$$\mathbf{A}\cdot\mathbf{B} = A_xB_x + A_yB_y + A_zB_z \tag{A-1}$$

$$\mathbf{A}\times\mathbf{B} = \begin{vmatrix} \mathbf{e}_1 & \mathbf{e}_2 & \mathbf{e}_3 \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix} \tag{A-2}$$

$$(\mathbf{A}\times\mathbf{B})\times\mathbf{C} = (\mathbf{A}\cdot\mathbf{C})\mathbf{B} - (\mathbf{B}\cdot\mathbf{C})\mathbf{A} \tag{A-3}$$

$$\mathbf{A}\times(\mathbf{B}\times\mathbf{C}) = (\mathbf{A}\cdot\mathbf{C})\mathbf{B} - (\mathbf{A}\cdot\mathbf{B})\mathbf{C} \tag{A-4}$$

$$(\mathbf{A}\times\mathbf{B})\cdot(\mathbf{C}\times\mathbf{D}) = (\mathbf{A}\cdot\mathbf{C})(\mathbf{B}\cdot\mathbf{D}) - (\mathbf{A}\cdot\mathbf{D})(\mathbf{B}\cdot\mathbf{C}) \tag{A-5}$$

$$\begin{aligned}(\mathbf{A}\times\mathbf{B})\times(\mathbf{C}\times\mathbf{D}) &= [\mathbf{A}\cdot(\mathbf{B}\times\mathbf{D})]\mathbf{C} - [\mathbf{A}\cdot(\mathbf{B}\times\mathbf{C})]\mathbf{D} \\ &= [\mathbf{A}\cdot(\mathbf{C}\cdot\mathbf{D})]\mathbf{B} - [\mathbf{B}\cdot(\mathbf{C}\times\mathbf{D}]\mathbf{A}\end{aligned} \tag{A-6}$$

$$\nabla\varphi\psi = \varphi\,\nabla\psi + \psi\,\nabla\varphi \tag{A-7}$$

$$\nabla\cdot(\varphi\mathbf{a}) = \varphi\,\nabla\cdot\mathbf{a} + (\nabla\varphi)\cdot\mathbf{a} \tag{A-8}$$

$$\nabla\times(\varphi\mathbf{a}) = \varphi(\nabla\times\mathbf{a}) + \nabla\varphi\times\mathbf{a} \tag{A-9}$$

$$\nabla\cdot(\mathbf{a}\times\mathbf{b}) = \mathbf{b}\cdot(\nabla\times\mathbf{a}) - \mathbf{a}\cdot(\nabla\times\mathbf{b}) \tag{A-10}$$

$$\nabla\times(\mathbf{a}\times\mathbf{b}) = \mathbf{a}(\nabla\cdot\mathbf{b}) + (\mathbf{b}\cdot\nabla)\mathbf{a} - \mathbf{b}(\nabla\cdot\mathbf{a}) - (\mathbf{a}\cdot\nabla)\mathbf{b} \tag{A-11}$$

$$\nabla(\mathbf{a}\cdot\mathbf{b}) = (\mathbf{a}\cdot\nabla)\mathbf{b} + (\mathbf{b}\cdot\nabla)\mathbf{a} + \mathbf{a}\times(\nabla\times\mathbf{b}) + \mathbf{b}\times(\nabla\times\mathbf{a}) \tag{A-12}$$

$$\nabla\times(\nabla\times\mathbf{a}) = \nabla(\nabla\cdot\mathbf{a}) - \nabla^2\mathbf{a} \tag{A-13}$$

$$\nabla\cdot(\nabla\times\mathbf{a}) = 0 \tag{A-14}$$

$$\nabla\times(\nabla\varphi) = 0 \tag{A-15}$$

The line element in orthogonal coordinates is

$$ds^2 = (h_1\,dx_1)^2 + (h_2\,dx_2)^2 + (h_3\,dx_3)^2$$

The ∇ operations are

$$\nabla\psi = \frac{1}{h_1}\frac{\partial\psi}{\partial x_1}\mathbf{e}_1 + \frac{1}{h_2}\frac{\partial\psi}{\partial x_2}\mathbf{e}_2 + \frac{1}{h_3}\frac{\partial\psi}{\partial x_3}\mathbf{e}_3$$

$$\nabla\cdot\mathbf{a} = \frac{1}{h_1h_2h_3}\left[\frac{\partial}{\partial x_1}(h_2h_3a_1) + \frac{\partial}{\partial x_2}(h_1h_3a_2) + \frac{\partial}{\partial x_3}(h_1h_2a_3)\right]$$

$$\begin{aligned}\nabla\times\mathbf{a} = &\frac{1}{h_2h_3}\left[\frac{\partial}{\partial x_2}(h_3a_3) - \frac{\partial}{\partial x_3}(h_2a_2)\right]\mathbf{e}_1 \\ &+ \frac{1}{h_1h_3}\left[\frac{\partial}{\partial x_3}(h_1a_1) - \frac{\partial}{\partial x_1}(h_3a_3)\right]\mathbf{e}_2 \\ &+ \frac{1}{h_1h_2}\left[\frac{\partial}{\partial x_1}(h_2a_2) - \frac{\partial}{\partial x_2}(h_1a_1)\right]\mathbf{e}_3\end{aligned}$$

$$\nabla^2\psi = \frac{1}{h_1h_2h_3}\left[\frac{\partial}{\partial x_1}\left(\frac{{}_2h_3h}{h_1}\frac{\partial\psi}{\partial x_1}\right) + \frac{\partial}{\partial x_2}\left(\frac{h_3h_1}{h_2}\frac{\partial\psi}{\partial x_2}\right) + \frac{\partial}{\partial x_3}\left(\frac{h_1h_2}{h_3}\frac{\partial\psi}{\partial x_3}\right)\right]$$