※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Explain the following noun. (20%)

    a). Diamagentism

    b). Antiferromagentism

    c). Matthiessen Rule

    d). Nordheim Rule

    e). Hall coefficient

    f). Wiedemann-Franz-Lorenz Law

    g). Seebeck Effect

    h). Peltier coefficient

    i). Fick's first lass

    j). Einstein relation

2. Copper (ion radius=0.125nm) and nickel (ion radius= 0.128nm) form a solid solution in all properties. Predict this result using the Hume-Rothery rules (15%)

3. At 200°C, a 50:50 Pb-Sn solder alloy exists as two phases, a lead-rich solid and a tin-rich liquid. Calculated the degree of freedom for this alloy (10%)

4. The fraction of vacant lattice sites in a crystal is typically small. For example, the fraction of aluminum sites vacant at 400°C is 2.29×10^{-5}. Calculate the density of these sites (in unit of m^{-3}). (the density of aluminum is 2.7Mg/m^3 and its atomic mass is 26.98amu).(10%)

5. Please address what are the effect of temperature and impurity on the conductivity for metal, insulator and semiconductor, respectively.(20%)

6. Calculate the critical angle of incidence, θ_C in s step-index fiber design for a light ray going from a glass-fiber core (with index of refraction, n=1.47) to the cladding(with n=1.460). (10%)

7. For intrinsic gallium arsenide, the room temperature electrical conductivity is 10^{-6} $(\Omega\text{-m})^{-1}$; the electron and hole mobilities are, respectively, 0.85 and 0.04 m^2/V-s. Calculate the intrinsic carrier concentration n_i at room temperature. (15%)