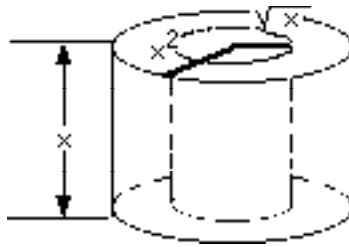


1. In designing a lawn area, an architect planned one such area of an estate to be between the parabolas $y = 20 - 0.01x^2$ and $y = 0.005x^2 - 15$ and the lines $x = -27$ and $x = 27$ where the dimensions are in meters. Find the area of this part of the lawn.
2. The tank on the wing of a jet is formed by revolving the region bounded by the graph $y = \frac{1}{8}x^2\sqrt{2-x}$ and the x-axis about the x-axis, where x and y are measured in meters. Find the volume of the tank.
3. When bacteria grow in the presence of unlimited food, they increase at a rate proportional to the number present. If, in a certain culture, the number present at a certain instant was 1000, and if the number present ten hours later was 8000, find the number of bacteria at the end of fifteen hours.
4. Find the length of the arc of the curve $y = \frac{2}{3}x^{\frac{3}{2}}$ from $x = 3$ to $x = 8$.
5. Every horizontal section of a solid at a height x above its lowest point is a ring between two concentric circles of radii $\sqrt{x}$ and x^2 respectively. Find the volume of the solid if it is 1 unit high.



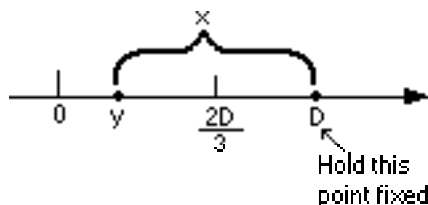
(Extra credit-if you can explain why the definite integral above may be negative!)

6. What is $\frac{d}{dx} \int_{\pi}^{3x^2} \sqrt{\sin u} \, du$?

(You **must** use the Fundamental Theorem of Calculus)

***The following problem(s) will be due Wednesday
November 20, 1996. 8:00 pm.***

1. Two like magnetic poles repel each other with a force $F = \frac{k}{x^2}$ newtons, where k is constant. Express the work needed to move them along a line from D meters apart to $\frac{D}{3}$ meters apart.

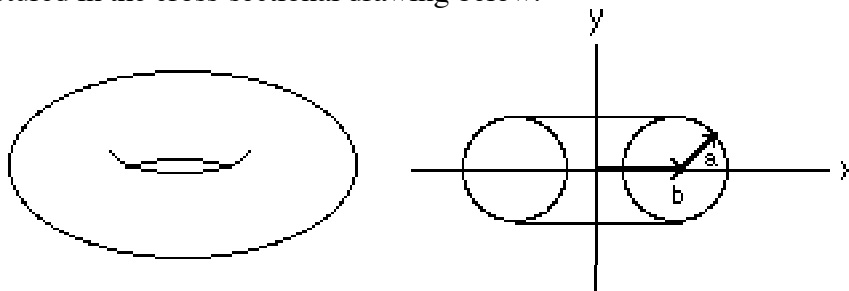


2. The sides of a beverage keg, 18 in. tall, bow out in the shape of a parabola. All horizontal cross sections are circles of varying size, from a maximum diameter of 12 in. in the middle, to a minimum diameter of 9 in. at the top and at the bottom. Calculate the volume of beverage that the keg can hold.
3. A conical ant hill has a height of 1 in. and a radius of 2 in. If the ant hill was constructed from very fine soil weighing about 20 lb/ft^3 , then roughly how much work was done by the ants in building their hill?
4. A pond is stocked with a certain species of fish. It has been determined that the food supply in 500 ft^3 of this pond water can adequately support one fish. The pond is nearly circular in circumference, is 20 ft deep at its center, and has a radius of 200 ft. Assuming that the bottom of the pond can be approximated by the model

$$y = 20 \left[\left(\frac{x}{20} \right)^2 - 1 \right]$$

find the volume of water in the pond and then estimate the maximum number of fish that the pond can support.

5. Find the volume of the torus with radii $a = 1$ in. and $b = 3$ in. where a and b are as pictured in the cross-sectional drawing below.



Assume that $b > a$ (if not, the torus has no "hole"). The equation of the circle which generates the torus having dimensions a and b is $(x-b)^2 + y^2 = a^2$.