The Vorticity in Two Dimensions

Consider a two-dimensional velocity field given by

$$\boldsymbol{u} = u_1(x, y)\boldsymbol{i} + u_2(x, y)\boldsymbol{j}.$$

Show that the vorticity $\boldsymbol{\omega} = \boldsymbol{\nabla} \times \boldsymbol{u}$ takes the form

$$\boldsymbol{\omega} = \omega_3(x, y)\boldsymbol{k}.$$

Determine ω_3 in terms of u_1 and u_2.