

1.4

$$U(\theta, \phi) = \cos^4(\theta) \cdot \sin^2(\phi) \quad \text{for } 0 \leq \theta \leq \frac{\pi}{2}, \quad 0 \leq \phi \leq 2\pi$$

$$U(\theta, \phi) = 0 \quad \text{elsewise}$$

$$\begin{aligned} a) \quad P_{\text{RAD}} &= \int_0^{2\pi} \left[\int_0^{\pi/2} \cos^4(\theta) \cdot \sin^2(\phi) \cdot \sin(\theta) d\theta \right] d\phi \\ &= \int_0^{2\pi} \sin^2(\phi) d\phi \cdot \int_0^{\pi/2} \cos^4(\theta) \cdot \sin(\theta) d\theta \\ &= \frac{\pi}{5} \text{ W (apparently)} \end{aligned}$$

$$D_0 = \frac{4\pi \cdot U_{\text{max}}}{P_{\text{RAD}}} = \frac{4\pi}{\pi/5} = 20 = 13 \text{ dB}$$



$$\begin{aligned} b) \quad U(\theta, \phi = \frac{\pi}{2}) &= \cos^4(\theta) \\ \cos^4(\frac{\text{HPBW}}{2}) &= \frac{1}{2} \Rightarrow 2 \cdot \cos^{-1}(\sqrt{0.5}) = 65.5^\circ = \text{HPBW} \end{aligned}$$