

## MAE123, Midterm 2

A homogeneous isotropic soil has porosity  $\omega$  and saturated hydraulic conductivity  $K_s$ , and is characterized by the Gardner-Russo constitutive relations

$$K(\psi) = K_s e^{-\alpha\psi}, \quad \theta(\psi) = \omega \left[ e^{-\alpha\psi/2} (1 + \alpha\psi/2) \right]^{2/2.5}. \quad (1)$$

A precipitation event has lead to infiltration into this soil, with constant infiltration rate  $q_0$  at the land surface  $z = 0$ .

### Question 1 (20 pts)

Write down an equation and corresponding boundary conditions that describe steady-state, one-dimensional infiltration into this soil. Hints: 1) Use a  $\psi$ -based form of this equation. 2) Assume that the soil is dry at  $z = \infty$ .

### Question 2 (50 pts)

Solve this equation to obtain a vertical suction distribution,  $\psi(z)$ .

### Question 3 (30 pts)

Without carrying out the calculations, list the steps necessary to compute the corresponding moisture profile,  $\theta(z)$ .