collision. An observant PHYS101 student notices that the composite mass subsequently rises to a maximum height of $h_f = h/9$.

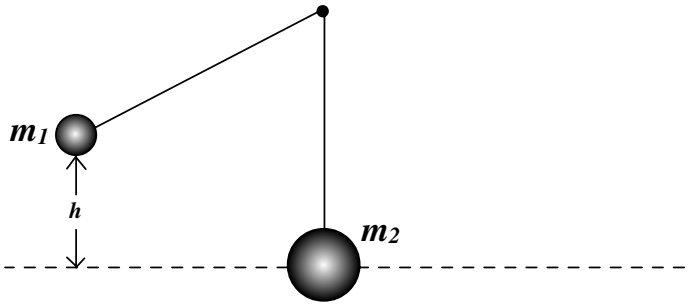


Figure 2: Problem 2

(a) What is the mass (m_2) of the second pendulum bob?

(b) How much energy was lost in the collision? *(Leave your answer in terms of g and h.)*

3. (**25 pts**) Two long barges are moving in the same direction in still water, one with a speed of 9 km/h and the other with a speed of 21 km/h. While they are passing each other, coal is shoveled from the slower barge to the faster barge at a rate of 925 kg/min as illustrated in the figure below (Fig 3). Assume that the shoveling is always perfectly sideways and that the frictional forces between the barges and the water do not depend on the weight of the barges. Determine how much additional force must be provided by the driving engines of each barge as the coal is shoveled if neither is to change speed?

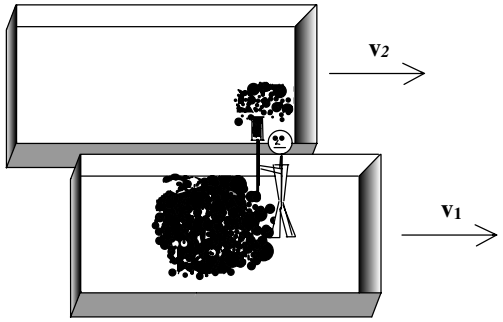


Figure 3: Problem 3

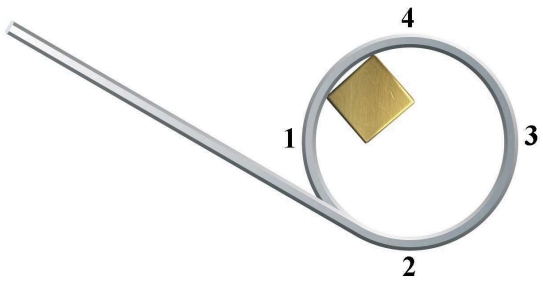
Physics 101 Fall 2006: Test 2—Multiple-Choice Questions

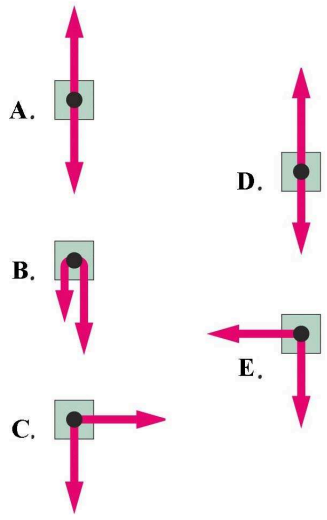
1. Two identical blocks are tied one behind the other and pulled across a horizontal, level surface. *Friction is not negligible.* The force required to pull the two blocks at constant speed is F. If one block is now stacked onto the other, the new force required to pull them at a constant speed will be approximately:

   (a) $F/2$
   (b) F
   (c) $\sqrt{2}\,F$
   (d) $2\,F$
   (e) $4\,F$

Refer to the figures below for question 2.

The figure below on the left represents a block of mass m sliding on a frictionless surface along a loop-the-loop, and the figure below on the right represent various free body diagrams. The block is moving fast enough that it never loses contact with the track.





2. At the point labeled 4, the free body diagram is best illustrated by:

   (a.) A.
   (b.) B.
   (c.) C.
   (d.) D.
   (e.) E.

3. On an icy winter day, the coefficient of static friction between the tires of a car and a roadway is reduced to one-half of its value on a dry day. As a result, the maximum speed at which a curve of radius R can be safely negotiated is

   (a) the same as on a dry day.

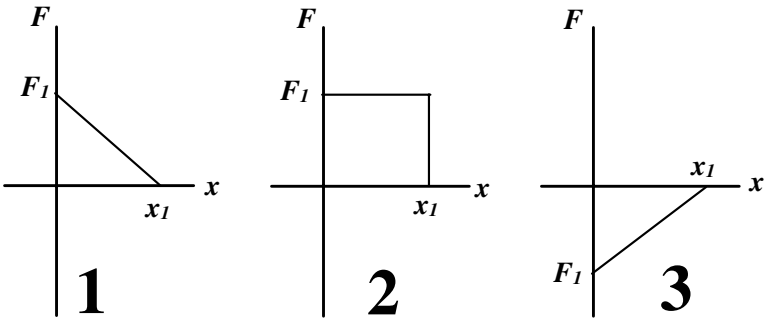
   (b) reduced to 71% of its value on a dry day.

   (c) reduced to 50% of its value on a dry day.

   (d) reduced to 25% of it value on a dry day.

   (e) reduced by an unknown amount depending on the car's mass.

4. The graphs below show the force acting on a particle as the particle moves along the positive x axis from the origin to $x = x_1$. The force is parallel to the x axis and is conservative. The maximum magnitude F_1 has the same value for all graphs. Rank the situations according to the change in the potential energy associated with the force, starting from the most negative to the most positive.



   (a) 1, 2, 3.

   (b) 1, 3, 2.

   (c) 2, 3, 1.

   (d) 3, 1, 2.

   (e) 2, 1, 3.

5. A small object of mass m, on the end of a light cord, is held horizontally at a distance r from a fixed support as shown in the figure below. The object is then released from rest. What is the tension in the cord when the object is at the lowest point of its swing?

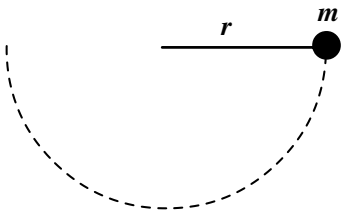
   (a) $m\,g/2$.

   (b) $m\,g$.

   (c) $2\,m\,g$.

   (d) $3\,m\,g$.

   (e) $m\,g\,r$.

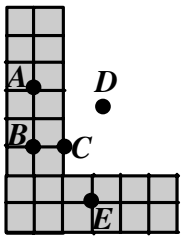


6. If a satellite of mass m is moved from a circular orbit of radius r to one of radius $2\,r$, its speed is

   (a) increased by a factor of 2.
   (b) increased by a factor of $\sqrt{2}$.
   (c) not changed.
   (d) reduced by a factor of 2.
   (e) reduced by a factor of $\sqrt{2}$.

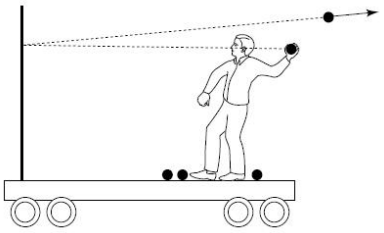
7. An L-shaped piece, represented by the figure below, is cut from a metal plate of uniform thickness. The point that corresponds to the center of the mass of the L-shaped piece is

   (a) A.
   (b) B.
   (c) C.
   (d) D.
   (e) E.



8. Suppose you are on a cart, initially at rest on a frictionless, horizontal track. You throw a series of identical balls against a wall that is rigidly mounted to the cart. If the balls are thrown at a steady rate and bounce straight back as shown in the figure below, is the cart put into motion?

   (a) Yes, it starts to move to the right with constant speed.
   (b) Yes, it starts to move to the right and steadily gains speed.
   (c) Yes, it starts to move to the left with constant speed.
   (d) Yes, it starts to move to the left and steadily gains speed.
   (e) No, it remains in place.



9. A double-barrelled pea shooter is shown in the figure below. Air is blown from the left end of the straw, and identical peas A and B are positioned inside the straw as shown. Pea B is closer to the exit than pea A. Which of the following statement(s) is (are) true after the peas leave the straw?

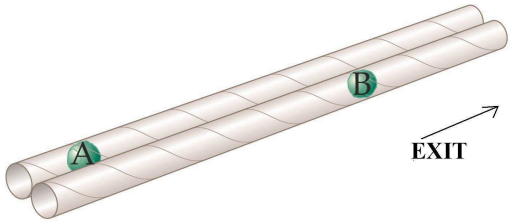
I. Upon leaving the straw, the momentum of pea A is greater than the momentum of pea B.

II. Upon leaving the straw, the momentum of pea A is smaller than the momentum of pea B.

III. The kinetic energy of pea A immediately after leaving the straw is greater than the kinetic energy of pea B immediately after leaving the straw.

IV. The kinetic energy of pea B immediately after leaving the straw is greater than the kinetic energy of pea A immediately after leaving the straw.

V. The kinetic energy of pea B immediately after leaving the straw is the same as the kinetic energy of pea A immediately after leaving the straw.



(a) Only I.

(b) Only II.

(c) Only V.

(d) Only I and III.

(e) Only II and IV

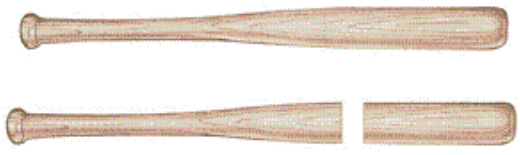
10. A baseball bat is cut at the location of its center of mass as shown in the figure below. The piece with the smaller mass after the cut is

(a) The piece on the left.

(b) The piece on the right.

(c) Both pieces have the same mass.

(d) Impossible to determine.



Last Name: First Name:

Physics 101 Fall 2006: Test 2—Multiple-Choice Answers

	A	B	C	D	E
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					