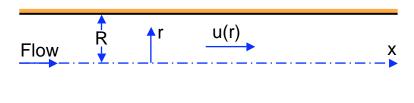## Problem 160E

Consider the fully developed pipe flow of an incompressible, non-Newtonian fluid :

This fluid is such that the normal stress in the x direction is equal to $-p$ where p is the pressure and the shear stress, σ, is related to the velocity gradient by

$$\sigma = C \left(-\frac{du}{dr} \right)^4$$

where C is a known constant. Find the friction factor, f, for this pipe flow in terms of C, ρ (the fluid density) and R (the radius of the pipe).

[Note: Remember the definition

$$f = \frac{4R}{\rho \bar{u}^2} \left(-\frac{dp}{dx} \right)$$

where $\bar{u}$ is the average velocity of flow in the pipe.]