EECS 170A
Section B
HW#1 Solutions & Grading Criteria

1) Copper (Cu) has an FCC crystal structure. The lattice constant is 3.61 Angstroms.
   a) Find the number of atoms/cm^3 in Cu. **(20 pts total)**
      3 pts *8 corners x 1/8 atom/corner = 1 atom*
      3 pts *6 faces x 1/2 atom/face = 3 atoms*
      3 pts *total #atoms = 1 atom + 3 atoms = 4 atoms*
      3 pts *a = 3.61 Angstroms x 10^{-8} cm/1 Angstrom = 3.61 x 10^{-8} cm*
      3 pts *volume = a^3 = (3.61 x 10^{-8} cm)^3 = 4.7045881 x 10^{-23} cm^3*
      3 pts *N = atoms / volume*
      2 pts *= 4 atoms / 4.7045881 x 10^{-23} cm^3 = 8.50 x 10^{22} atoms/cm^3*
   b) Find the number of atoms/m^3 in Cu. **(20 pts total)**
      5 pts *1 m = 10^2 cm*
      5 pts *1 m^3 = (10^2 cm)^3 = 10^6 cm^3*
      5 pts *N = (8.50 x 10^{22} atoms/cm^3)(10^6 cm^3/m^3)*
      5 pts *= 8.50 x 10^{28} atoms/m^3*

      or

      5 pts *a = 3.61 Angstroms x 10^{-10}m/Angstrom = 3.61 x 10^{-10}m*
      5 pts *volume = a^3 = (3.61 x 10^{-10} m)^3 = 4.7045881 x 10^{-29} m^3*
      5 pts *N = atoms / volume*
      5 pts *= 4 atoms / 4.7045881 x 10^{-29} m^3 = 8.50 x 10^{28} atoms/cm^3*

2) A current of 10^{-6} A flows through a wire of diameter 1 mm.
   a) How many electrons per second flow past a plane perpendicular to the wire?
      (20 pts total)
      5 pts *I = nq/t*
      5 pts *n/t = I/q*
      5 pts *= (10^{-6} C/sec) / (1.6 x 10^{-19}C/electron)*
      5 pts *= 6.25 x 10^{12} electrons/sec*
   b) What is the current density in the wire? **(20 pts total)**
      10 pts *J = I/A*
      5 pts *= (10^{-6} A) / (3.14159 x .25 mm^2)*
      5 pts *= 1.27 x 10^{-6} A/mm^2 = 1.27 A/m^2*
      (Note: Students do not have to convert answer to SI units to get credit.)

3) In a modern integrated circuit, such as a Pentium, there are 10^8 transistors. If the total power dissipated by the Pentium is 100W, how much power is dissipated by each transistor, assuming the power is divided equally?
   10 pts *Power/transistor = total power/# transistors*
   5 pts *= 100W / 10^8 transistors*
   5 pts *= 10^{-6} W/transistor*

******NOTE: Students will be marked off for wrong units. Student will receive no credit if there are no units. ******