Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Department of Science and Technology
200 Level 1st Semester Examination – Jul/Aug 2016
MRT 253-2 Principles of Hydrogeology

Uva Wellassa University

Instructions to candidates
Duration: Two (02) hours
Number of questions: Four (04) Essay
Answer all questions
Mark allocation: 100 Mark

1. A soil sample was collected in the field and placed in a container with a volume of 75.0 cm^3. The mass of the soil at the natural moisture content was 151.5 g. The soil sample was then saturated with water and reweighed. The saturated mass was 160 g. The sample was then oven-dried to remove all the water and reweighed. The dry mass was 136.6 g. Note that masses were determined by weighing on a balance. All measurements were made at 26 °C.
(Consider that the density of water at 26 °C is 0.997 g/cm^3)

   a. Determine the soil porosity (4 mark)
   b. Determine the gravimetric water content under natural conditions (4 mark)
   c. Determine the volumetric water content (4 mark)
   d. Determine the saturation ratio (4 mark)
   e. Determine the dry bulk density (4 mark)
   f. Determine the particle density (4 mark)
   g. Determine the soil porosity using the relationship between soil porosity, dry bulk density and particle density (4 mark)

2. The following data were collected at a nest of piezometers (several piezometers of different depths located within a few meters of each other)

	A	B	C
Elevation at surface (meters above mean sea level)	251	224	241
Depth of piezometers (meters)	147	95	87
Depth to water (meters below surface)	85	73	60

   a. What is the hydraulic head at A, B, and C? (6 mark)
   b. What is the pressure head at A, B, and C? (6 mark)
   c. What is the elevation head in each well? (6 mark)
   d. What is the vertical hydraulic gradient between the piezometers? Explain to which direction water flows between A and B, B and C, and A and C. (6 mark)

47

3. The properties of a fresh-water-table aquifer (A) and two confined saline-water-aquifers (B,C) which are located below each other are given in the table.

Aquifer	Water density (kg/m^3)	Elevation head (m)	Point-water head (m)
A	1000	56	57
B	1100	33	52
C	1200	3	50

a. If a hole is bored to connect the A and B aquifers, to which direction water will flow? From A to B or B to A? Explain with calculations. (6 mark)
b. If a hole is bored to connect the B and C aquifers, to which direction water will flow? From B to C or C to B? Explain with calculations. (6 mark)
c. If the A and C aquifers are connected using a large diameter PVC pipe, to which direction water will flow? From A to C or C to A? Explain with calculations. (6 mark)

4.

a. For a watershed from 1995 to 2015, the precipitation is 975 mm/yr, average stream flow is 4.5 m^3/sec, and the watershed area is 501.8 km^2. Estimate the average annual evapotranspiration in mm/yr for the watershed mentioning the assumptions that can be made for long-term water balance. (Consider 1 year = 365.25 days) (10 mark)

b. An aquifer has three different formations which are located below each other. Formation A has a thickness of 8.2 m and a hydraulic conductivity of 21.5 m/d. Formation B has a thickness of 3.4 m and a hydraulic conductivity of 135 m/d. Formation C has a thickness of 35 m and a hydraulic conductivity of 33 m/d. Assume that each formation is isotropic and homogeneous. Compute both the overall horizontal and vertical conductivities in m/d. (10 mark)

c. A constant-head permeameter has a sample of medium-grained sand 15cm in length and 25 cm^2 in cross sectional area. With a head of 5.0 cm, a total of 100 mL of water is collected in 11 min. Find the hydraulic conductivity in m/d. (10 mark)