

MAE 123, Midterm 1

Problem 1 (30 pts)

Consider two-dimensional groundwater flow in a homogeneous anisotropic aquifer with hydraulic conductivity tensor \mathbf{K} given by

$$\mathbf{K} = \begin{pmatrix} K_{xx} & K_{xy} \\ K_{yx} & K_{yy} \end{pmatrix}. \quad (1)$$

The flow is driven by hydraulic head gradient

$$\nabla h = \begin{pmatrix} 1 \\ 0 \end{pmatrix}. \quad (2)$$

Find Darcy's flux.

Problem 2 (70 pts)

You are conducting a pumping test in a fractured rock. Assume that the pumping well extracts water from a single fracture of constant (and known) aperture a . The fracture walls are covered with bacterial growth that induces slip velocity U at the fracture walls. Suppose that the slip velocity U increases linearly with the bacterial mass m , such that $U = \beta m$ where β is a known constant. Use the pumping test to determine the biomass m in the fracture.