Department of Chemical Engineering, Indian Institute of Technology Delhi
CLL141: Introduction to Materials for Chemical Engineers
Semester I, 2017-2018

Time: 50 Min | **Minor-II** | Marks: 20
Date: 07/10/17 | Closed Book & Closed Notes

Note: Supplementary answer sheets will not be provided.

1. [5 Marks] In a region of space a quantum particle with mass m and with zero energy has a time-independent wave function

$$\psi(x) = Ax\exp\left(-\frac{x^2}{L^2}\right)$$

where A and L are constants. Determine the potential energy of the particle. Time-independent Schrodinger equation is:

$$-\frac{\hbar^2}{2m}\nabla^2\psi + U\psi = E\psi$$

where U is the potential energy.

2. [5+1 Marks] For a monoatomic BL crystal, the number of Schottky defects at 300 K are 10^{14} cm^{-3}, while the number of lattice sites are 10^{19} cm^{-3}. The number of defects increased to 5×10^{14} cm^{-3} at 900 K. Assume the number of lattice sites per cm^3 remains unchanged. What is enthalpy for formation of Schottky defects for the crystal? What would be the energy for defect formation if these were Frenkel defects? [R = 8.314 J/mol-K]

3. A polymer sample contains chains of different sizes. The number of repeat units varied between 10000 and 60000 and the mass of each repeat unit is 50 Da. Chains of different sizes are present in equal proportion. Assuming a continuous distribution of repeat unit/polymer mass calculate
   a. [3 Marks] the number averaged molecular weight,
   b. [5 Marks] the weight averaged molecular weight, and
   c. [1 Marks] the polydispersity index.

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