EECS 170A Section B
Homework Solution #1
Fall 2007 – Prof. Burke

1) In a modern integrated circuit, there are 10^8 transistors. They fit onto one chip. The chip size is typically about 1 cm x 1 cm. Calculate the area that each transistor occupies. If the area is a square geometry, calculate the length of one side of the square?

(25 pts)   *Chip area = 1 cm x 1 cm = 1 cm^2*

No. Of transistors = 10^8

∴ Area each transistor occupied = $1 \div 10^8 = 10^{-8}$ cm^2

(Any incorrect answer, -5pt)

(25 pts)   *Length of one side = 10^{-4} cm*

2) A current of 10 A flows through a copper wire. It's diameter is 0.25".
   a. What is the current density in the wire?
   b. How many electrons per second flow past a plane perpendicular to the wire?

(25 pts) *a.*   *Diameter = 0.25" = 0.635 cm*   *(Incorrect unit conversion, -5pt)*

Cross-sectional area of wire, A
$= (\pi D^2)/4 = (\pi x (0.635\ cm)^2)/4 = 3.17\ x\ 10^{-1}\ cm^2$

Current Density = J
$= I/A$
$= (10\ A)/(3.17\ x\ 10^{-1}\ cm^2)$
$= 31.6\ A/cm^2$ *(Any incorrect answer, -5pt)*

(Acceptable range: 31 – 32 A/cm^2)

(25 pts) *b.*   *No. of electrons per second $= I/q$*
$= (10\ A)/(1.6\ x\ 10^{-19}\ C)$
$= 6.25\ x\ 10^{19}$ electrons/second
(Any incorrect answer, -5pt)

(Acceptable range: $6\ x\ 10^{19} – 6.5\ x\ 10^{19}$ electrons/ second)

(Any correct answer but no units, then no credits)
(Any correct answer but wrong unit, -2pt)