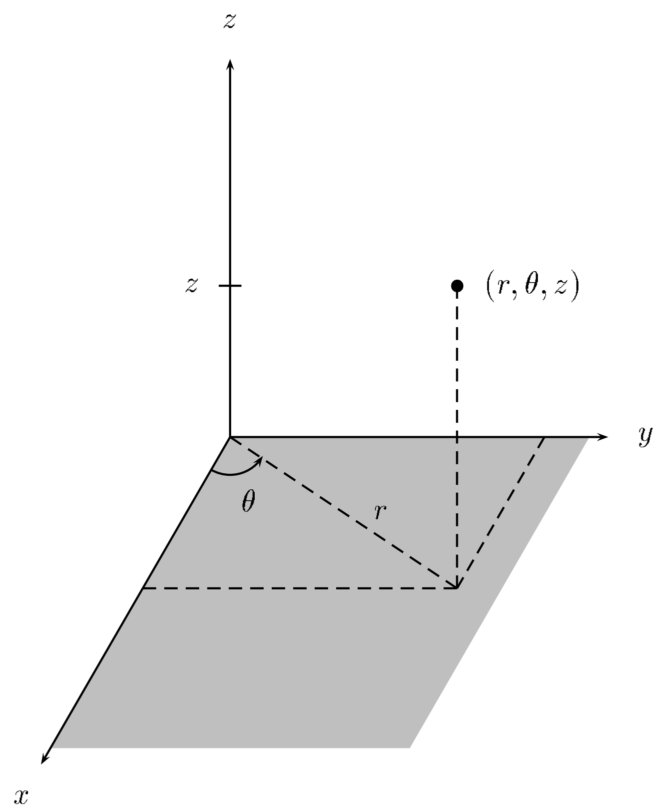
Cylindrical Coordinates



$$x = r\cos\theta \qquad r^2 = x^2 + y^2$$
$$y = r\sin\theta \qquad \tan\theta = y/x$$
$$z = z \qquad z = z$$

$$\hat{i} = \cos\theta\,\hat{r} - \sin\theta\,\hat{\theta} \qquad \hat{r} = \cos\theta\,\hat{i} + \sin\theta\,\hat{j}$$
$$\hat{j} = \sin\theta\,\hat{r} + \cos\theta\,\hat{\theta} \qquad \hat{\theta} = -\sin\theta\,\hat{i} + \cos\theta\,\hat{j}$$
$$\hat{k} = \hat{k} \qquad \hat{k} = \hat{k}$$

$$d\vec{s} = dr\,\hat{r} + r\,d\theta\,\hat{\theta} + dz\,\hat{k}; \quad dV = r\,dr\,d\theta\,dz$$

$$\nabla f = \frac{\partial f}{\partial r}\hat{r} + \frac{1}{r}\frac{\partial f}{\partial \theta}\hat{\theta} + \frac{\partial f}{\partial z}\hat{k}$$

$$\nabla \cdot \vec{v} = \frac{1}{r}\frac{\partial}{\partial r}(r v_r) + \frac{1}{r}\frac{\partial v_\theta}{\partial \theta} + \frac{\partial v_z}{\partial z}$$

$$\nabla \times \vec{v} = \left[\frac{1}{r}\frac{\partial v_z}{\partial \theta} - \frac{\partial v_\theta}{\partial z}\right]\hat{r} + \left[\frac{\partial v_r}{\partial z} - \frac{\partial v_z}{\partial r}\right]\hat{\theta} + \frac{1}{r}\left[\frac{\partial}{\partial r}(r v_\theta) - \frac{\partial v_r}{\partial \theta}\right]\hat{k}$$

$$\nabla^2 f = \frac{1}{r}\frac{\partial}{\partial r}\left(r\frac{\partial f}{\partial r}\right) + \frac{1}{r^2}\frac{\partial^2 f}{\partial \theta^2} + \frac{\partial^2 f}{\partial z^2}$$