

6. (a) The Pythagorean theorem leads to

$$\begin{aligned} B &= \sqrt{B_h^2 + B_v^2} = \sqrt{\left(\frac{\mu_0\mu}{4\pi r^3} \cos \lambda_m\right)^2 + \left(\frac{\mu_0\mu}{2\pi r^3} \sin \lambda_m\right)^2} \\ &= \frac{\mu_0\mu}{4\pi r^3} \sqrt{\cos^2 \lambda_m + 4 \sin^2 \lambda_m} = \frac{\mu_0\mu}{4\pi r^3} \sqrt{1 + 3 \sin^2 \lambda_m} , \end{aligned}$$

where $\cos^2 \lambda_m + \sin^2 \lambda_m = 1$ was used.

(b) We use Eq. 3-6:

$$\tan \phi_i = \frac{B_v}{B_h} = \frac{(\mu_0\mu/2\pi r^3) \sin \lambda_m}{(\mu_0\mu/4\pi r^3) \cos \lambda_m} = 2 \tan \lambda_m .$$