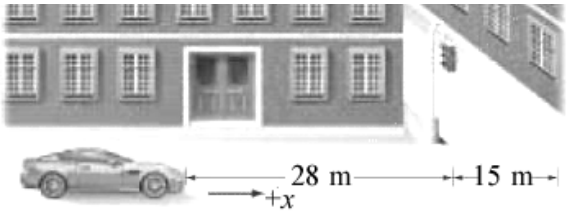
Physics 7A, Spring 2010 **Lecture 1, Professor Yildiz** **MT 1, 2/22/10**

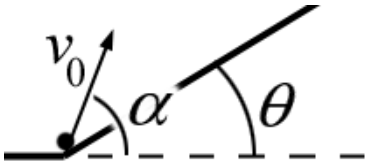
1. (Kinematics in 1D) Giancoli, Chapter 2, Problem 87. (15 points)

   A person driving her car at v_0 = 45 km/h approaches an intersection just as the traffic light turns yellow. She knows that yellow lights only last for Δt_{yellow} = 2 seconds before turning to red, and she is d = 28 m away from the intersection. Should she try to stop or should she speed up to cross the intersection before the light turns red? The intersection is w = 15 m wide. Her car's maximum deceleration is a_{max} = -5.8 m/s^2, whereas it can accelerate from v_0 = 45 km/h to v_1 = 60 km/h in Δt_{acc} = 6.0 s. Ignore then length of the car and her reaction time. [Do not just answer 'stop' or 'speed up'! You must provide physical justification for your answer!]



2. (Projectile Motion) (20 Points)

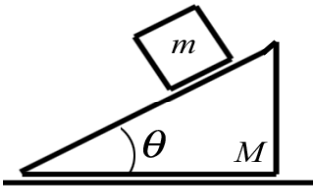
   a) A person stands at the base of a hill that is a straight incline making an angle θ with the horizontal. For a given initial speed of v_0, at what angle α (to the horizontal) should objects be thrown so that the distance, d, they travel before they land up the hill is as large as possible?
   b) If the objects are thrown downward from where they landed, at what angle β should they be thrown so that the object lands back down at the base of the hill?



3. (Newton's 3rd Law) (20 Points)
   A box of mass m is placed on an incline of mass M that makes an angle θ with the horizontal surface of a table. (See figure on the next page)

   a) Determine the acceleration of the box along the incline, assuming that there is no friction between the box and the incline, but the incline is fixed in place on the table.
   b) Determine the acceleration of the box if there is no friction between the box and the incline *or* between the incline and the surface. (That is, the incline is free to move along the surface as well.)

c) What should be the minimum coefficient of static friction between the incline and the table such that the incline does not move?

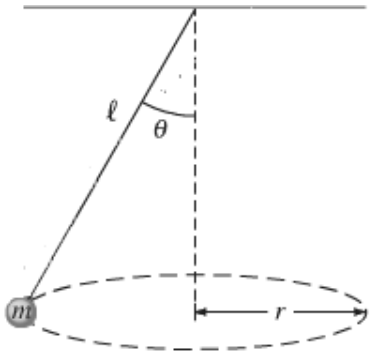


4. (Centripetal Force) Workbook problem WS7 problem 5. (20 Points)
An automobile enters a turn whose radius is R. The road is banked at an angle θ, and the coefficient of static friction is μ.

a) Find the *largest* speed of which the car will not skid *upwards* along the bank.
b) Find the *smallest* speed of which the car will not skid *downwards* along the bank.

5. (Circular Motion) (25 Points)

a) A small ball of mass m, suspended by a cord of length l, revolves in a circle where θ is the angle the string makes with the vertical. Calculate the speed and period of the ball in terms of m, l, θ, and g.



b) Write down the x, y coordinates of a point P on a circle in terms of radius R and the angle θ with respect to the x-axis. If an object revolves around this circle with uniform angular velocity ω, what would be the position of the object as a function of time t and ω? ($\theta = 0$ at $t = 0$)

c) For an object revolving uniformly in a horizontal circle of radius R, show that acceleration vector ($\vec{a}$) is opposite to the displacement vector and hence directed towards the center of the circle at any given time. (Hint. Use the circular coordinates from Question 5b)