Consider flow of a polymer in a slit which is 1 mm high and 3 cm wide. The polymer behaves as a power law fluid whose viscosity is shown in the figure below. The density is 1.0 gm/cm$^3$. The force per unit area exerted on the top plate is $10^3$ Newtons per meter squared (N/m$^2$).

**Problem #1a**
This is for drag flow where the velocity of the upper plate is 1.0 m/sec. What is the Reynolds number for flow in the slit? Do you have to make any assumptions and if so what are they?

**Problem #1b**
Can you estimate the volumetric flow rate?

**Problem 2**
Using the data in the above viscosity chart, compute the power law index.
Problem #3a
Assume a melt as a Newtonian fluid flowing through a cylindrical channel of length 5.0 cm. The viscosity is $10^3$ poise. The channel diameter is 3.0 mm. The flow rate is 2.0 gm/min. The density is 1.0 gm/cm$^3$.

What is the Reynolds number? (base this on the maximum velocity)

Problem #3b
Can you estimate what the pressure drop would be to achieve this flow rate?

Problem #4
The following data is from an experiment using the capillary rheometer.

- Force on piston = 600 pounds force
- Cross-sectional area of piston = 0.15 in$^2$
- Density of melt = 1.1 gm/cm$^3$
- Flow rate from die = 20 gm/min.
- Length of the die = 2.0 inches
- Die diameter = 0.08 inches

If you know the polymer melt behaves as a power law fluid with power law index of $n = 0.5$, then compute the viscosity using the Rabinowitsch equation.

You can break this up into a number of steps.
- What is the shear stress at the wall?
- What is the apparent shear rate at the wall?
- What is the actual shear rate at the wall?
- What is the viscosity of material at the wall?