Homework 12

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Problem 1

Solution The data used are $m_{\mathrm{e}} = 0.066m$, $m_{\mathrm{h}} = 0.5m$, and the conservation laws are

$$\frac{p_{\mathrm{e}}}{2m_{\mathrm{e}}} + \frac{p_{\mathrm{h}}}{2m_{\mathrm{h}}} = E_{\mathrm{photon}}, \quad p_{\mathrm{e}} + p_{\mathrm{h}} = \frac{E_{\mathrm{photon}}}{c}, \tag{1}$$

and we get

$$p_{\mathrm{e}} = 1.65 \times 10^{-25}\,\mathrm{kg \cdot m/s}, \quad p_{\mathrm{h}} = -1.64 \times 10^{-25}\,\mathrm{kg \cdot m/s}, \quad \frac{p_{\mathrm{e}}^2}{2m_{\mathrm{e}}} = 1.41\,\mathrm{eV}, \quad \frac{p_{\mathrm{h}}^2}{2m_{\mathrm{h}}} = 0.18\,\mathrm{eV}. \tag{2}$$

Problem 2

Solution

Problem 3

Solution Here we use

$$d_{n,p} = 105 \left\{ \frac{(N_a/N_d)^{\pm 1}}{10^{-18}\,(N_d + N_a)} [\epsilon e \Delta\phi]_{\mathrm{ev}} \right\}^{1/2} \text{Å} \tag{3}$$

from A&M (29.18). Since $N_a = N_d$, we have $d_n = d_p = 25\,\text{Å}$, and therefore $N_a = N_d = 4.4 \times 10^{18}\,\mathrm{cm}^{-3}$.

Problem 4

Solution

Problem 5

Solution

(a) The energy of a 620 nm photon is 2.0 eV. The energy gap of CdSe is 1.7 eV, and the energy gap of CdS is 2.5 eV, so the percentage of CdSe should be 62.5 %, and the percentage of CdS should be 37.5 %.

(b)