PYL114
Solid State Physics
MINOR-II

Date: 22.03.2015
Duration: 1 hr

Full marks: 20

Q1. Answers should be brief and to the point. (For, B and D, indicate the correct choice and write few lines of reasoning. No mark will be awarded if only the choice is indicated)

(2 × 5 = 10)

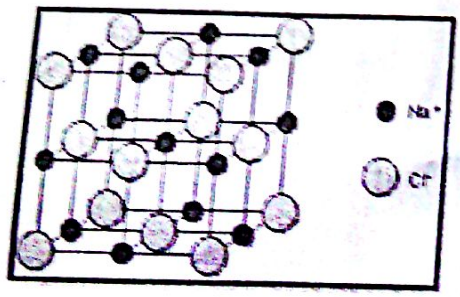
A] In a perfectly periodic ionic lattice structure (initially at 10K), a Schottky pair is created as the crystal is brought to room temperature (300K). What is the change in ~~internal~~ free energy of the system?

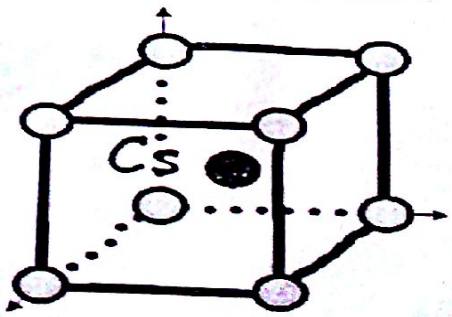
B] Crystal A has lattice parameter two times higher than crystal B. The 'jump frquency' of atoms in B is twice that of A. Yes/ No.

C] In an ionic crystal M⁺X⁻ (i) electrons and (ii) holes can be created by exposing it to appropriate vapor. With schematic show the process electron and hole creation.

D] The phonon dispersion of KF can be considered as mirror symmetric with that of NaCl. True / False

E] Choose proper crystallographic directions [hkl] (one each) of the following crystals for which theoretical model of 'diatomic lattice vibration' can be applied. Give justification for your answer.





Q2. i. In 1 m^3 KCl crystal, 5 x 10^{11} Schottky pairs are generated at room temperature. If the interionic separation is 2.8 angstrom, what is the average energy required to create one pair?
ii. If $CaCl_2$ is added to KCl, its density decreases. Why? [k_B = 8.61 x 10^{-5} eV/K] [4 + 1 = 5]

Q3. Show that for long wavelength limit the force equation in a monoatomic lattice can be written as

$$\frac{d^2u_s}{dt^2} = \frac{v^2}{a^2}(u_{s+1} + u_{s-1} - 2u_s)$$

where v is the group velocity. Is this equation represents optical or acoustic branch of phonon vibration? Justify.

[3 + 2=5]