

2.4 The cylindrical coordinates of point Q are $\rho = 5$, $\phi = 120^\circ$, $z = 1$. Express Q as rectangular and spherical coordinates.

$$\text{Per (2.8)} \quad x = \rho \cos \phi = 5 \cos 120^\circ = -2.5$$

$$y = \rho \sin \phi = 5 \sin 120^\circ = 4.33$$

$$z = z = 1$$

$$\underline{Q_{\text{cart}}(-2.5, 4.33, 1)}$$

$$\text{Per (2.21)} \quad r = \sqrt{x^2 + y^2 + z^2} = \sqrt{(-2.5)^2 + 4.33^2 + 1^2}$$

$$= \sqrt{26} = 5.099$$

$$\theta = \tan^{-1}\left(\frac{\sqrt{x^2 + y^2}}{z}\right) = \tan^{-1}\left(\frac{\sqrt{(-2.5)^2 + 4.33^2}}{1}\right)$$

$$= \tan^{-1}(5) = 78.69^\circ$$

$$\phi = \phi = 120^\circ$$

$$\underline{Q_{\text{sph}} = (5.099, 78.69^\circ, 120^\circ)}$$