2.33 If $\mathbf{H} = \rho^2 \cos\phi \mathbf{a}_\rho - \rho \sin\phi \mathbf{a}_\phi$, find $\mathbf{H} \cdot \mathbf{a}_x$ at point $P(2, 60°, -1)$.

$$\bar{H} \cdot \hat{a}_x = (\rho^2 \cos\phi\, \hat{a}_\rho - \rho \sin\phi\, \hat{a}_\phi) \cdot \hat{a}_x$$

$$= \rho^2 \cos\phi\, (\hat{a}_\rho \cdot \hat{a}_x) - \rho \sin\phi\, (\hat{a}_\phi \cdot \hat{a}_x)$$

$$= \rho^2 \cos\phi (\cos\phi) - \rho \sin\phi (-\sin\phi)$$

$$= \rho^2 \cos^2\phi + \rho \sin^2\phi$$

$$(\bar{H} \cdot \hat{a}_x)_P = 2^2 \cos^2 60° + 2 \sin^2 60° = 1 + 1.5$$

$$\underline{\underline{(\bar{H} \cdot \hat{a}_x)_P = 2.5}}$$