SOLUTION
MINI EXAM 1
17 Sept 08

1. $$\langle v \rangle = \frac{Q}{\pi R^2}$$

$$\langle v \rangle = \left(\frac{4.5\ \text{gal}}{60\ \text{sec}}\right)\left(\frac{1}{\pi}\right)\left(\frac{2}{2.54\ \text{cm}}\right)^2 \times \left(\frac{100\ \text{cm}}{\text{m}}\right)^2\left(\frac{\text{m}^3}{264.17\ \text{gal}}\right)$$

$$= 0.5603\ \frac{\text{m}}{\text{s}}$$

$$= \boxed{0.56\ \text{m/s} \quad 2\ \text{sig figs}}$$

$$\langle v \rangle_1 = \frac{Q}{\pi R_1^2}$$

$$\langle v \rangle_2 = \frac{Q}{\pi R_2^2}$$

$$\frac{\langle v \rangle_1}{\langle v \rangle_2} = \frac{R_2^2}{R_1^2}$$

$$\langle v \rangle_2 = \langle v \rangle_1 \frac{R_1^2}{R_2^2}$$

$$\langle v \rangle_2 = \left(0.5603 \frac{m}{s}\right)\left(\frac{1\,in}{4\,in}\right)^2$$

$$= 0.035032\ m/s$$

$$= \boxed{0.035\ m/s} \quad \text{2 sig figs}$$

2. Newton's Law of Viscosity:

$$\tau_{yz} = -\mu \frac{dV_z}{dy}$$

$$\frac{F}{A} = -\mu \frac{V}{H}$$

$$V = \frac{FH}{A(-\mu)}$$

$$= \frac{\left(125\times10^{-3}\ \frac{kg\ m}{s^2}\right)(0.01\ m)}{(25\ cm^2)\left(\frac{m}{10^2\ cm}\right)^2\left(1.069\ \frac{kg}{m\,s}\right)}$$

$$= 0.4677\ m/s$$

$$\approx \boxed{0.47\ m/s}$$ 2 sig figs