Name: «Name_»	Signature:
Surname: «Surname_»	Student ID Number: «Student_ID»

PHYS 101 General Physics I – Midterm 1

April 3, 2015 Friday 17:30 -19:10

Please read!

- Count to make sure that there are 5 pages in the question booklet
- Check your name and surname on front page, and student ID number on each page, and sign each page.
- This examination is conducted with closed books and notes.
- Put all your personal belongings underneath your seat and make sure that pages of books or notebooks are not open.
- Absolutely no talking or exchanging anything (like rulers, erasers) during the exam.
- You must show all your work to get credit; you will not be given any points unless you show the details of your work (this applies even if your final answer is correct!).
- Write neatly and clearly; unreadable answers will not be given any credit.
- If you need more writing space, use the backs of the question pages and put down the appropriate pointer marks.
- Make sure that you include units in your results.
- Make sure that you label the axis and have units in your plots.
- You are not allowed to use calculators during this exam.

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1	2	3	4	5	Total

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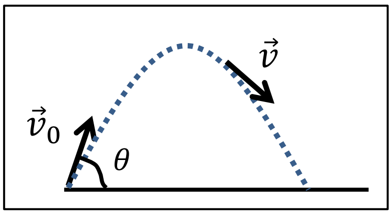
1-(25 points) A projectile is launched from the origin on the ground with initial velocity $\vec{v}_0$ which makes an angle θ with the ground. At an arbitrary time, t, the velocity vector of the projectile is $\vec{v}$. The gravitational acceleration is g.



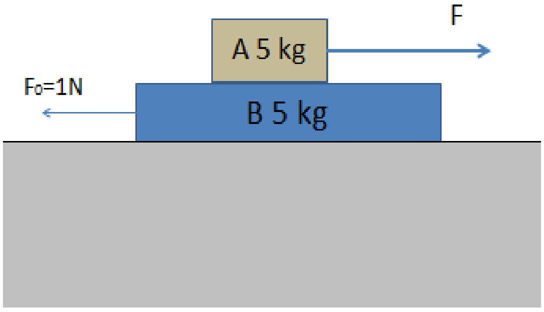
a) Find the time, $t_\perp$, at which $\vec{v}$ becomes perpendicular to $\vec{v}_0$.

b) Find the distance of the projectile from the launch point at time $t_\perp$.

c) Determine the values of the launch angle θ for which $\vec{v}$ cannot be perpendicular to $\vec{v}_0$ before the particle hits the ground.

Solution continues on the back side of the page **Yes** □ **No** □

2-(25 points) A person is pulling two boxes **A** and **B**, one on top of the other, by applying a force (**F**) to the box **A**. A constant force F_0=1N is applied to the box **B** and there is friction **only** between the boxes. The coefficient of friction is 0,1 (Assume that the static and kinetic coefficients are the same and g=10m/s^2).



a) Draw a free-body diagram for each box

b) Calculate the acceleration of each box when F is F=0 N, F=1 N, F=9 N, F=15 N

c) Calculate the friction force between two boxes when F is F=0 N, F=1 N, F=9 N, F=15 N

d) Plot the acceleration as a function of F for each box <u>on the same graph</u>.

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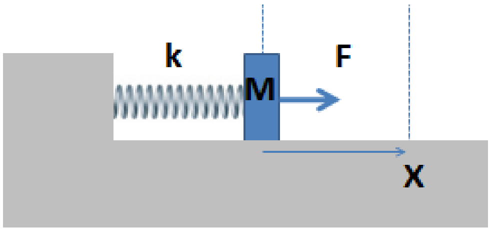
3-(25 points) A block of mass **M** is attached to a spring with a force constant **k** as shown in figure**.** Initially the block is at rest and a spring is neither stretched nor compressed. A constant force **F** is moving the block to the right on a frictionless horizontal surface.



a) Draw a free body diagram of the system when the block is pulled to a position **X** to the right of the equilibrium.

b) Calculate the acceleration of the block when it is pulled to a position **X** and **plot** the acceleration as a function of **X**.

c) Calculate the velocity of the block from the acceleration found in part (b) when it is pulled to a position **X**.

d) Find the maximum distance that the spring will stretch and check the unit of your result by using dimensional (unit) analysis (use the basic units kg, m, sec)

 Solution continues on the back side of the page **Yes** □ **No** □

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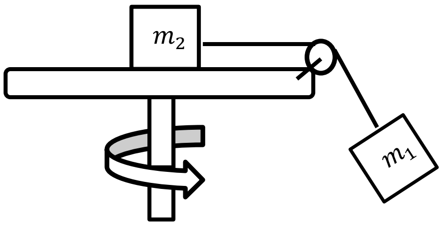
4-(25 points) A box of mass m_2 is standing at the center of a circular table of radius R. The box is attached by a light string of total length $2R$ to a hanging mass m_1, through a small frictionless pulley which is fixed at the edge of the table. The static friction coefficient between the box and the table surface is μ_s. We would like to demonstrate that it is possible to rotate the table with constant speed about an axis through its center while the box on the table does not slide.



a) m_2 must be greater than some minimum value, otherwise it will slide even before the table is rotated. Find this value.

b) Draw the free body diagrams of the boxes during rotation and write the dynamic equations.

c) Given that $m_1 = 100\text{g},\ m_2 = 200\text{g},\ R = \frac{1}{\sqrt{3}}\text{m},\ \mu_s = \frac{1}{\sqrt{3}},\ g = 10.0\text{m/s}^2$, determine the maximum speed m_1 can have in this demo, and the corresponding period of rotation. (Leave the square-root numbers as they are if they cannot be simplified as integers)

 Solution continues on the back side of the page **Yes** □ **No** □