

$$b \quad \nabla f = F$$

$$\frac{\partial f}{\partial x} = M_1, \quad \frac{\partial f}{\partial y} = N_1, \quad \frac{\partial f}{\partial z} = P_1$$

$$f(x, y, z) = \sqrt{x^2 + y^2} + g(y, z)$$

$$\frac{y}{\sqrt{x^2 + y^2}} + \frac{\partial g}{\partial y} = \frac{y}{\sqrt{x^2 + y^2}} \Rightarrow \frac{\partial g}{\partial y} = 0$$

$$\Rightarrow f(x, y, z) = \sqrt{x^2 + y^2} + h(z)$$

$$0 + \frac{\partial h}{\partial z} = 0 \Rightarrow \frac{\partial h}{\partial z} = 0, \quad h(z) = \overset{C}{z} + \cancel{0}$$

$$\Rightarrow f(x, y, z) = \sqrt{x^2 + y^2} + \cancel{z} + C$$