Problem 1

a) neglecting minority carrier

$$J_{drift} = e\mu_n n E$$

b) $J_{drift} = 216.29 \ A/cm^2$

c) $J_{drift} = e \times 400 \times 10^{18} \times 100$

$= 6408.706 \ A/cm^2$

Although introducing more dopants increased scattering, increasing electron concentration in the conduction band compensated for the effect.

Problem 2

a) $p = \frac{5\times10^{16} - 10^{17}}{50\times10^{-4}} x$

$= \cancel{2\times10^{19} x}$

$= -10^{19} x$

neglecting minority carrier current

$J_p = -eD_p \frac{dp}{dx}$

$= e \times 12 \times 10^{19}$

$= 19.23 \ A/cm^2$

b) $J_{drift} = e\mu_p p E$

$= e \times 450 \times 10^{17} \times 10^3$

$= 7209.8 \ A/cm^2$

Problem 3

a) Neglecting minority carrier

$$\frac{dn}{dx} = 3\times10^{14}.$$

$$\therefore J = e\mu_n n E + eD_n \frac{dn}{dx}$$

$$= e\mu_n nE + eD_n \cdot \times 3\times10^{14}.$$

$$= e\mu_n E\left(5\times10^{15} + 3\times10^{14}x\right) + 1.68\times10^{-3}$$

$$= \left(54.07 + 3.24x\right) + \cancel{1.8}\ 1.68\times10^{-3}$$

$$\approx 54.07 + 3.24x.$$

(b) at $x = 10\mu m = 10^{-3}$ cm

$J_{drift} \approx 54.07$

$J_{diff} = 1.68\times10^{-3}.$

$J_{total} \approx 54.07$

(c) $J_{diff} \ll J_{drift}.$