Problem 1

as there is no spatial variation of excess carriers,

$$\frac{d(\Delta P)}{dt} + \frac{\Delta P}{\tau_p} = 0.$$

$$\therefore \Delta P = \Delta P(0) \exp\left(\frac{t}{\tau_p}\right)$$

(a) $\frac{\Delta P}{\Delta P(0)} = \frac{1}{e}$ $\therefore t = 50$ ns.

(b) $\frac{\Delta P}{\Delta P(0)} = 0.1$ $\therefore t = 115.13$ ns.

Problem 2

$$\frac{d(\Delta P)}{dt} = g_0 - \frac{\Delta P}{\tau_{P0}}.$$

$$\Rightarrow \frac{d(\Delta P)}{dt} + \frac{\Delta P}{\tau_{P0}} = g_0.$$

$$IF = \exp\left(\int \frac{dt}{\tau_{P0}}\right) = \exp\left(\frac{t}{\tau_{P0}}\right)$$

$$\therefore \Delta P \cdot IF = \int g_0 \exp\left(\frac{t}{\tau_{P0}}\right) dt + C_1$$

$$= g_0 \tau_{P0} \exp\left(\frac{t}{\tau_{P0}}\right) + C_1$$

$$\therefore \Delta P = g_0 \tau_{P0} + C_1 \exp\left(-\frac{t}{\tau_{P0}}\right)$$

At $t = 0$, $\Delta P = 0$ so, $C_1 = -g_0 \tau_{P0}$

$$\therefore \Delta P = g_0 \tau_{P0} \left\{1 - \exp\left(-\frac{t}{\tau_{P0}}\right)\right\}$$

at $t = 10^{-7}$ s $\quad \Delta P = 3.16 \times 10^{14}$ cm^{-3}

Problem 3

(a) $L_n = \sqrt{D_n \tau_{no}} = 3.53 \times 10^{-3}$ cm

(b) $\Delta n(x) = \Delta n(0) \exp\left(-\frac{x}{L_n}\right)$

$\therefore$ at $x = 30\ \mu m$

Δn @ $= 4.27 \times 10^{14}$ cm^{-3}