Problem #1

Figure 1 is a profile through an unconfined aquifer on a circular island. Rainfall on the island is collected and recharged to the aquifer from a circular pond as shown. Derive the equation that relates head in the aquifer to recharge (N) and position (r).

The water level around the island is fixed at elevation $h_L=10.0$ m. The recharge rate is $N=0.001$ m/d, the hydraulic conductivity is $K=1$ m/d. Assume $R = 10,000$ m and $r* = 1,000$ m. Sketch the water table and determine the maximum height of the groundwater mound in the center of the island.
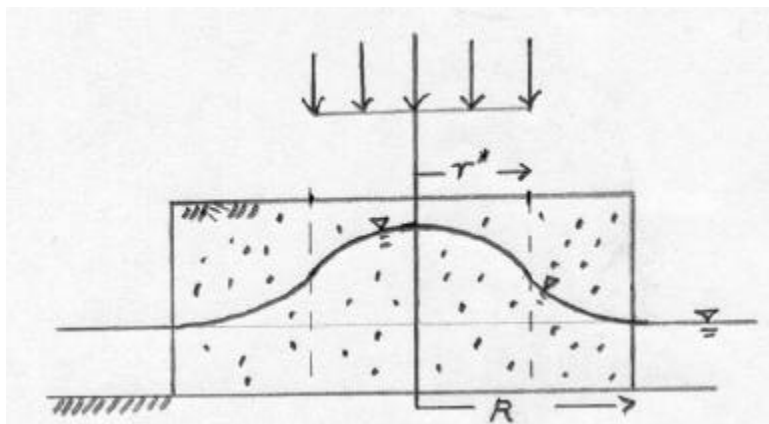

Figure 1. Diagram of unconfined aquifer

Problem 2.

Calculate the porosity of uniform sized spheres packed in a simple cubic structure. Figure 2 depicts the structure.
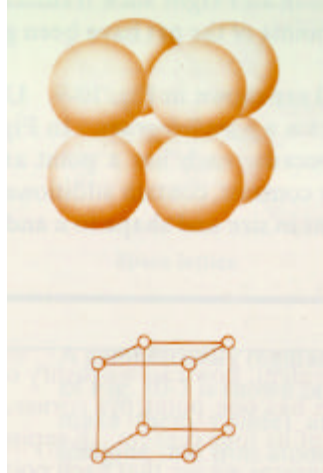

Figure 2. Simple Cubic Packing

Problem 3.

Heavy infiltration (due to excess irrigation) of *3 cm/d* causes a perched water table to form above a low permeability, flow-restricting layer. The top of the flow-restricting layer is at a depth of *2 m*, it is *0.4 m* thick, and it has a K_v, of *0.03 m/d*. The material above the restricting layer is a silt loam with a K_v, of *0.36 m/d*. Coarse sand and gravel occurs below the restricting layer. After flowing through the restricting layer, the water moves as unsaturated flow through the sand and gravel to an unconfined aquifer. What is the height of the perched water table above the top of the restricting layer? The setting is shown below.
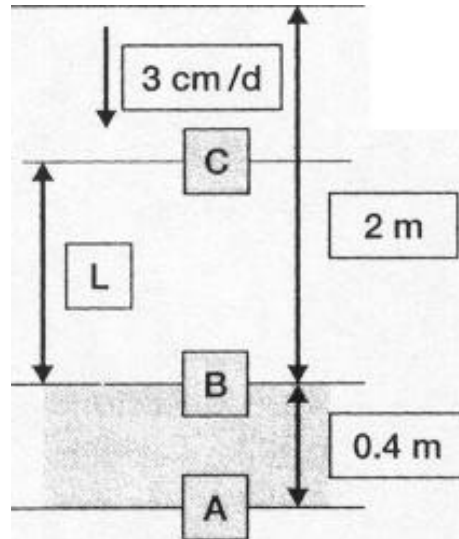
Problem 4.

A piezometer is screened at a depth of *40 m* below land surface and records a pressure of *120 kPa* on a pressure transducer. An immediately adjacent piezometer is screened at a depth of *20 m* below land surface, and the depth to water in this piezometer is *14 m* below land surface. Is the vertical component of flow upward or downward at this location, and what is the depth of the water table below land surface? Assume the specific weight of water is *9810 N/m³*.

Problem 5

During a drought period the following declines in the water table were recorded in an unconfined aquifer.

Area	Size (mi^2)	Decline (ft)
A	14	4.75
B	7	6.56
C	28	5.42
D	33	9.78

The total volume of water removed from storage in this aquifer during the time period was 5.7385 x 10^4 acre-feet. Estimate the specific yield of this aquifer.

Problem 6

Draw sufficient flow lines on the profile below to illustrate the regional flow pattern.