83.

Problem 18.38 (RHK)

We have to calculate the greatest speed at which, blood at 37^0 C, *can flow through an artery of diameter* 3.8 mm *if the flow is to remain laminar*.

Solution:

The critical speed v_c at which flow of a liquid of density ρ in a pipe of diameter D changes from laminar to turbulent is determined by the *Reynolds number R* and the viscosity of the liquid η,

$$R = \frac{\rho D v_c}{\eta}.$$

For cylindrical pipes, the Reynolds number corresponding to critical velocity is about 2000.

Density of blood, $\rho_{blood} = 1.060 \times 10^3$ kg m^{-3}, and its viscosity at 37^0 C, $\eta_{blood} = 4.0 \times 10^{-3}$ N s m^{-2}. Therefore, the greatest speed at which blood can flow through an artery of diameter 3.8 mm if the flow is to remain laminar is

$$v_c = \frac{2000 \times 4.0 \times 10^{-3}}{1.060 \times 10^{3} \times 3.8 \times 10^{-3}} \text{ m s}^{-1} = 1.98 \text{ m s}^{-1}.$$