Physics I

Viscosity

Viscosity: $\frac{F}{A} = \eta \frac{v}{l}$ for two parallel surfaces

$$Q = \frac{\pi R^4 (P_1 - P_2)}{8\eta L}$$ Poiseuille's equation

Problem 1.- A pipeline has a diameter of 25.4cm and a difference in pressure of 30 psi. What new diameter would you need to increase the flow 3 times?

Problem 1a.- A pipeline has a diameter of 25.4cm (10 inches), but it is going to be replaced to accommodate 5 times the flow of oil. If you keep the same pressure difference, how much should be the new diameter?

Problem 2.- Based on the Poiseuille's equation for laminar flow with viscosity η, what must be the pressure difference between the two ends of a 19km pipeline, 12.3 cm in diameter if it is to transport oil at a rate of Q = 950cm^3/s?

The viscosity of oil is $\eta = 0.20\ \text{Pa} \cdot \text{s}$

Problem 3.- Based on the Poiseuille's equation for laminar flow

$$Q = \frac{\pi R^4 (P_1 - P_2)}{8\eta L}$$

Suppose the radius of an artery is reduced to 0.8R due to accumulation of plaque. By what factor do you need to increase the pressure difference $(P_1 - P_2)$ to keep the same flow?