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1. Explain the following noun. (20%)

   a). Ionic Polarization

   b). Interfacial Polarization

   c). Orientation Polarization

   d). Electrical Polarization

   e). Paramagnetism

   f). Ferromagnetism

   g). Frenkel defect

   h). Schottky defect

   i). Gibbs phase rule

   j). The level rule

2. Calculate the drift mobility and mean scattering time of conduction electrons in copper at room temperature , given that the conductivity of copper is 5.9×10^5 /Ω -cm. The density of copper is 8.96g/cm^3 and its atomic mass is 63.5 g/mol.(20%)

3. Calculate the atomic packing factor (APF) for BCC unit cell, assuming the atoms to be hard spheres.(10%)

4. The diffusivity of silver atoms in solid silver metal is $1 \times 10^{-17} \text{m}^2/s$ at 500°C and $1 \times 10^{-13} \text{m}^2/s$ at 1000°C. Calculate the activation energy (joules/mole) for the diffusion of Ag in Ag at the temperature range from 500°C to 1000°C (20%)

5. Draw the following direction vectors in cubic unit cells(10%)

   (a). [100] and [110]

   (b) [112]

   (c) [-110]

   (d) [-321]

6. A copper-nickel alloy contains 47 wt% Cu and 53 wt% Ni at 1300°C, Using Fig.1 and answer the following: (20%)

   (a). What is the weight percent of copper in the liquid and solid phases at this temperature?

   (b) What weight percent of this alloy is liquid and what weight percent is solid?

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Fig.(1)