

Convert the following Cartesian points (in meters) to cylindrical and spherical coordinates (put angles in degrees): a) $H(2, -3, 4)$ and b) $I(-4, 2, -6)$.

a) $H(2, -3, 4)$

Cartesian to cylindrical:

$$\text{Per (2.7)} \quad \rho = \sqrt{x^2 + y^2} = \sqrt{2^2 + (-3)^2} = \sqrt{13} \Rightarrow \rho = 3.60555 \text{ m},$$

$$\phi = \tan^{-1}(y/x) = \tan^{-1}(-3/2) = -56.3099^\circ + 360^\circ (4^{\text{th}} \text{ quadrant}) \Rightarrow \phi = 303.69^\circ,$$

$$\text{and } z = z \Rightarrow z = 4 \text{ m}$$

$$\Rightarrow \underline{H_{\text{cyl}}(3.60555 \text{ m}, 303.69^\circ, 4 \text{ m})}$$

Cartesian to spherical:

$$\text{Per (2.21)} \quad r = \sqrt{x^2 + y^2 + z^2} = \sqrt{2^2 + (-3)^2 + 4^2} = \sqrt{29} \Rightarrow r = 5.3852 \text{ m},$$

$$\theta = \tan^{-1}(\sqrt{x^2 + y^2}/z) = \tan^{-1}(\sqrt{2^2 + (-3)^2}/4) = \tan^{-1}(0.90139) = 42.031^\circ, \text{ and}$$

$$\phi = \tan^{-1}(y/x) = \tan^{-1}(-3/2) = -56.3099^\circ + 360^\circ \Rightarrow \phi = 303.69^\circ.$$

$$\Rightarrow \underline{H_{\text{sph}}(5.385 \text{ m}, 42.03^\circ, 303.69^\circ)}$$

b) $I(-4, 2, -6)$

Cartesian to cylindrical:

$$\text{Per (2.7)} \quad \rho = \sqrt{x^2 + y^2} = \sqrt{(-4)^2 + 2^2} = \sqrt{20} \Rightarrow \rho = 4.472136 \text{ m},$$

$$\phi = \tan^{-1}(y/x) = \tan^{-1}(2/-4) = -26.565^\circ + 180^\circ (2^{\text{nd}} \text{ quadrant}) \Rightarrow \phi = 153.435^\circ,$$

$$\text{and } z = z \Rightarrow z = -6 \text{ m}$$

$$\Rightarrow \underline{I_{\text{cyl}}(4.472 \text{ m}, 153.435^\circ, -6 \text{ m})}$$

Cartesian to spherical:

$$\text{Per (2.21)} \quad r = \sqrt{x^2 + y^2 + z^2} = \sqrt{(-4)^2 + 2^2 + (-6)^2} = \sqrt{56} \Rightarrow r = 7.4833 \text{ m},$$

$$\theta = \tan^{-1}(\sqrt{x^2 + y^2}/z) = \tan^{-1}(\sqrt{(-4)^2 + 2^2}/-6) = \tan^{-1}(-0.74536) = -36.699^\circ + 180^\circ$$

$$\Rightarrow \theta = 143.301^\circ \text{ (lower hemisphere), and}$$

$$\phi = \tan^{-1}(y/x) = \tan^{-1}(-3/2) = -56.3099^\circ + 360^\circ \Rightarrow \phi = 153.435^\circ, \text{ and}$$

$$\Rightarrow \underline{I_{\text{sph}}(7.483 \text{ m}, 143.301^\circ, 153.435^\circ)}$$