Physical Hydrogeology

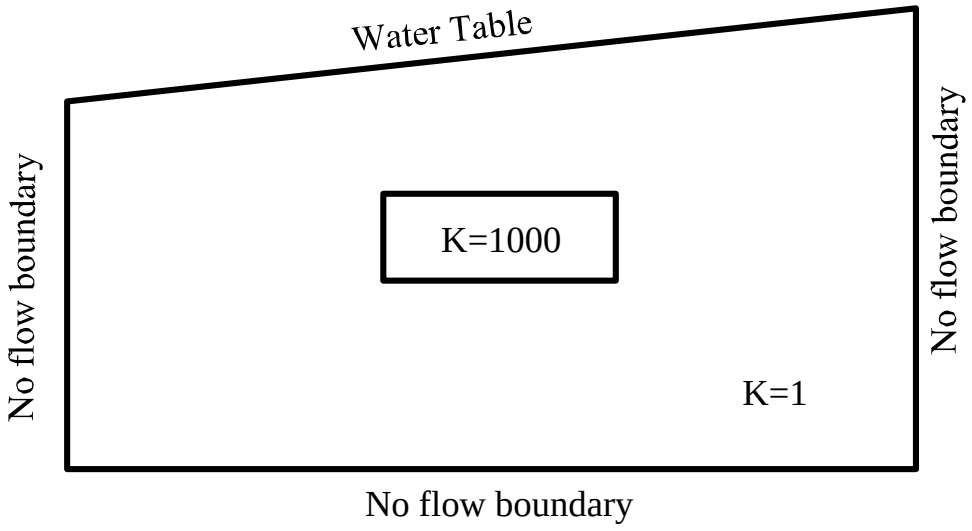
Problem Set 3 Due: 3/17/09

1. An earthen dam is constructed on an impermeable, horizontal bedrock layer. It is 700 ft across (i.e., the distance from the water in the reservoir to the tailwaters below the dam is 700 ft). The average hydraulic conductivity of the material used in the dam construction is 0.25 ft/day. The water in the reservoir behind the dam is 80 ft deep and the tailwaters below the dam are 20 ft deep. Compute the volume of water that seeps from the reservoir, through the dam, and into the tailwaters per a 100-ft-wide strip of the dam in cubic feet per day.

2. A soil sample is collected and taken to the lab. The volume of the sample is 75 cm^3. At the natural water content, the sample weighs 165 g. It is then saturated with water and reweighed. The saturated weight is 168 g. The sample is gravity-drained, and its weight is found to be 157.5 g. Finally, it is dried in an oven; the dry weight is 154 g. Assume the density of water is 1 g/cm^3. Find each of the following.

   A. Volumetric water content
   B. Gravimetric water content
   C. Saturation ratio
   D. Porosity
   E. Specific yield
   F. Specific retention
   G. Dry-bulk density

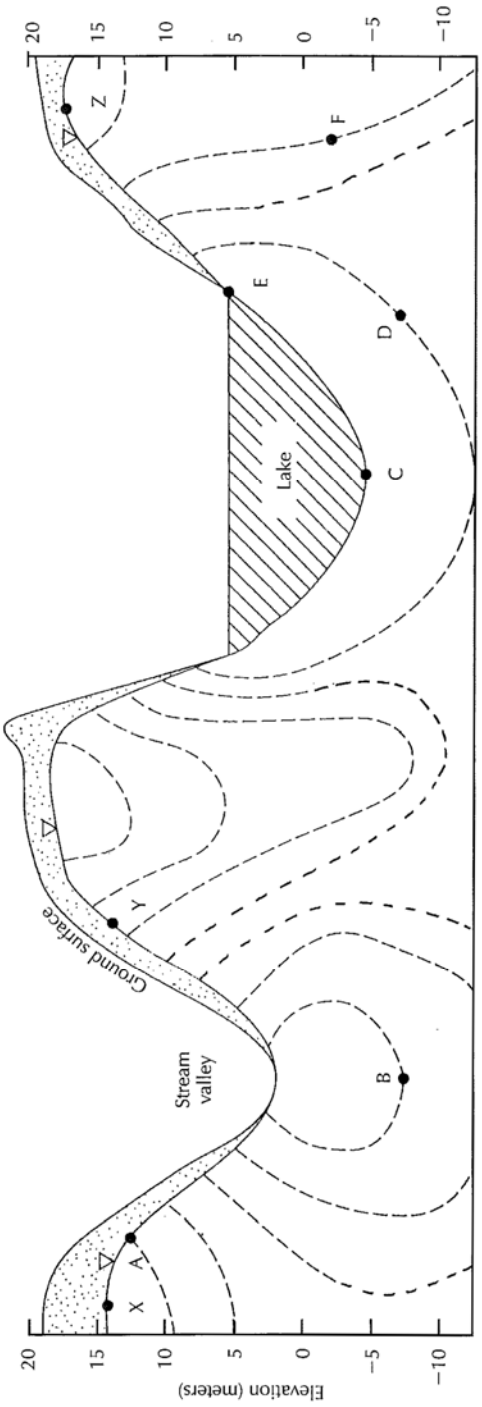
3. Draw a flow net on the figure below



4. Using equation 7.30 from the Handout on driving forces, determine the permeability at which convection will occur for a 1 km thick layer and a 100 m thick layer. Assume that the thermal expansion coefficient for water is 0.001 per °C, water density is 1000 kg/m^3, Specific Heat Capacity is 4200 J/kg-°C, geothermal gradient is 25 °C/km, water viscosity is 0.0005 kg/m-s, and thermal conductivity is 2.25 W/m-°C. How do these values compare to sand permeability?

5. Answer the following questions based on the Figure below.

a. Determine the Elevation Head, Pressure Head, and Total Head at the locations A, B, C, D, E, and F.
b. Find one place on the figure where recharge is occurring, and label it R
c. Find one place on the figure where discharge is occurring and label it D
d. Draw in flow lines on the figure starting at points X, Y, and Z.



▲ FIGURE 7.39
Diagram for Problem 3. The dashed lines are equipotentials. Heads are in meters.