## **Exercises 6:** Rubber Elasticity

**6.1.** Young's modulus for an elastomer at 25°C is 3 x $10^7$ dynes / cm². Calculate the shear modulus. What is the retractive stress if a sample 1cm x 1cm x 10 cm is stretched to 25 cm length at 100°C? The front factor is set to 1.

**6.2.** A styrene-butadiene rubber with 23.5 mol% styrene in the polymer is vulcanized with sulfur. (a) Calculate the stress at 20% elongation of the vulcanizate in which 1.4% of the butadiene units are crosslinked. (b) What would be the corresponding stress if 2% of the butadiene units are crosslinked? Assume random distribution of styrene and butadiene units in the polymer chain. [Density of vulcanizate (without filler) = 0.98 g/cm$^3$ at 25°C]

**6.3.** A 2g piece of a typical rubber-band is placed in a toluene-bath at 25°C. The material swells 4.88 times to its original volume. Calculate the number of elastically active chains per unit volume $n$ and the Young modulus $E$ of the dry rubber.
$\rho$(toluene) = 0.8669 g/cm$^3$, $\chi$ = 0.39