

$$1. \vec{F}(x, y, z) = (\overbrace{2x^2})^M \vec{i} + (\overbrace{3y^2})^N \vec{j} + (\overbrace{z^2})^P \vec{k}$$

$$S: x=0, x=2, y=0, y=1, z=0, z=3$$

$$\operatorname{div} F = \frac{\partial M}{\partial x} + \frac{\partial N}{\partial y} + \frac{\partial P}{\partial z}$$

$$\operatorname{div} F = 4x + 6y + 2z$$

$$\int_{x=0}^{x=2} \int_{y=0}^{y=1} \int_{z=0}^{z=3} (4x + 6y + 2z) dz dy dx$$

$$= \int_{x=0}^{x=2} \int_{y=0}^{y=1} \left[4xz + 6yz + 2 \cdot \frac{1}{2} z^2 \right]_{z=0}^{z=3} dy dx$$

$$= \int_{x=0}^{x=2} \int_{y=0}^{y=1} [4x \cdot 3 + 6y \cdot 3 + 3^2] dy dx$$

$$= \int_{x=0}^{x=2} \int_{y=0}^{y=1} (12x + 18y + 9) dy dx$$

$$= \int_{x=0}^{x=2} \left[12xy + \frac{18}{2} \cdot y^2 + 9y \right]_{y=0}^{y=1} dx$$

$$= \int_{x=0}^{x=2} (12x \cdot 1 + 9 \cdot 1^2 + 9(1)) dx$$

$$= \int_{x=0}^{x=2} (12x + 18) dx$$

$$= \left[12 \cdot \frac{1}{2} x^2 + 18x \right]_{x=0}^{x=2}$$

$$= [6x^2 + 18x]_{x=0}^{x=2}$$

$$= 6(2)^2 + 18(2)$$

$$= 24 + 36$$

$$= \boxed{60}$$