Physics 2211 BCD Test form **444** Name ____________________________
Spring 2015
Test 4 Recitation Section (see back of test):__________

A

1) Print your name, test form number (above), and nine-digit student number in the section of the answer card labeled "STUDENT IDENTIFICATION".

2) Bubble your test form number (**ABOVE**) in columns 1-3, skip column 4, then bubble in your student number in columns 5-13.

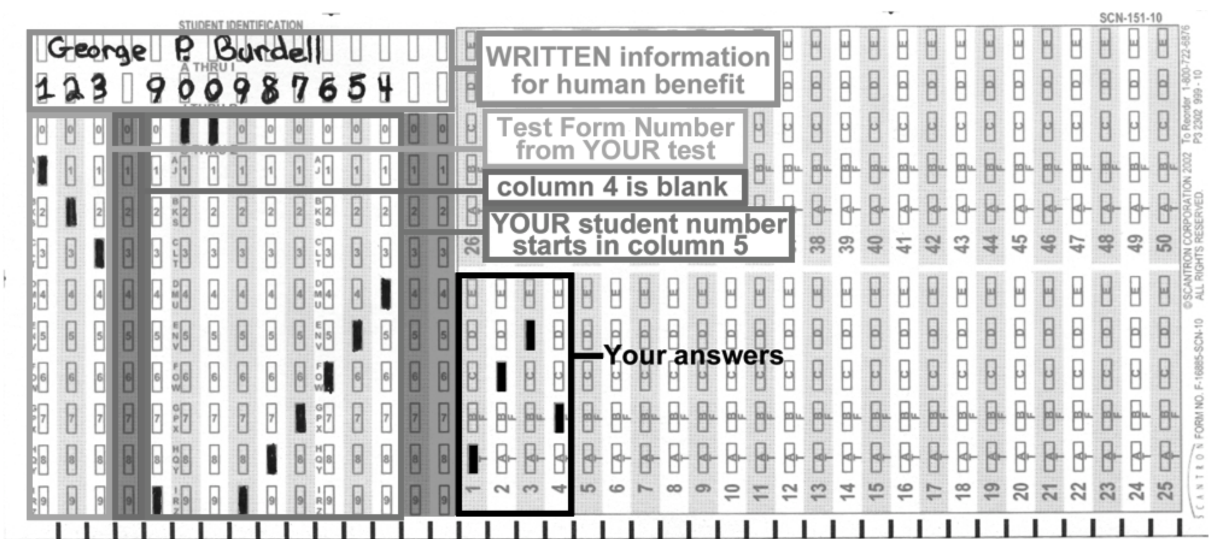
3) For each free-response question, show all relevant work supporting your answer. **Clearly box or underline your final answer.** "Correct" answers which are not supported by adequate calculations and/or reasoning will be counted wrong.

4) For each multiple-choice question, select the answer most nearly correct, **circle this answer on your test**, and bubble it in on your answer card. **Show all relevant work on your quiz.**

5) Be prepared to present your Buzzcard as you turn in your test. Scores will be posted to WebAssign after they have been been graded. **Quiz grades become final when the next quiz is given.**

6) You may use a simple scientific calculator capable of logarithms, exponentials, and trigonometric functions. **Programmable engineering calculators with text or graphical capabilities are not allowed. Wireless devices are prohibited.**

Your test form is: 444

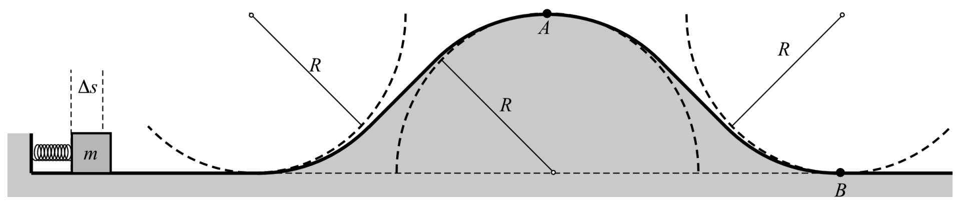


Our Final Exam will be on Monday, April 27 at 8:00am!

The following problem will be hand-graded. Show all your work for this problem. Make no marks and leave no space on your answer card for it.

[I] A block of mass m lies on a frictionless horizontal surface. It is placed against a spring having elastic constant k, which is then compressed by an unspecified distance Δs and then released from rest. After it leaves the spring, the block passes over a semicircular hill having radii of curvature R (with upward curvature at the bottom of the hill, and downward curvature at the top).

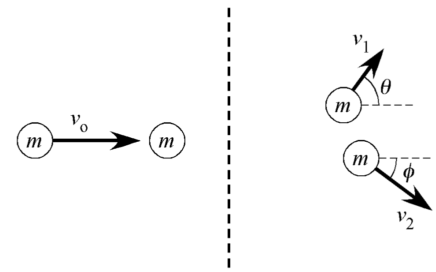
(A) *(10 points)* What maximum compression distance $\Delta s_{\max}$ will allow the block to travel over the top of the hill, without becoming airborne at the (downcurving) apex of the hill, point A? (Hint: what would be the *forces* acting on the block, at the moment it becomes airborne?)



(B) *(10 points)* Suppose instead that the spring is compressed so that the block will only *just barely* make it over the top of the hill without stopping. What will be the apparent weight of the block as it reaches the (upcurving) base of the hill, just before it reaches point B—while still ***on*** the hill. (Recall that apparent weight is found from the normal force acting on the block, at the point in question.)

The following problem will be hand-graded. *<u>Show all your work for this problem</u>.* *Make no marks and leave no space on your answer card for it.*

[II] A puck of mass m is sliding on frictionless ice with speed v_o when it collides with an idential puck having the same mass m. Assume that the collision is <u>perfectly elastic</u>. After the collision, the first puck is observed to travel away from the collision at some angle θ, moving with a speed $v_1 = 0.600\ v_o$, while the second puck departs at some angle ϕ, moving with some speed v_2.



(15 points) Determine the speed v_2 of the second puck after the collision (expressed as a *decimal* fraction or multiple of v_o), and then determine the two deflection angles θ and ϕ for the pucks, expressed as <u>numerical values</u> relative to the first puck's initial direction of travel.

Question value 5 points — mark your answer in space #1 on the answer card.

(1) Suppose instead that the collision between the two pucks is perfectly *<u>inelastic</u>*. What percentage of the their total initial kinetic energy will be <u>lost</u> in the collision?

(a) 75%

(b) 50%

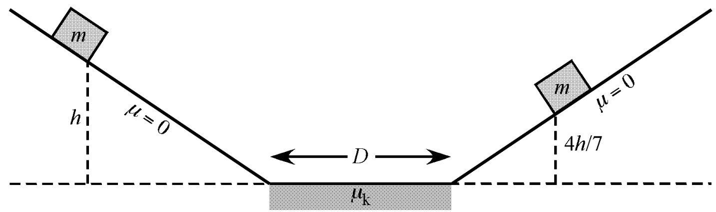
(c) 0%

(d) 25%

(e) 100%

The following problem will be hand-graded. *Show all your work for this problem.* *Make no marks and leave no space on your answer card for it.*

[III] A block is placed on a frictionless ramp at a height h, and released from rest. It slides down the ramp to a rough horizontal surface, sliding a distance D along that surface to a second, upward-directed frictionless ramp. It is observed to rise to a height (4/7) h before coming to a momentary stop. It then starts back down the ramp and recrosses the rough surface.



(15 points) If the length of the rough surface is $D = 1.5\ h$, what is the coefficient of friction for that surface? Express your answer as a numerical value, to two-digit precision.

Question value 5 points — mark your answer in space #2 on the answer card.

(2) Where along the rough horizontal surface will the block eventually come to a complete stop?

(a) at a distance $D/4$ from the left side.

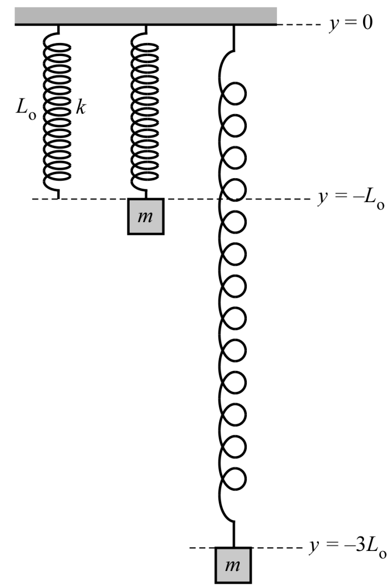
(b) at a distance $D/2$ from the left side.

(c) at a distance $3D/4$ from the left side.

(d) at a distance $2D/3$ from the left side.

(e) at a distance $D/3$ from the left side.

An ideal massless spring hangs from the ceiling. When nothing is attached to the spring, its natural length is L_o, so that the lower end hangs at position $y_o = -L_o$, relative to the ceiling. A mass m is then attached to the lower end of the spring, and released from rest. The mass drops to a position $y_1 = -3L_o$, where it stops mometarily before bouncing back upward.



Question value 5 points

(3) What is the elastic constant for the spring?

(a) $k = mg/3L_o$

(b) $k = mg/L_o$

(c) $k = 2mg/L_o$

(d) $k = 3mg/L_o$

(e) $k = mg/2L_o$

(4) What will be the position of the block (relative to the ceiling) at the moment it is moving back upward, with maximum speed?

(a) $y = -1.5L_o$

(b) $y = -2.5L_o$

(c) $y = -1.0L_o$

(d) $y = -2.0L_o$

(e) $y = -3.0L_o$

(5) Suppose that, instead of simpy releasing the block, it is gently lowered until it hangs at rest, with the block in equilibrium. What will be the position of the block at this moment?

(a) $y = -3.0L_o$

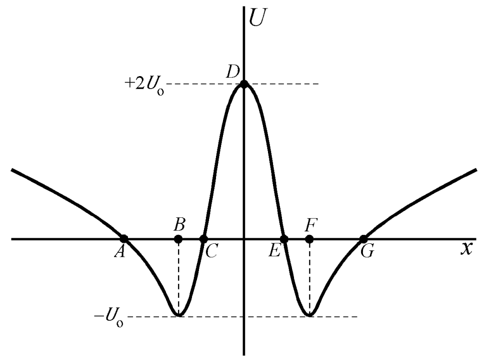
(b) $y = -2.0L_o$

(c) $y = -1.0L_o$

(d) $y = -1.5L_o$

(e) $y = -2.5L_o$

George P. Burdell has engineered a 21st-century elastic device called the "sproing"; unlike an antiquated 20th-century spring, the sproing has a potential energy function given by the graph at right.



Question value 5 points

(6) In what intervals will the sproing exert a positively-directed force?

(a) between A and C, and also between E and G.

(b) between B and D, and also to the right of F.

(c) nowhere in the regions shown.

(d) to the left of B, and also between D and F.

(e) to the left of A, between C and E, and to the right of G.

Question value 5 points

(7) A mass is attached to the sproing when it is at position B, and the "system" is defined to be the mass and sproing together. The block is moved from position B to position G. How much work was done on the block by the sproing?

(a) $W_s = +2U_o$

(b) $W_s = -3U_o$

(c) $W_s = -U_o$

(d) $W_s = -2U_o$

(e) $W_s = +U_o$

Question value 5 points

(8) Suppose the block began at rest at position B, and was observed to have kinetic energy K as it passed through position G. How much external work was done on the system, as the block was moved from B to G?

(a) $W_{ext} = +2U_o - K$

(b) $W_{ext} = +U_o + K$

(c) $W_{ext} = -U_o + K$

(d) $W_{ext} = +U_o - K$

(e) $W_{ext} = -2U_o + K$

Two sprinters run a footrace of total distance D. Both start from rest. Francine runs with constant applied force F_o, for the entire duration of the race. Peter runs with constant power output P_o, for the entire duration of the race.

Question value 5 points

(9) Suppose that Francine crosses the finish line with a final speed v_f. Let W_1 be the amount of work required for her to go from rest to speed $v_f/2$, which occurs over a total distance D_1. Let W_2 be the amount of work required for her to go from speed $v_f/2$ to speed v_f, which occurs in a distance D_2. How does the distance D_2 compare to the distance D_1?

(a) $D_2 = D_1$

(b) $D_2 = 2D_1$

(c) $D_2 = D_1/2$

(d) $D_2 = 3D_1$

(e) $D_2 = 4D_1$

Question value 5 points

(10) Suppose that Peter crosses the finish line at time t. If his speed at time $t/2$ is v, what is his speed at the end of the race?

(a) 1.41 v

(b) 1.73 v

(c) 2.00 v

(d) 2.23 v

(e) 1.00 v

PHYS 2211 BCD Recitation TA and Room Assignments

Tests will be returned in recitation, in the week *after* the test. In order to ensure that you receive your test back as soon as possible, please enter your recitation section from the table above on the front of this test.

	Clough 123	Clough 125	Clough 127	Clough 131	Clough 325
Monday					
2:05 – 2:55 pm				B01 Greenway, Lucas	B05 Baker, Caitlin
3:05 – 3:55 pm				B02 Greenway, Lucas	C02 Eswar, Aditya
4:05 – 4:55 pm	C01 Eswar, Aditya			B06 Greenway, Lucas	
Tuesday					
1:05 – 1:55 pm					C04 Liberi, Brandon
2:05 – 2:55 pm		D02 Zhou, Jiarun		C03 Baker, Caitlin	
3:05 – 3:55 pm					B04 Strauss, Hunter
4:05 – 4:55 pm					B03 Strauss, Hunter
5:05 – 5:55 pm	C09 Eswar, Aditya			D04 Strauss, Hunter	
Wednesday					
1:05 – 1:55 pm		B09 Ravipati, Akshay			
2:05 – 2:55 pm		D01/D05 Liberi, Brandon			
3:05 – 3:55 pm			C05 Ravipati, Akshay		
4:05 – 4:55 pm			C06/D06 Eswar, Aditya		
Thursday					
2:05 – 2:55 pm				B08 Zhou, Jiarun	C07 Baker, Caitlin
3:05 – 3:55 pm			B07 Tao, Liangyu		D07 Baker, Caitlin
4:05 – 4:55 pm			C08/D03 Tao, Liangyu		
5:05 – 5:55 pm					
6:05 – 6:55 pm			C10/D09 Tao, Liangyu		