$$\therefore \quad \nabla \times \underline{F} = \underline{i}\left(\frac{\partial P}{\partial y} - \frac{\partial N}{\partial z}\right) - \underline{j}\left(\frac{\partial P}{\partial x} - \frac{\partial M}{\partial z}\right) + \underline{k}\left(\frac{\partial N}{\partial x} - \frac{\partial M}{\partial y}\right)$$

$$= \underline{i}\left[0 - xy\right] - \underline{j}\left[0 - x^2\right] + \underline{k}\left[yz - 0\right]$$

$$\therefore \quad \nabla \times \underline{F} = -\underline{i}\, xy + \underline{j}\, x^2 + \underline{k}\, yz$$

Note that $\underline{F}$ is a vector as well as $\nabla \times \underline{F}$ is a vector.

Exercises:

① Given $\underline{F}(x, y, z) = \sin x\, \underline{i} + \cos y\, \underline{j} + z^2 \underline{k}$, find div $\underline{F}$

② Given $\underline{F}(x, y, z) = \ln(xyz)(\underline{i} + \underline{j} + \underline{k})$, evaluate div $\underline{F}(x, y, z)$ at $(3, 2, 1)$

③ Given $\underline{F}(x, y, z) = \underline{i} + 2x\, \underline{j} + 3y\, \underline{k}$ and $\underline{G}(x, y, z) = x\underline{i} - y\underline{j} + z\underline{k}$, find

(a) div $\underline{F}$ (b) Curl $\underline{G}$ (c) div $(\underline{F} \times \underline{G})$

(d) Curl $(\underline{F} \times \underline{G})$ (e) div (Curl $\underline{G}$) (f) grad (div $\underline{F}$)