

※ 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. Briefly explain the following items (20%)
 - (a) Screw dislocation
 - (b) Bragg's law
 - (c) Intermetallic compounds
 - (d) Piezoelectric material
 - (e) Seebeck effect
 - (f) Fick's first law
 - (g) Grain boundary
 - (h) Hall effect
 - (i) Eutectic reaction
 - (j) Ferromagnetism
2. Compare the atomic packing factors (the volume fraction of atoms in a unit cell) of the bcc, fcc, and hcp crystal structures. (10%)
3. To form a solid solution, the Hume-Rothery rule is the main criterion. Based on this rule, please indicate which one of Zn (atomic radius=0.133) and Ni (atomic radius=0.1246) is easier to form a solid solution with the Cu (atomic radius=0.125 nm). (10%)
4. Draw direction vectors in a unit cell for the following directions. (10%)
 - (a) $[110]$
 - (b) $[2\bar{1}0]$
 - (c) $[112]$
5. Compare the bonding types and electric conductivity of polymer, semiconductor and metal. (15%)
6. Calculate the planar atomic density in atoms per square millimeter for the (0001) plane in HCP beryllium, which has a lattice constant $a=0.22856$ nm and a c constant of 0.35832 nm. (10%)
7. Calculate the electrical resistivity of intrinsic silicon at 300 K. For Si at 300 K, the intrinsic carrier concentration $n_i=1.5 \times 10^{16}$ carriers/m³, the electronic charge $q=1.60 \times 10^{-19}$ C, electron mobility = 0.135 m²/V-s, and hole mobility=0.048 m²/V-s. (10%)

8. If 500g of a 40 wt % Ag–60 wt % Cu alloy is slowly cooled from 1000°C to just below 780°C (15 %)
- (a) How many grams of liquid and proeutectic alpha are present at 850 °C?
 - (b) How many grams of liquid and proeutectic alpha are present at temperature just above 780°C?
 - (c) How many grams of alpha are present in the eutectic structure at temperature just below 780°C?

