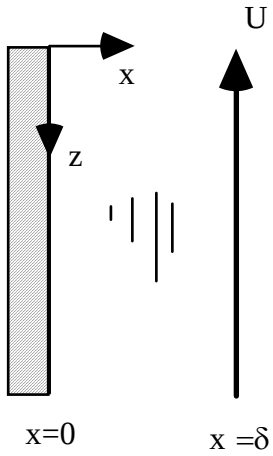
SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY
DEPARTMENT OF METALLURGICAL ENGINEERING

MET 422	HQ 1	October 10,1997
MI 220	(closed book)	2:00 PM

1. Write Newton's Law of Viscosity and give the units of each quantity in the equation. Use the CGS system of units.

2. Derive an equation showing the laminar velocity distribution between two vertical flat plates. One plate (the one at x=0) is stationary while the second plate (the one at x=∂) is moving upward at velocity U. Assume the z direction is down. Gravity acts on the fluid in the z direction. There is no pressure gradient.



3. The Hagen-Poiseuille Equation describes the laminar flow of water through a tube. Derive an equation showing the **volume** flow rate through a tube.

$$v_z = \left[\frac{P_o - P_L}{L} + \rho g\right]\left(\frac{R^2}{4\eta}\right)\left[1 - \frac{r^2}{R^2}\right]$$

4. Find the drag force in dynes for a tethered sphere pulled through water. The room-temperature water is flowing past the 1 cm. diameter sphere at 1000 cm/sec. The viscosity of water is 1 cP.

5. The time required to mix reagents in a reaction vessel is a function of

   L = length of the vessel
   D = diameter of the vessel
   η = viscosity
   ρ = fluid density
   V_o= mixer speed, cm/sec

   Reduce the number of independent variables in the function by the use of dimensionless variables. Be sure to make time dimensionless.