Solutions to the Exercise of

C. J. Foot's Atomic Physics

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Early atomic physics

Key formulas:

$$\frac{1}{\lambda} = R\left(\frac{1}{n^2} - \frac{1}{n'^2}\right) \qquad (1.1)$$

$$R_H = R \frac{m_H}{m_e + m_H}$$
(1.2)

$$a_0 = \frac{\hbar^2}{(Ze^2/4\pi\epsilon_0)m_e} = 0.529 \times 10^{-10} \text{ m}$$
 (1.3)

$$E = -\frac{Ze^2/4\pi\epsilon_0}{2a_0} \frac{1}{n^2} \propto Z^2 \qquad (1.4)$$

$$E = -\frac{Ze^2/4\pi\epsilon_0}{2a_0} \frac{1}{n^2} \propto Z^2$$

$$\Delta E = \frac{\alpha^2}{n^2} E$$
(1.4)

$$\alpha = \frac{e^2/4\pi\epsilon_0}{\hbar c} = 1/137 \qquad (1.6)$$

$$\frac{f}{c} = R_{\infty}((Z - \sigma_K)^2 - (Z - \sigma_L)^2)$$
 (1.7)

$$\rho(\omega) = \frac{\hbar \omega^3}{\pi^2 c^3} \frac{1}{\exp \hbar \omega / kT - 1}$$
(1.8)

$$\frac{N_2}{g_2} = \frac{N_1}{g_1} \exp \left(-\frac{\hbar \omega}{kT}\right) \qquad (1.9)$$

$$P = \frac{e^2 x_0^2 \omega^4}{12\pi \epsilon_0 c^3}$$
(1.10)

$$Ω_L = \frac{eB}{2m_e}$$
(1.11)

$$\tau = \frac{6\pi\epsilon_0 m_e c^3}{c^2 \omega^2} \qquad (1.12)$$

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David Halliday, Robert Resnick, Jearl Walker

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