

69. (a) In the lasing action the molecules are excited from energy level E_0 to energy level E_2 . Thus the wavelength λ of the sunlight that causes this excitation satisfies

$$\Delta E = E_2 - E_0 = \frac{hc}{\lambda} ,$$

which gives (using the result of problem 3 in Chapter 39)

$$\lambda = \frac{hc}{E_2 - E_0} = \frac{1240 \text{ eV} \cdot \text{nm}}{0.289 \text{ eV} - 0} = 4.29 \times 10^3 \text{ nm} = 4.29 \mu\text{m} .$$

- (b) Lasing occurs as electrons jump down from the higher energy level E_2 to the lower level E_1 . Thus the lasing wavelength λ' satisfies

$$\Delta E' = E_2 - E_1 = \frac{hc}{\lambda'} ,$$

which gives

$$\lambda' = \frac{hc}{E_2 - E_1} = \frac{1240 \text{ eV} \cdot \text{nm}}{0.289 \text{ eV} - 0.165 \text{ eV}} = 1.00 \times 10^4 \text{ nm} = 10.0 \mu\text{m} .$$

- (c) Both λ and λ' belong to the infrared region of the electromagnetic spectrum.