Physics 2211 A/B Test form **633** Name _____
Fall 2015
Exam 3 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.

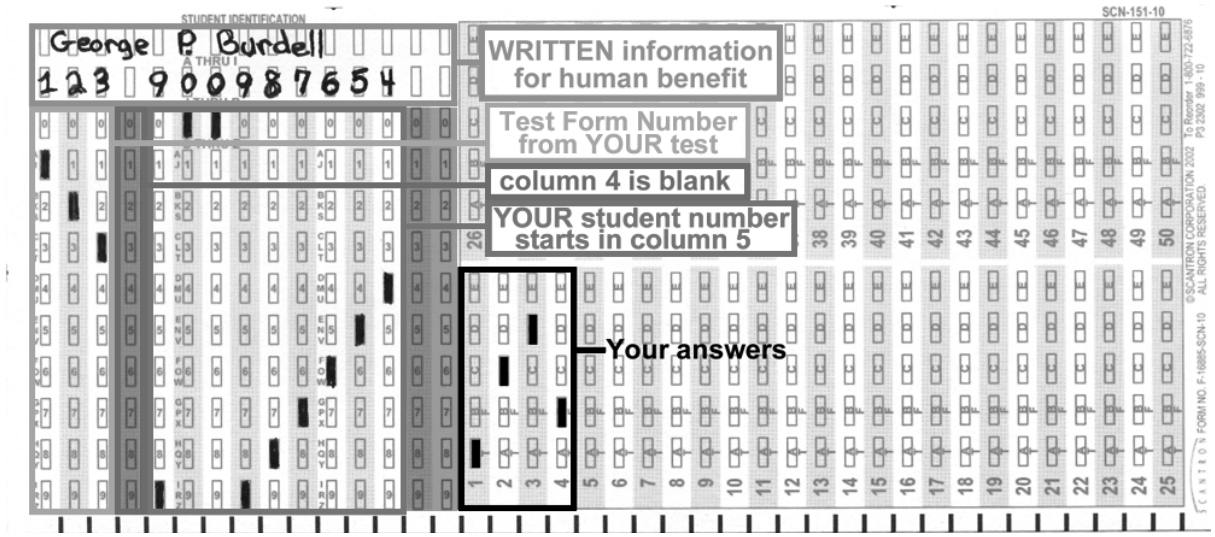
3) For each free-response question, show all relevant work supporting your answer. **Clearly box or underline your final answer.** "Correct" answers which are not supported by adequate calculations and/or reasoning will be counted wrong.

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.**

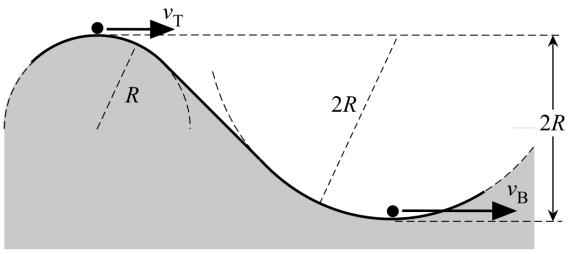
Your test form is: 633



Our next test will be on Monday, November 23!

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.

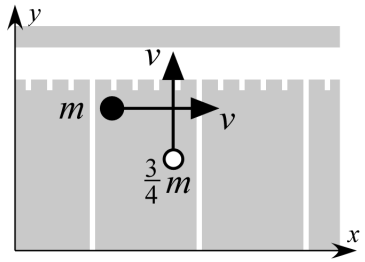
[I] *(20 points)* A roller-coaster car is travelling along a frictionless track. As it passes over the top of a hill having radius of curvature R, it has just enough speed v_T to become momentarily airborne. It than travels down into a valley; at the very bottom of the valley (a distance $2R$ below the top of the hill), the radius of curvature is $2R$.



What will be the percieved weight of a passenger in the roller-coaster car, at the very bottom of the hill? Express your answer as a multiple of the passenger's true weight, mg.

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.

[II] *(20 points)* A football player (mass m) is returning a punt, running parallel to the sideline at speed v. The runner is tackled by the kicker (mass ¾ m), who collides with him moving directly perpendicular to the sideline at the same speed v. The kicker "wraps up", and the two players fall to the ground together.

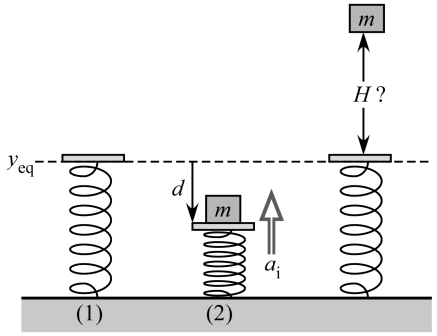


What impulse is delivered to the runner during the collision? Express your answer in cartesian vector form, in terms of the parameters m and v.

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.

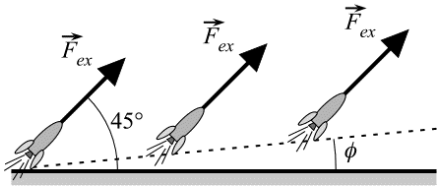
[III] *(20 points)* A vertical spring has a massless platform attached to it (1). A block of mass m is placed of the platform, and then the spring is compressed down by a distance d below its natural length (2). The spring is then released, and the block is launched vertically up into the air. An accelerometer indicates that at the moment of release, the block experiences an initial upward acceleration $\vec{a}_i$ of magnitude $5g$.

How high H will the block rise above the spring's natural equilibrium height? Express your answer as a multiple of the original compression distance d.



Question value 5 points

(1) A toy rocket of mass m is lauched from the ground, with it's nose maintaining a gyroscopically controlled angle θ = 45° with above the horizontal. It's trajectory as it leaves the ground, however, is a straight-line path directed at an angle ϕ = 15° above the horizontal. What is the magnitude of the thrust force generated by the rocket, as a multiple of the rocket's weight?



(a) $\vec{F}_{ex} = 0.73\ mg$
(b) $\vec{F}_{ex} = 1.93\ mg$
(c) $\vec{F}_{ex} = 1.41\ mg$
(d) $\vec{F}_{ex} = 1.37\ mg$
(e) $\vec{F}_{ex} = 3.73\ mg$

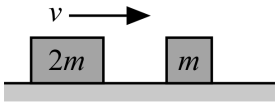
Question value 5 points

(2) Spring A has elastic constant k, and spring B has elastic constant $2k$. Spring B is stretched by a distance d, while spring A is compressed by a distance $2d$. Compare the potential energy stored in the two springs.

(a) $U_A = 2U_B$
(b) $U_A = U_B/2$
(c) $U_A = -2U_B$
(d) $U_A = U_B$
(e) $U_A = -U_B/2$

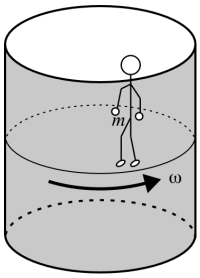
Question value 5 points

(3) A moving block of mass $2m$ strikes with a second block of mass m that is initially stationary, resulting in a perfectly inelastic 1D collision. What percentage of the system's initial energy is lost in the collision?



(a) 0%
(b) 50%
(c) 100%
(d) 67%
(e) 33%

The next two questions involve the following situation:
In the "Barrel Ride" at the amusement park, a passenger finds himself "stuck" to the inner wall of a vertical cylinder that is rotated at high speed, at which point the floor drops out from under his feet.



Question value 5 points

(4) What is the force that pushes the passenger radially outward, so that he will stick to the wall?

(a) There is no force at all pushing outward on the passenger.
(b) The force of the passenger's inertia.
(c) The centripetal force by the barrel wall.
(d) The static friction force by the barrel wall.
(e) The normal force by the barrel wall.

Question value 5 points

(5) The ride is designed to spin the barrel at a minimum speed ω, before allowing the floor to drop. Suppose that on a rainy day, the walls of the barrel become slippery, so the the coefficient of static friction is <u>half</u> of its usual value. With what mimimum speed must the barrel rotate, on the rainy day?

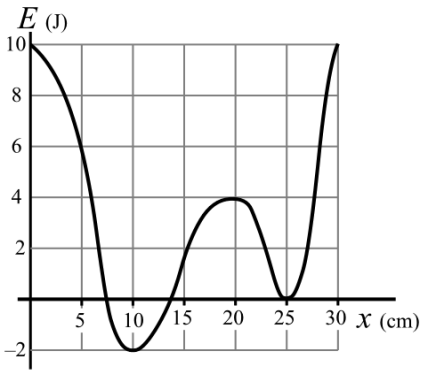
(a) 0.70 ω
(b) 1.4 ω
(c) 2.0 ω
(d) 4.0 ω
(e) 0.50 ω

The next two question involve the following situation:

An object of mass m = 1.0 kg moves while subject to the potential energy diagram shown below. The object is observed to have a speed v = 2.0 m/s when the ball is at location x = 20 cm.

Question value 5 points

(6) What will be the turning points of the object's motion along the x-axis?



(a) x = 6 cm and x = 27 cm
(b) x = 0 cm and x = 30 cm
(c) x = 5 cm and x = 28 cm
(d) It will not have *any* turning points in this situation.
(e) x = 15 cm and x = 23 cm

Question value 5 points

(7) What maximum speed can the object have, during its motion?

(a) 2.8 m/s
(b) 2.0 m/s
(c) 1.4 m/s
(d) 3.5 m/s
(e) 4.0 m/s

Question value 10 points

(8) A rubber ball and an egg having identical masses are dropped from a height h. The ball rebounds to height h, while the eggs splatters on the ground without rebounding. The ball is in contact with the ground for a total time T_o, while the duration of the egg's splatter is $2T_o$. Compare the average force magnitude felt by each object, while in contact with the ground.

(a) $F_{ball} = (1/2)\, F_{egg}$
(b) $F_{ball} = F_{egg}$
(c) $F_{ball} = 4\, F_{egg}$
(d) $F_{ball} = 2\, F_{egg}$
(e) $F_{ball} = (1/4)\, F_{egg}$

PHYS 2211 A/B Recitation TA and Room Assignments

Tests will be returned in recitation, ideally in the *same* week as the test is given. 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
WEDNESDAY				
1:05 – 1:55 pm	B01 Dark, Jason			
2:05 – 2:55 pm		A01 Coenen, Ashley		
3:05 – 3:55 pm			B06 Coenen, Ashley	A05 Cowan, Erika
4:05 – 4:55 pm	B05 Eswar, Aditya	B02 Dark, Jason	A02 Coenen, Ashley	A06 Cowan, Erika
THURSDAY				
1:05 – 1:55 pm				
2:05 – 2:55 pm	A03 Eswar, Aditya	B08 Cowan, Erika	B03 Dark, Jason	
3:05 – 3:55 pm			A07/B07 Dark, Jason	
4:05 – 4:55 pm	A04 Eswar, Aditya		B04 Dark, Jason	
5:05 – 5:55 pm			A08 Dark, Jason	