

3. The Gibbs free energy of a piece of elastic satisfies  $dG = -SdT - Ld\mathcal{F}$ , where  $\mathcal{F}$  is the tension and  $L$  the string's length. At fixed temperature  $T$  the entropy is

$$S = S_0 - a(L - L_0) + b(L - L_0)^2,$$

where  $L_0$  is the length of the elastic at zero tension and  $a$  and  $b$  are positive constants. Show that the thermal expansion coefficient at zero tension is negative.