2.14 Find the directivity (dimensionless and in dB) for the antenna of Problem 2.12 using
(a) Kraus' approximate formula (2-26)
(b) Tai and Pereira's approximate formula (2-30a)

2.12 The normalized radiation intensity of a given antenna is given by
(b) $U = \sin\theta \sin^2\phi$
The intensity exists only in the $0 \le \theta \le \pi, 0 \le \phi \le \pi$ region, and it is zero elsewhere. Find the
(a) exact directivity (*dimensionless* and *in dB*).
(b) azimuthal and elevation plane half-power beamwidths (in degrees).

From part b) of 2.12b:

$HPBW_{elevation} = 120^\circ = \frac{2\pi}{3} = \theta_{1r}$

$HPBW_{azimuthal} = 90^\circ = \pi/2 = \theta_{2r}$

a) Per Kraus' (2-26),

$$D_{max} = D_0 \simeq \frac{4\pi}{\theta_{1r}\theta_{2r}} = \frac{4\pi}{(2\pi/3)(\pi/2)}$$

$$\underline{\underline{D_{max} = D_0 \simeq 3.8197 = 5.82 \text{ dBi}}}$$

b) Per Tai & Pereira's (2-30a),

$$D_{max} = D_0 \simeq \frac{32\ln 2}{\theta_{1r}^2 + \theta_{2r}^2} = \frac{32\ln 2}{(2\pi/3)^2 + (\pi/2)^2}$$

$$\underline{\underline{D_{max} = D_0 \simeq 3.2362 = 5.10 \text{ dBi}}}$$

For comparison, the exact max directivity was $D_{max} = D_0 = 5.093 = 7.07$ dBi

$\Rightarrow$ Not a very directive radiation pattern.