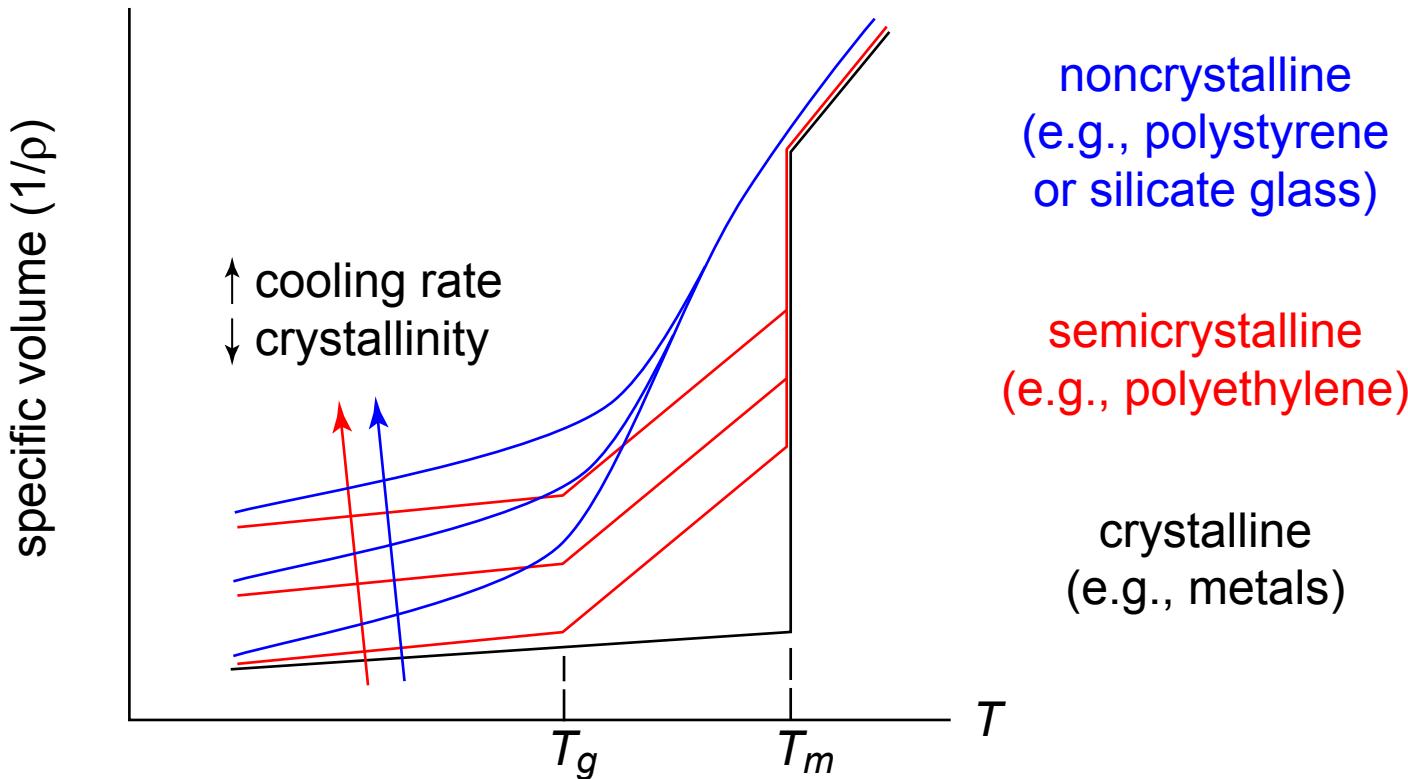
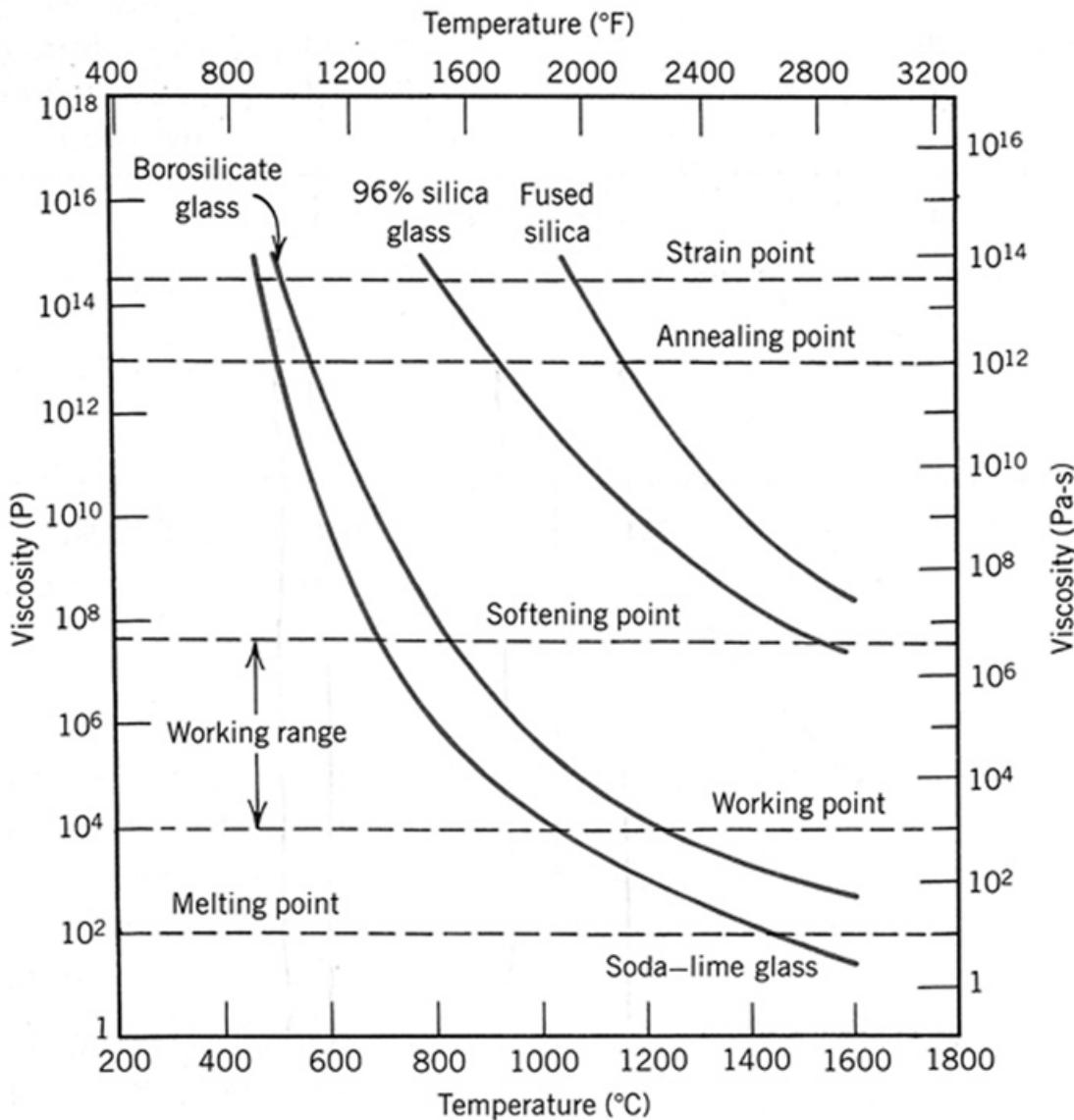


Molecular Structure: Crystallinity



Glass Viscosity



Adapted from: E.B. Shand, *Engineering Glass*, Modern Materials, Vol. 6, Academic Press, New York, NY, 1968.

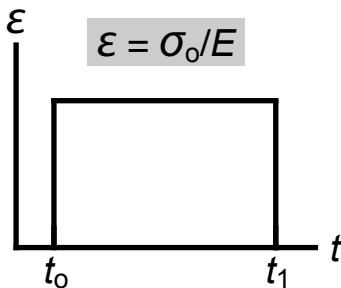
Viscoelastic Constitutive Models

element/model

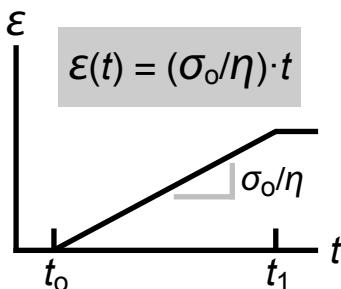
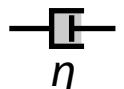
(a) spring
(linear elastic)



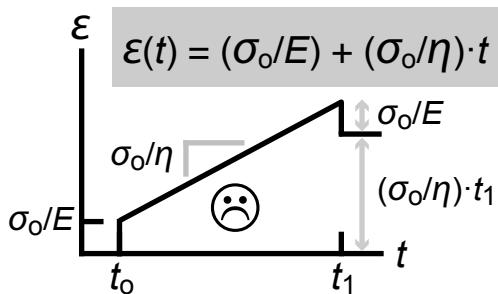
creep



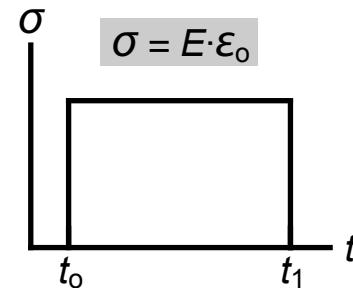
(b) dashpot
(viscous)



(c) Maxwell

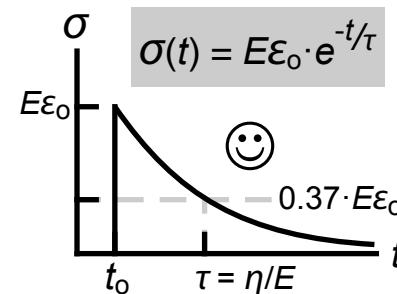


stress relaxation



$$\sigma(t) = \eta \frac{d\epsilon}{dt}$$

instantaneous strain
not possible

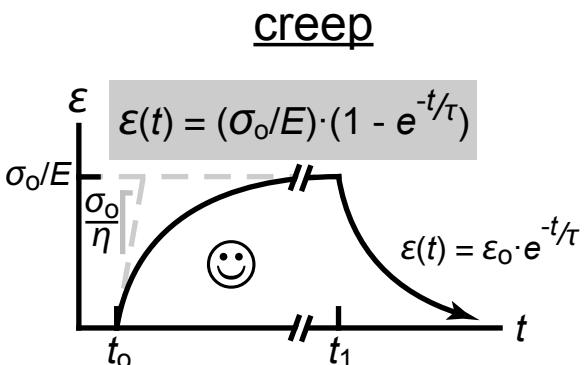
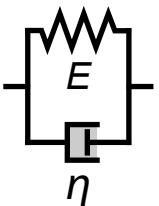


R.K. Roeder, "Mechanical Characterization of Biomaterials"; in *Characterization of Biomaterials*, Elsevier, 2013.

Viscoelastic Constitutive Models

element/model

(d) Kelvin/Voigt



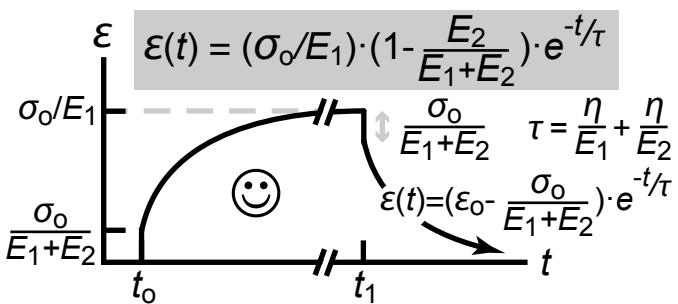
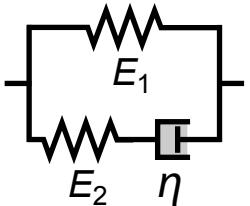
stress relaxation

$$\sigma(t) = E \cdot \varepsilon_0 + \eta \frac{d\varepsilon}{dt}$$

instantaneous strain
not possible



(e) standard
linear solid



A graph showing the stress σ as a function of time t . The vertical axis is labeled σ and the horizontal axis is labeled t . A solid black curve starts at a point labeled $(E_1+E_2)\epsilon_0$ on the vertical axis at $t=t_0$ and decays exponentially towards a horizontal dashed line labeled $E_2\sigma_0 / (E_1+E_2)$. A small smiley face is drawn near the curve. The graph is enclosed in a light gray box.