

# MT 250 Metallurgical Concepts

## Physical Metallurgy

### Mid-term Test 1 (12.9.2003)

Answer all the questions in one hour. Each question carries 2 points.

- List all the members of the (111) family of planes in
  - a simple orthorhombic crystal.
  - a *bcc* crystal.
- In a hexagonal crystal, sketch two members of the  $(11\bar{2}1)$  family of planes.
- Calculate the density of atoms (number of atoms per unit area) on the
  - (111) planes in an *fcc* crystal.
  - (110) planes in a *bcc* crystal.
- Calculate the equilibrium number of vacancies per cubic metre of copper at 1000 °C. The free energy of formation of a vacancy is 0.9 eV; the atomic weight and density (at 1000 °C) for copper are 63.5 g/mol and 8.4 g/cm<sup>3</sup>, respectively.
- The energy necessary to generate a dislocation is proportional to  $b^2$ , where  $b$  is the magnitude of the Burgers vector,  $\mathbf{b}$ . This means that the most stable (lowest energy) dislocations have the smallest Burgers vectors. For the *fcc* structure, calculate the energies of dislocations whose Burgers vectors are  $\mathbf{b}_1 = (a/2) [110]$  and  $\mathbf{b}_2 = a [100]$ .