Math 142 **Group Project # 2** **Spring, 1996**

This is due in class Thursday March 14. You are to work in your present groups that were assigned the last time we handed out the playing cards. These groups should not be any larger than 4 persons and preferable of size 4 exactly. Each group will turn in one paper with all your names on it. As usual each name should have a percentage after it that represents the percentage of the work that the group as a whole felt that each person did. Thus if the people in the group are A, B, C, and D and everyone put about the same amount of work into the project, then everyone would be rated 25%. If however person A put in a lot of effort and person C only only did a little bit the numbers might look like A 40%, B 25%, C 10% D 25%. As long as all the numbers are above 10 % this will not effect the grade, but anyone who does less than 10 % will be penalized.

1. This problem is to reinforce that we can compute volumes by "integrating up" the area of cross sections. Assume that very modern building is made so that the its base is an ellipse 100ft long and and 50ft wide. Its cross sections perpendicular to both the ground and its the major (that is longest) axis of its base is an isosceles triangle of height 75 feet. Find the volume of the building giving complete details of what you have done and why it works.

2. A rock is thrown off the top of a 150 ft building so that its initial motion straight out from the side of the building at a rate of 128feet/sec. Let $x(t)$ be the horizontal distance from of the rock t second after it has been released and $y(t)$ its height above the ground after the same time. Then Newton's Laws on Motion tell us that

$$x'(t) = 128\text{ft/sec}, \quad x(0) = 0\text{ft}.$$
$$y''(t) = -32\text{ft/sec}^2, \quad y(0) = 150\text{ft}, \quad y'(0) = 0\text{ft/sec}$$

   (You don't have to worry where these equations can from, you can just take them on faith.)

   (a) Solve these equations for x and y as functions of t.

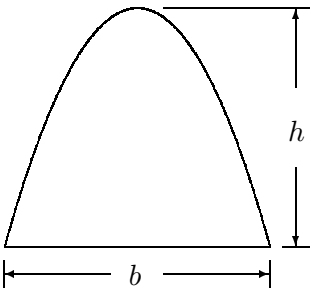
   (b) How long does it take for the rock to hit the ground? Explain how you got your answer.

   (c) How far form the base of the building is the spot where the rock hit the ground. Explain how you got your answer.

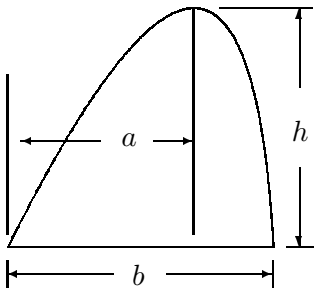
   (d) Find the x-y equation of the path taken by the rock. Explain how you got your answer and also explain why the equation you found results form "eliminating t" from you equations for $x(t)$ and $y(t)$.

   (e) Find the distance travel by the rock between the time it is released and the time it hits the ground. Explain how you got your answer.

3. (a) Find a formula for area of the figure bounded by a parabolic arc and a line segment perpendicular to the axis of the parabola. Formula should be in terms of the length b of the base and the height h (see the figure labeled symmetric parabola). You should have a detailed description of why your formula holds even if you use the computer to do most of the calculations.



Symmetric Parabola



Skew Parabola

   For extra credit you can do the same thing for the skew parabola as in the second figure in terms of b, h, and a.