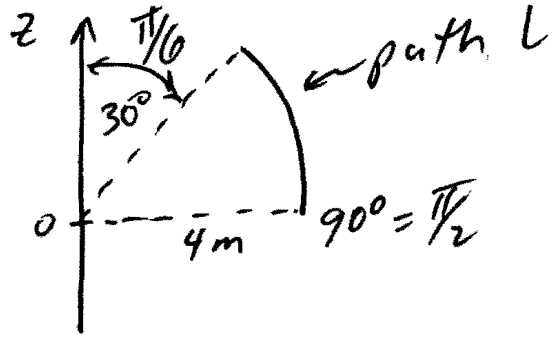
3.1 Using the differential length *dl*, find the length of each of the following curves:

- Sketch path.

c) $r = 4$, $30° < \theta < 90°$, $\phi =$ constant



$$d\bar{\ell} = dr\,\hat{a}_r + r\,d\theta\,\hat{a}_\theta + r\sin\theta\,d\phi\,\hat{a}_\phi$$

Only θ is changing and $r = 4m$, so

$$d\ell = 4\,d\theta \text{ (m)}$$

$$\text{Length} = \int_L d\ell = 4\int_{\pi/6}^{\pi/2} d\theta$$

$$= 4\left(\pi/2 - \pi/6\right) = 4\pi/3$$

$$\text{Length} = 4.1888 \text{ m}$$