25.1

The irradiance I of a sinusoidal electromagnetic wave is related to E_0, the maximum value of its E-field, via Eq. (22.8):

$$\begin{aligned} I &= \frac{1}{2}c\epsilon_0 E_0^2 \\ &= \frac{1}{2}(2.998 \times 10^8\,\text{m/s})(8.8542 \times 10^{-12}\,\text{C}^2/\text{N}\cdot\text{m}^2)(1000\,\text{V/m})^2 \\ &= 1327\,\text{W/m}^2 . \end{aligned}$$

25.35

The distance between the m-th irradiance maximum and the central axis, denoted as y_m, satisfies Eq. (25.7), $y_m \approx sm\lambda/a$, where $s = 1.00\,\text{m}$ is the distance between the slits and the screen, $a = 0.200\,\text{mm}$ is the slit separation, $m = 4$, and $\lambda = 487.99\,\text{nm} = 487.99 \times 10^{-6}\,\text{mm}$ is the wavelength of the incident light beam. Thus

$$y_4 \approx \frac{sm\lambda}{a} = \frac{(1.00\,\text{m})(4)(487.99 \times 10^{-6}\,\text{mm})}{0.200\,\text{mm}} = 9.76 \times 10^{-3}\,\text{m} = 9.76\,\text{mm} .$$

25.41

Similar to the previous problem, for the first minima on either side of the central axis $r_1 - r_2 \approx ay/s = m\lambda/2$, where $m = \pm 1$. So $y \approx m\lambda s/2a$, and the separation between the two adjacent black stripe is $\Delta y = \Delta(m\lambda s/2a) = \lambda s \Delta m/2a$, where $\Delta m = +1 - (-1) = 2$. Plug in $\lambda = 450\,\text{nm}$, $s = 4.00\,\text{m}$, and $\Delta y = 0.500\,\text{cm}$, and solve for a:

$$a = \frac{\lambda s \Delta m}{2\Delta y} = \frac{(450 \times 10^{-9}\,\text{m})(4.00\,\text{m})(2)}{2(0.500 \times 10^{-2}\,\text{m})} = 3.60 \times 10^{-4}\,\text{m} = 0.360\,\text{mm} .$$

25.46

Measured from the central axis, the location of the first-order maximum for violet light with wavelength λ_1 is given by Eq. (25.7), $y_1 \approx sm_1\lambda_1/a$, with $m_1 = 1$. Similarly, the location of