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.