

## HW2 答案

1.

$$\begin{cases} G(V) = \Delta n B_{21} \frac{\mu}{c} h \nu f(V) \\ \frac{A_{21}}{B_{21}} = \frac{8\pi\mu^3 h \nu^3}{c^3} \end{cases}$$

$$\Rightarrow G(V) = \Delta n \cdot A_{21} \frac{c^3}{8\pi\mu^3 h \nu^3} \cdot \frac{\mu}{c} h \nu f(V) = \Delta n \cdot A_{21} \frac{\lambda^2}{8\pi\mu^2} \cdot f(V)$$

$$= 5 \times 10^{18} \cdot \frac{1}{3 \times 10^{-3}} \cdot \frac{(0.6943 \times 10^{-4})^2}{8\pi \times 1.5^2} \cdot \frac{1}{2 \times 10^{11}} = 0.71 \text{ cm}^{-1}$$

4.

$$0 < (1 - \frac{L}{R_1})(1 - \frac{L}{R_2}) < 1$$

$$\Rightarrow 0 < (1 - \frac{L}{40})(1 - \frac{L}{100}) < 1$$

$$\Rightarrow 0 < L < 40 \text{ cm 或 } 100 < L < 140 \text{ cm}$$

8.

$$\begin{cases} G(V) = \Delta n B_{21} \frac{\mu}{c} h \nu f(V) \\ \frac{A_{21}}{B_{21}} = \frac{8\pi\mu^3 h \nu^3}{c^3} \\ O_e(V) = \frac{G(V)}{\Delta n} \end{cases}$$

$$\Rightarrow O_e(V) = A_{21} \frac{c^3}{8\pi\mu^3 h \nu^3} \cdot \frac{\mu}{c} h \nu f(V)$$

$$= \frac{1}{c} \frac{c^2}{8\pi\nu^2\mu^2} \cdot f(V)$$

$$= \frac{c^2 f(V)}{8\pi\nu^2\mu^2 c}$$

11.

$$\Delta n_{\text{阈}} = \frac{8\pi\nu^2\mu^2 c \alpha_{\text{th}}}{c^2 f(V)} = \frac{8\pi\mu^2 c \frac{1-R}{L}}{\lambda^2 f(V)} = \frac{8\pi \times 10^{-7} \times \frac{0.0167}{0.1}}{(0.6328 \times 10^{-6})^2} \times 10^9 = 1.048 \times 10^{15} / \text{m}^3$$