Due at the start of class on Tues Oct 21, 2003.

Answer the following questions in groups of three. Turn in one solution sheet per group. Write the names of your group’s members at the top of the first page of your solution sheet.

1. A block of ice, in the shape of a cube, originally having volume 1,000 cm³, is melting in such a way that the length of each of its edges is decreasing at the rate of 2 cm/hr. (Assume that the block of ice maintains its cubical shape.)
   
   (a) Sketch a picture of this situation and label relevant items in your picture.
   
   (b) Specify what data you are given in terms of mathematical symbols.
   
   (c) Find a formula for the volume of the ice.
   
   (d) Find a formula for the surface area of the ice.
   
   (e) Find the rate of change of the surface area at the time the volume is 64 cm³? (You should state first what you need to find in terms of mathematical symbols.)

2. A ferris wheel with radius 25 meters is revolving at the rate of 10 radians per minute. How fast is a passenger rising when the passenger is 15 meters higher than the center of the ferris wheel and rising? Before attempting to answer this question, do the following.
   
   (a) Sketch a picture of this situation and label relevant items in your picture.
   
   (b) Specify what data you are given in terms of mathematical symbols, and state what you need to find in terms of mathematical symbols.
   
   (c) Now try to answer the question.

3. Assume that a certain artery in the body is modeled by a circular tube whose cross section has radius 1.2 mm. Fat deposits are observed to build up uniformly on the inside wall of the artery. Find the rate at which the cross-sectional area of the artery is decreasing relative to the thickness of the fat deposit at the instant when the deposit is 0.3 mm thick. Before attempting to answer this question, do the following.
   
   (a) Sketch a picture of this situation and label relevant items in your picture.
   
   (b) Specify what data you are given in terms of mathematical symbols, and state what you need to find in terms of mathematical symbols.
   
   (c) Now try to answer the question.
4. A ball is dropped from a height of 160 feet. A light is located at the same level, 10 feet away from the initial position of the ball. How fast is the ball’s shadow moving along the ground one second after the ball is dropped? You might find the formula \( h(t) = -16t^2 + v_0t + s_0 \) useful. Before attempting to answer this question, do the following.

   (a) Sketch a picture of this situation and label relevant items in your picture.

   (b) Specify what data you are given in terms of mathematical symbols, and state what you need to find in terms of mathematical symbols.

   (c) Now try to answer the question.

5. The minute-hand on an analog watch is 8 mm long and the hour hand is 4 mm long. How fast is the distance between the tips of the hands changing at one o’clock? You might find the formula \( a^2 = b^2 + c^2 - 2bc \cos \alpha \) useful. Before attempting to answer this question, do the following.

   (a) Sketch a picture of this situation and label relevant items in your picture.

   (b) Specify what data you are given in terms of mathematical symbols, and state what you need to find in terms of mathematical symbols.

   (c) Now try to answer the question.

6. At noon on a certain day, a truck is 250 miles due East of a car. The truck is travelling West at a constant speed of 25 mph, while the car is travelling due North at 50 mph. (You might find your lecture notes from Wed Oct 8 useful.)

   (a) Sketch a picture of this situation and label relevant items in your picture.

   (b) Specify what data you are given in terms of mathematical symbols.

   (c) Find a formula relating the distance between the two vehicles to other items in your picture.

   (d) Find the rate of change of the distance between the two vehicles with respect to time at time \( t \). (You should state first what you need to find in terms of mathematical symbols.)

   (e) At what time is the distance between the two vehicles neither increasing nor decreasing?

   (f) The minimal distance between the two vehicles occurs at the time found in (e); why? Find the minimal distance between the two vehicles.