Math 181 **Spring 2007** **Project 03**

Due February 13

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Name

Be sure to re-read the WRITING GUIDELINES rubric, since it defines how your project will be graded. In particular, you may discuss this project with others but **you may not collaborate on the written exposition of the solution.**

"Obvious" is the most dangerous word in mathematics." – Eric Temple Bell

Modeling Blood Flow

In order to design a model of the flow of blood through a blood vessel, such as a vein or an artery, we assume the shape of a modeled blood vessel to be a cylindrical tube with radius R and length l. Because of friction at the walls of an artery or vein, the velocity v of the blood is greatest along the central axis of the tube and decreases as the distance r from the axis increases until v becomes 0 at the wall. The relationship between v and is given by the law of laminar flow first described by Poisseuille:

$$v = \frac{P}{4nl}\left(R^2 - r^2\right)$$

where n is the viscosity of the blood and P is the pressure difference between the ends of the tube. If P and l are constant, then v is a function of r with domain $[0, R]$.

The purpose of this project is for you carefully follow the procedure for building a definite integral from Riemann Sums to derive a definite integral that computes the flux (volume of blood that crosses a given cross section of the blood vessel per unit time). To do so you should begin by partitioning the interval $[0, R]$ and use this partition to think of the interior of the blood vessel as a collection of nested cylindrical shells. Then estimate the amount of blood in each shell that passes a given cross section of the blood vessel.