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HOMEWORK SET #9

Note: Please show all the steps leading to the final answer.

1. For an E-plane horn with $\rho_1 = 6\lambda, b_1 = 3.47\lambda$, and $a = 0.5\lambda$,
   (a) Find the maximum phase difference.
   (b) Compute its directivity.
2. Design an E-plane horn such that the maximum phase difference between two points at the aperture, one at the center and the other at the edge, is 120°. Assuming that the maximum along its wall (ρ_e), measured from the aperture to its apex, is 10λ, find the
   (a) maximum total flare angle of the horn
   (b) largest dimension of the horn at the aperture
   (c) directivity of the horn (dimensionless and in dB)
   (d) gain of the antenna (in dB) when the reflection coefficient within the waveguide feeding the horn is 0.2. Assume only mismatch losses. The waveguide feeding the horn has dimensions of 0.5λ and 0.25λ.
3. Plot the normalized directivity (given by $(\lambda/a)D_E$) of the E-plane horn versus b_1 (in wavelength) for $\rho_1 = (6, 10, 15, 20, 30, 50, 75, 100)\lambda$ and verify that the optimum directivity occurs when

$$b_1 \cong \sqrt{2\lambda\rho_1}. \tag{1}$$