$r = 0{,}05\,m \qquad \vec{E} = (-y, z, z^2)$

a) Zylindermantel $x^2 + y^2 = r^2 \qquad -\infty < z < \infty \qquad \phi(x,y,z) = x^2 + y^2$

Gradient: $\nabla f = \left(\frac{\partial}{\partial x}[f], \frac{\partial}{\partial y}[f], \frac{\partial}{\partial z}[f]\right)$

Zylindrische Koordinaten:

$r = \sqrt{x^2 + y^2}$

$\varphi = \arctan\left(\frac{y}{x}\right) + \text{Quadrant}$

$z = z$

Daraus folgt:

$\nabla f = \left(\frac{\partial}{\partial r}[f], \frac{\partial}{\partial \varphi}[f], \frac{\partial}{\partial z}[f]\right)$

b) Elektrischer Fluss:

$$\phi = \int_A \vec{E}\, dA$$

c) C_1: $x = 0$; $y = 0$

$$W_1 = Q \int_{-\infty}^{\infty} E\, dr$$

C_2: $x = 0{,}05\,m$; $y = 0$

$$W_2 = Q \int_{-\infty}^{\infty} E\, dr$$

C_3: $x = 0$; $y = 0{,}03\,m$

$$W_3 = Q \int_{-\infty}^{\infty} E\, dr$$

d)