

$$12. \vec{F}(x, y) = \underbrace{x^3}_{M} \vec{i} + \underbrace{4e^y}_{N} \vec{j}$$

$$\begin{aligned} \operatorname{div} \vec{F}(x, y) &= \frac{\partial M}{\partial x} + \frac{\partial N}{\partial y} \\ &= \boxed{3x^2 + 4e^y} \end{aligned}$$

$$13. \vec{F}(x, y, z) = \underbrace{w(x^2 + y)}_M \vec{i} + \underbrace{x^2 y^3}_N \vec{j} + \underbrace{w(2y^2 - z^2)}_P \vec{k}$$

$$\begin{aligned} \operatorname{div} \vec{F}(x, y, z) &= \frac{\partial M}{\partial x} + \frac{\partial N}{\partial y} + \frac{\partial P}{\partial z} \\ &= \frac{1}{x^2 + y} \cdot 2x + 3x^2 y^2 + \frac{1}{2y^2 - z^2} \cdot -2z \\ &= \boxed{\frac{2x}{x^2 + y} + 3x^2 y^2 - \frac{2z}{2y^2 - z^2}} \end{aligned}$$