

$$\begin{aligned}w_x &= (x^2)_x + (y^2)_x - 3(z^2)_x - (x)_x y + (yz)_x + 3(zx)_x \\ &= 2x - y\end{aligned}$$

$$\begin{aligned}w_y &= (x^2)_y + (y^2)_y - 3(z^2)_y - x(y)_y + (y)_y z + 3(zx)_y \\ &= 2y - x + z\end{aligned}$$

$$\begin{aligned}w_z &= (x^2)_z + (y^2)_z - 3(z^2)_z - (xy)_z + y(z)_z + 3(z)_z x \\ &= -6z + y + 3x\end{aligned}$$