2351 polymer

$$Z_G(\beta, f) = \left(e^{-\beta(E_a - fa)} + e^{-\beta(E_b - fb)} \right)^N \qquad x = a, b$$

$$Z_G = \left[\frac{1}{\beta f} \left(e^{\beta f a} - e^{\beta f b} \right) \right]^N \qquad x \in [a, b]$$

$$\frac{F_G}{N} = \left[\frac{E_a + E_b}{2} - \frac{a+b}{2} f \right] - T \ln \left[2 \cosh \left(\overbrace{\frac{(b-a)f - (E_b - E_a)}{2T}}^{\text{the nonlinear term}} \right) \right]$$

$$\frac{L}{N} \triangleq \frac{a+b}{2} + \frac{b-a}{2} \tanh \left(\frac{(b-a)f - (E_b - E_a)}{2T} \right)$$

$$\approx \frac{a+b}{2} + \frac{(b-a)^2}{4T} f \qquad [\text{for } E_a = E_b,\ f \to 0]$$

$$\frac{L}{N} = \frac{a+b}{2} + \frac{T}{f} - \frac{b-a}{2} \operatorname{ctgh} \left(\frac{(b-a)f}{2T} \right) \qquad \text{for } x \in [a, b]$$

$$P(L) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{1}{2} \left(\frac{L - L_0}{\sigma} \right)^2}$$

$$L_0 = N \cdot (a+b)/2, \quad \sigma = N \cdot (b-a)^2/4$$

$$f = \frac{1}{\beta} \frac{\partial \ln P(L)}{\partial L} = \frac{4T}{(b-a)^2} L$$