Name: _____
Soc. Sec. #: _____
Winter Quarter, 1994

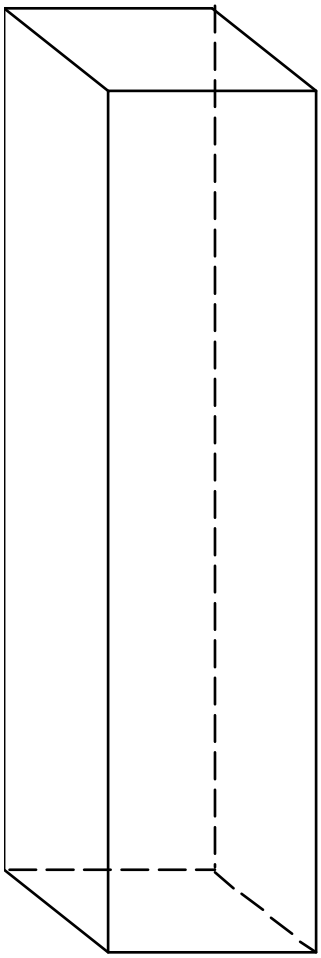
Ground-Water Geology II

15-040-602

Winter Quarter, 1994

1. (20) Derive an equation for head as a function of distance away from a pumping well in an unconfined aquifer. Assume that steady-state conditions prevail. Discuss each step.

2. (20) Completely and neatly derive (as far as you can) an equation for steady-state flow in a heterogeneous, anisotropic, confined aquifer starting with $\Delta Q_X + \Delta Q_y = Q_R$. Show and briefly discuss each step. You may use the diagram below in your derivation.



3. (10) Below is a longitudinal section through a device similar to a Darcy's apparatus except that it is infinitely long in the direction perpendicular to the paper. It is packed with porous material in such a way that the conductivity at a point a distance x downflow from h_{in} is $K_x = K_0 + ax$ where a is a constant. If flow is steady state, draw a flow net. Be carefull, this is not the same situation we dealt with in class.

4. (30) Pictured below is the "island problem". Given the values of *T*, *R*, and *L* shown below, determine an analytical expression for head using the Poisson equation $\left(\frac{d^2h}{dx^2} = -\frac{R}{T}\right)$ and calculate the head at the center of the island.

   Repeat the question above but this time use the Dupuit assumption for unconfined conditions $\left(\frac{d^2h^2}{dx^2} = -\frac{2R}{K}\right)$

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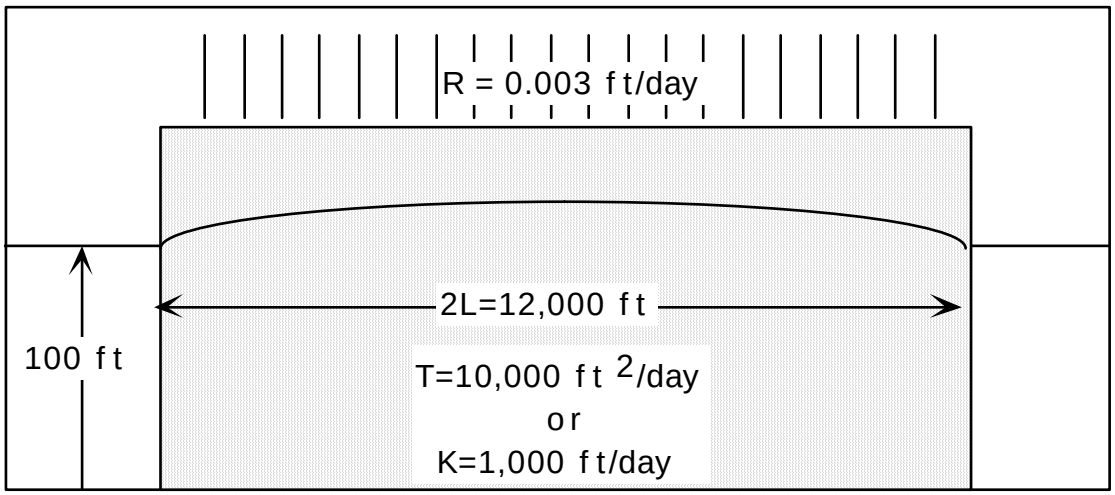
   How do the heads calculated both way compare? What would be the effect if the thickness of the island were increased to 200ft? Why?



5. (20) Pictured below is a map view of an area underlain by 10 foot thick aquifer having a transmissivity of 50,000 ft^2/day and a porosity of 20%. Each grid of the square is 1,000 feet. A sand quarry in the aquifer has been converted into an unlined dump. The piezometric surface in three wells is shown (you may assume the surface through the area is planar). If contamination from the dump moves purely advectively (*i.e.*, there is no component of transport by dispersion or diffusion), where will the contaminated plume reach the river and how long will it take?