

Hence,

$$\cos \phi = \frac{-2}{\sqrt{40}}, \quad \sin \phi = \frac{6}{\sqrt{40}}$$

$$\begin{aligned} \mathbf{A} &= \left[\sqrt{40} \cdot \frac{-2}{\sqrt{40}} \cdot \frac{6}{\sqrt{40}} + \left(\sqrt{40} \cdot \frac{-2}{\sqrt{40}} + 3 \right) \cdot \frac{6}{\sqrt{40}} \right] \mathbf{a}_\rho \\ &+ \left[-\sqrt{40} \cdot \frac{36}{40} + \left(\sqrt{40} \cdot \frac{-2}{\sqrt{40}} + 3 \right) \cdot \frac{-2}{\sqrt{40}} \right] \mathbf{a}_\phi \\ &= \frac{-6}{\sqrt{40}} \mathbf{a}_\rho - \frac{38}{\sqrt{40}} \mathbf{a}_\phi = -0.9487 \mathbf{a}_\rho - 6.008 \mathbf{a}_\phi \end{aligned}$$

\hat{a}_ρ
 \hat{a}_ϕ
 x

↑ note neg sign, at P need vector pointing opposite \hat{a}_ρ & opposite \hat{a}_ϕ

Similarly, in the spherical system

$$\begin{bmatrix} A_r \\ A_\theta \\ A_\phi \end{bmatrix} = \begin{bmatrix} \sin \theta \cos \phi & \sin \theta \sin \phi & \cos \theta \\ \cos \theta \cos \phi & \cos \theta \sin \phi & -\sin \theta \\ -\sin \phi & \cos \phi & 0 \end{bmatrix} \begin{bmatrix} y \\ x+z \\ 0 \end{bmatrix}$$

or

$$A_r = y \sin \theta \cos \phi + (x+z) \sin \theta \sin \phi$$

$$A_\theta = y \cos \theta \cos \phi + (x+z) \cos \theta \sin \phi$$

$$A_\phi = -y \sin \phi + (x+z) \cos \phi$$

But $x = r \sin \theta \cos \phi$, $y = r \sin \theta \sin \phi$, and $z = r \cos \theta$. Substituting these yields

$$\begin{aligned} \mathbf{A} &= (A_r, A_\theta, A_\phi) \\ &= r[\sin^2 \theta \cos \phi \sin \phi + (\sin \theta \cos \phi + \cos \theta) \sin \theta \sin \phi] \mathbf{a}_r \\ &+ r[\sin \theta \cos \theta \sin \phi \cos \phi + (\sin \theta \cos \phi + \cos \theta) \cos \theta \sin \phi] \mathbf{a}_\theta \\ &+ r[-\sin \theta \sin^2 \phi + (\sin \theta \cos \phi + \cos \theta) \cos \phi] \mathbf{a}_\phi \end{aligned}$$

At P

$$r = 7, \quad \tan \phi = \frac{6}{-2}, \quad \tan \theta = \frac{\sqrt{40}}{3}$$

Hence,

$$\cos \phi = \frac{-2}{\sqrt{40}}, \quad \sin \phi = \frac{6}{\sqrt{40}}, \quad \cos \theta = \frac{3}{7}, \quad \sin \theta = \frac{\sqrt{40}}{7}$$