

AE/AM/CE/ME 102b Homework 2

Mechanics of Structures and Solids - Winter 2012

Due: Tuesday, January 24, 2012, 9:00am in class

Office Hours:

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Problem 1

Consider a solid neo-Hookean cylinder of undeformed length L and radius a subjected to a twisting moment M .

- a) Find the relation between M and the angle of twist τ per unit length.
- b) Will the radius of the cylinder change?
- c) Will the length of the cylinder change?

Hint: Assume a deformation of the form

$$r = f(R) \tag{1}$$

$$\theta = \hat{\theta} + \tau\lambda Z \tag{2}$$

$$z = \lambda Z \tag{3}$$

in cylindrical coordinates for λ constant.

Problem 2

Consider a system with n particles, n_A of type A and n_B of type B ($n_A + n_B = n$), trying to occupy n sites.

- a) Find the probability of any particular configuration.

b) Show that the energy of the system for large n is given by

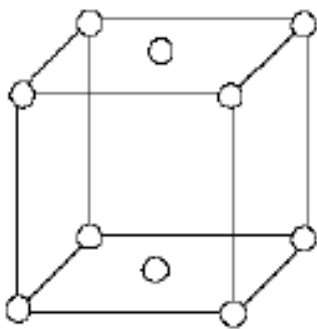
$$F = nk_b T \{ \lambda \log \lambda + (1 - \lambda) \log(1 - \lambda) \} \quad (4)$$

where $\lambda = n_A/n$, k_b and T are the Boltzmann constant and temperature, respectively.

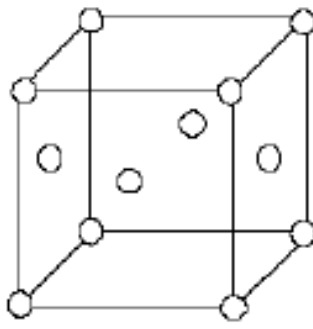
Hint: Stirling formula: $\log n! \approx n \log n - n$ for large n .

Problem 3

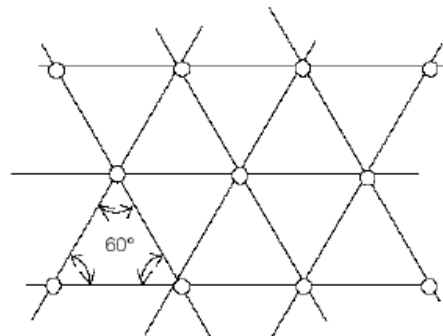
Which of the following are Bravais lattices, and what are the lattice vectors?



(a) Base centered cubic



(b) Side centered cubic



(c) Triangular lattice (in 2D)

- a) Base centered cubic: atoms at the corners of a cube, and at the center of the base and the top.
- b) Side centered cubic: atoms at the corners of a cube, and at the center of each vertical face.
- c) Triangular lattice (in 2D).