1. Given that the width of an energy band is typically 10eV, calculate the following , in per cm^3 and per eV units: .(20%)

    a). The density of states at the center of the band

    b). The number of states per unit volume within a small energy range kT about the center.

    c). The density of states at kT above the bottom of the band

    d). The number of states per unit volume within a small energy range kT to 2 kT from the bottom of the band.. ($h=6.626\times10^{-34}$, $m_e=9.1\times10^{-31}$kg)

2. A certain transmitter-type vacuum tube has a cylindrical Th-coated W cathodw, which is 4cm long and 2mm in diameter. Estimate the saturation current if the tube is operated at a temperature of 1600°C, given that the emission constant is $B_e = 3.0\times10^4$ A/m^2K^2 for Th on W (ϕ =2.6eV, $k=1.38\times10^{-23}$) (10%)

3. For low concentration of Zn in Cu, the diffusion coefficient of Zn has been measured to be 3.67×10^{-11} cm^2/s at 1000K and 8.32×10^{-18} cm^2/s at 600K. Determine the activation energy for this process and then determine the value of the diffusion coefficient at 450K. (10%)

4. Fig.(1) shows a hypothetical binary eutectic phase diagram on which we indicate an alloy of composition 0.27B. Calculate the following quantities (20%)

    a. The fraction of primary solid that forms under equilibrium cooling at the eutectic temperature .

    b. The fraction of liquid with the eutectic composition that will transform to two solid phases below the eutectic isotherm

    c. The amount of α and β that will form from the liquid just below the eutectic isotherm.

    d. The total amount of phase in the alloy at a temperature just below the eutectic temperature.

5..Which of the following are valid slip systems in an FCC metal crystal (10%)

    a. $(a_o/2)[111](101)$

    b. $(a_o)[110](111)$

    c. $(a_o/2)[101](111)$

    d. $(a_o/2)[101](111)$

6. Calculate the linear density along [111] in a BCC material. Repeat the calculation for the [110] direction in BCC (10%)

(背面仍有題目,請繼續作答)

7. Please explain or define following noun: (20%)

   a). Eutectic reaction

   b). Peritectic reaction

   c). Monotectic reaction

   d). Electron Effective Mass

   e). Boltzmann probability function

   f). Fermi-Dirac function

   g). Schottky effect

   h). Frenkel defects

   i). Schottky defects

   j). Bragg's law

Fig.(1)