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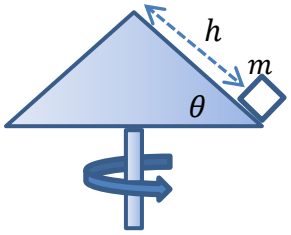
4-[25 pts.] A block of mass m is placed at the side surface of a cone. The cone can rotate about an axis through its center so that the block can make circular motion. The static friction coefficient between the block and the table is μ_s. The base angle of the cone is θ. Take gravitational acceleration as g.



(a) Draw the coordinate system you are using and draw the free body diagram of the block during rotation with constant speed.

(b) Write the relevant Newton's equations for the block explicitly using your free-body diagram.

(c) The block is placed at a distance h from the tip of the cone. Determine the expression for the maximum rotation speed in terms of given parameters for which the block does not slide.

(d) For $\mu_s = \frac{2}{\sqrt{3}}, h = \frac{1}{3}$ meters, $g = 10\,\frac{m}{s^2}$, and $\theta = \frac{\pi}{6}$,calculate the maximum rotation speed.

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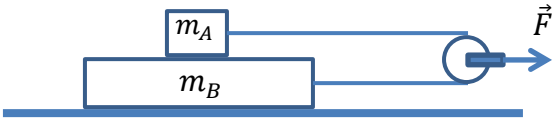
3-[25 pts.] Two blocks with respective masses m_A and m_B are attached by an ideal rope through a massless pulley. m_B is on the ground and m_A is placed on top of m_B. The coefficients of kinetic and static frictions are both equal to μ on all surfaces. The pulley is pulled horizontally by a force. Note that the tension in the rope is the same on either branch.



(a) Suppose that for a given magnitude of force F the blocks move together (like a single object) with the same acceleration. Draw the free body diagram of the blocks. Find this acceleration in terms of F, m_A, m_B, μ, g.

(b) At a particular value of the force F, the top block moves with constant acceleration and the bottom block moves with constant velocity. Draw the free body diagram of the blocks. Using Newton's laws find this particular value of the force and the acceleration of the top block in terms of m_A, m_B, μ, g.

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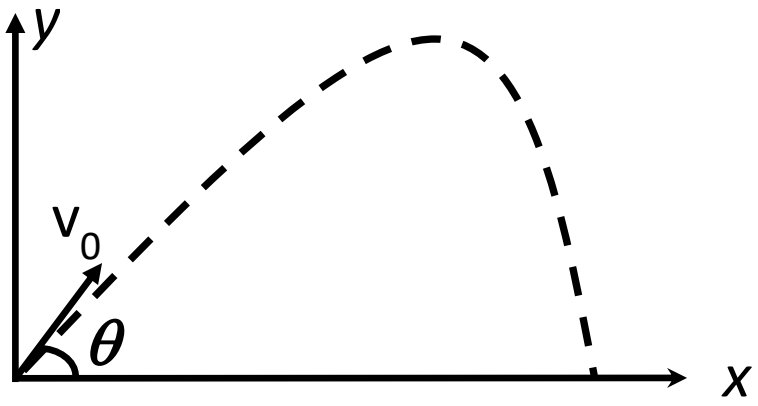
2-[25 pts.] A source in a laboratory experiment emits particles from the origin of the coordinate space with speed v_0 and at an angle θ from the x axis. The experiment is designed so that the acceleration of the particles is $\vec{a}=-Ct\,\hat{j}$ where C is a positive constant, t is time, and gravity can be ignored.



a) Find the x and y coordinates of the particles as functions of time.

b) Find h, the maximum value of y achieved during this trajectory.

c) Find l, the value of x where the particles hit $y=0$.

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1-[25 pts.] An object is dropped from **rest** under the influence of gravitational acceleration $g > 0$. If the object travels half its total path in the last second before it hits the ground, find

(a) the time it took to fall, and

(b) the initial height in terms of g.

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PHYS 101 General Physics I – MT1 Exam

November 11, 2016 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.
- Only the answers in the boxes will be graded and NO partial credit will be given. No points will be given to unjustified answers. Incomplete calculations will not be graded.

Signature: