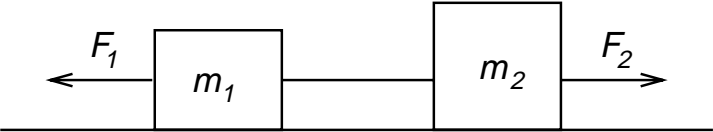


PHY 2060 Fall 2005 — Exam 1

Instructions: Attempt all ten questions, each of which carries a maximum of 10 points. You will receive credit only for knowledge and understanding that you demonstrate in your written solutions. To maximize your score, you should briefly explain your reasoning and show all working. Give all final answers in terms of variables defined in the problem (and possibly also g , the acceleration due to gravity). Please try to write neatly!

During this exam, you may use a single formula sheet. You are not permitted to consult any other books, notes, or papers, to use calculators or any other electronic device, or to communicate with anyone other than the proctor. In accordance with the UF Honor Code, by turning in this exam to be graded, you affirm the following pledge: *On my honor, I have neither given nor received unauthorized aid in doing this assignment.*

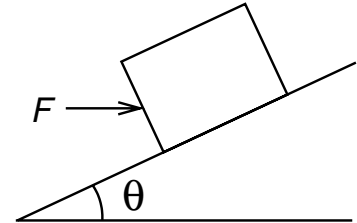
1. An object moving in one dimension is observed to have a position x that varies with time t according to $x(t) = x_0 \cos(2\pi t/\tau)$, where $x_0 = 10$ cm and $\tau = 3$ seconds.
 - (a) Determine the particle's velocity $v(t)$ and acceleration $a(t)$.
 - (b) What is the maximum velocity, and at what position(s) does it occur?
 - (c) What is the maximum acceleration, and at what position(s) does it occur?
2. Two blocks rest on a horizontal, frictionless surface, and are connected by an ideal string, which is also horizontal. Mass m_1 is subjected to a force of magnitude F_1 , and mass m_2 is subjected to a force of magnitude F_2 , directed as shown in the figure.
 - (a) What is the acceleration of mass m_1 ?
 - (b) What is the tension in the string?

The diagram shows two rectangular blocks, labeled m_1 and m_2 , resting on a horizontal surface. They are connected by a thin horizontal line representing a string. To the left of block m_1 , there is a horizontal arrow pointing left, labeled F_1 . To the right of block m_2 , there is a horizontal arrow pointing right, labeled F_2 .
3. A plane flying at a constant airspeed of 120 km/hr has enough fuel to power the engine for only another 17 minutes. The pilot hopes to reach a landing strip located 32 km due north of the plane's current position. The pilot is initially unaware that there is a 30 km/hr wind heading due west. However, after 12 minutes of steering due north, the pilot realizes that the plane is being blown off course and corrects the plane's heading to properly take the wind into account.
 - (a) At the moment the plane corrects course, how far is it from the landing strip?
 - (b) Still flying at an airspeed of 120 km/hr, can the plane reach the landing strip before the fuel runs out? Explain your answer.

You should be able to do all necessary arithmetic without the aid of a calculator. It may be helpful to recall that 60 km/hr = 1 km/min and that $3^2 + 4^2 = 5^2$.

4. A construction worker stands in a crane bucket that is being lowered vertically downward at a constant speed v_b . The worker throws a pebble vertically upward at a speed v_p relative to the bucket. If the pebble is released at a height h above the ground, what is the greatest distance above the ground that the pebble reaches during its subsequent motion? You may ignore drag forces and the possibility that the pebble hits anything else before reaching the ground.

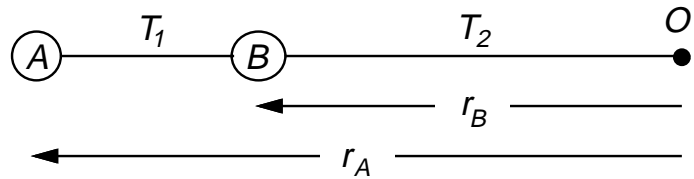
5. A block of mass m rests on a plane inclined at an angle θ above the horizontal. To prevent the block sliding down the incline, a horizontal force of minimum magnitude F must be applied to the block.



- (a) Find the magnitude of the normal force exerted on the block by the plane.
- (b) Find the coefficient of static friction between the block and the plane.

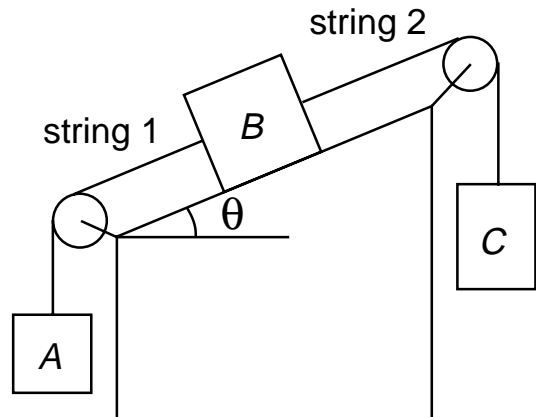
6. Two beads A and B , of masses m_A and m_B , are attached at different points to an ideal string, which is then twirled in a horizontal plane so that the beads pursue circular motion about point O with radii r_A and r_B , respectively. The outer bead (A) is observed to have a constant speed v_A .

- (a) Find the tension T_1 in the string between A and B .
- (b) Find the tension T_2 in the string between B and O .



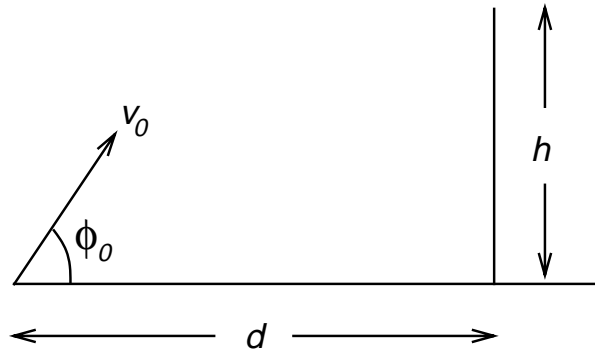
7. Three blocks (A , B , C of masses m_A , m_B , m_C , respectively) are connected by two ideal strings (1, 2) running over massless pulleys, as shown in the diagram. There is no friction in the system. Find the mass m_C that causes block B to ...

- (a) move up the incline with a constant speed v .
- (b) move up the incline with a constant acceleration $a = g/2$.

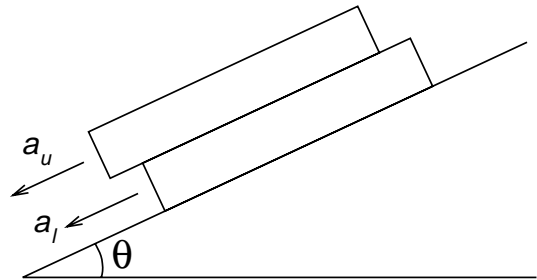


8. You want to fire a dart from a blowgun pointing at a fixed angle ϕ_0 above the horizontal ground. Your goal is for the dart to pass over the top of a wall of height h that stands with its base a distance d from the firing point. By blowing harder or more softly, you can vary the initial speed v_0 with which the dart leaves the blowgun.

- (a) What is the minimum initial speed with which the dart must be launched in order for it to pass over the top of the wall?
- (b) What is the maximum height of wall that it is possible for the projectile to pass over (for fixed d , ϕ_0 , and g)?



9. A runaway railway locomotive traveling at a steady speed v_r is spotted passing through a station. After a delay time T , a pursuit party sets off from the station on a track parallel to the runaway's. The pursuit locomotive undergoes a constant acceleration a_p from rest until it reaches its top speed v_p (where $v_p > v_r$), which it then maintains until it catches up with the runaway. How far along the tracks from the station does the pursuit locomotive overhaul the runaway?
10. Two identical slabs of polished granite sit on top of one another on a concrete ramp, which is inclined at an angle θ to the horizontal. The upper slab starts sliding downward along the top of the lower slab, which in turn starts sliding down the ramp. The coefficient of kinetic friction between the two slabs is μ_g , while the coefficient of kinetic friction between the granite and concrete surfaces is μ_c (where $\mu_c > \mu_g$).



Find the acceleration (a) a_u of the upper slab, (b) a_l of the lower slab.