

EC5103

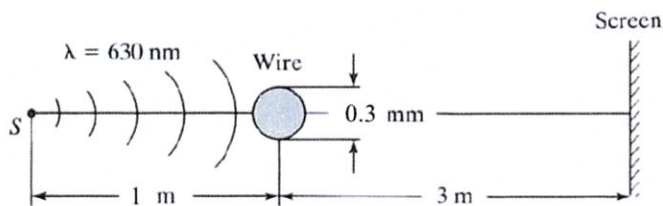
Quiz #8

2021.05.31

Name:

Fresnel diffraction is observed behind a wire 0.3 mm thick, which is placed 1 m from the light source and 3 m from the screen. If light of wavelength 630 nm is used, compute, using the Cornu spiral, the irradiance of the diffraction pattern on the axis at the screen. Express the answer as some number times the unobstructed irradiance there.

- (i) Mark your calculated Cornu spiral positions on the Cornu diagram and denote them for amplitudes.
- (ii) Refer to Table 13-1 in p. 323 of the textbook. For v values, use approximation.



$$S.O.L.) \quad \frac{1}{L} = \frac{1}{1} + \frac{1}{9} = \frac{1}{1} + \frac{1}{3} = \frac{4}{3} \quad \therefore L = \frac{3}{4} \text{ (m)} = 0.75 \text{ (m)}$$

$$I_u = \frac{1}{2} I_0$$

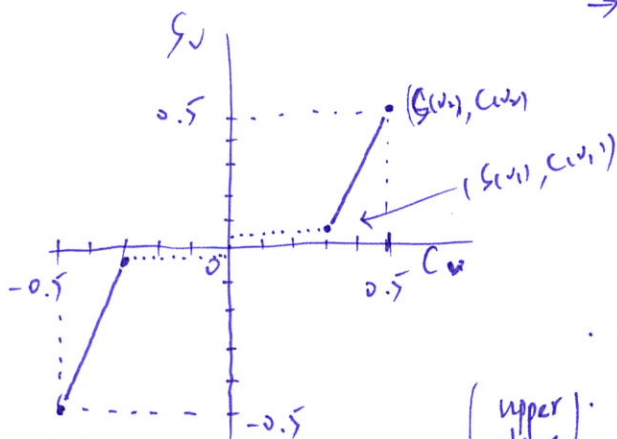
(i) Positions in the upper plane, $z_{u1} = 1.5 \times 10^{-4} \text{ (m)}$, $z_{u2} = \infty$

$$\rightarrow v_{u1} = z_{u1} \sqrt{\frac{2}{\lambda L}} = 1.5 \times 10^{-4} \sqrt{\frac{2}{6.3 \times 10^{-7} \cdot 0.75}} = 0.309$$

$$v_{u2} = z_{u2} \sqrt{\frac{2}{\lambda L}} = \infty$$

(ii) positions in the lower plane, $z_{l1} = -z_{u1}$, $z_{l2} = -\infty$

$$\rightarrow v_{l1} = -v_{u1}, \quad v_{l2} = -v_{u2} = -\infty$$



$$E_p = E_0 \left\{ (C_{v2} - C_{v1}) + i(S_{v2} - S_{v1}) \right\}$$

$$I_p = I_0 \left\{ (C_{v2} - C_{v1})^2 + (S_{v2} - S_{v1})^2 \right\}^{1/2}$$

$$C(v_2) = C(\infty) = 0.5 \quad ; \quad v_{u2}, v_{l2}$$

(upper plane)

$$C(v_1) = C(0.309) \sim C(0.3) \sim 0.2994$$

$$S(v_1) = S(0.309) \sim S(0.3) \sim 0.014$$

$$S(v_2) = C(v_2) = 0.5$$

due to symmetry (sum)

$$\therefore I_p = I_0 \left\{ [0.5 - 0.2994]^2 + [0.5 - 0.014]^2 \right\}^{1/2} = I_0 (0.16 + 0.945) = 1.105 I_0$$

$$\therefore I_p = 0.55 I_u$$