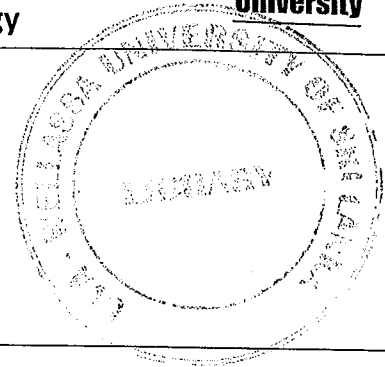


**Uva Wellassa University of Sri Lanka**  
**Faculty of Science and Technology**  
**Department of Science and Technology**  
**300 Level 1<sup>st</sup> Semester Examination – Jul/Aug 2016**  
**MRT 352-2 Principles of Hydrogeology**



**Instructions to candidates**

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

1.
  - a. For a watershed from 1995 to 2015, the precipitation is 990 mm/yr, average stream flow is  $5.9 \text{ m}^3/\text{sec}$ , and the watershed area is  $496.5 \text{ km}^2$ . 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 7.8 m and a hydraulic conductivity of 22.5 m/d. Formation B has a thickness of 3.1 m and a hydraulic conductivity of 137 m/d. Formation C has a thickness of 33 m and a hydraulic conductivity of 35 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 falling-head permeameter containing a silty, fine sand has a falling-head tube diameter of 2.0 cm, a sample diameter of 10.0 cm, and a flow length of 15 cm. The initial head is 6.0 cm. It falls to 0.50 cm over a period of 531 min. Find the hydraulic conductivity in m/d. (10 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)	249	226	239
Depth of piezometers (meters)	146	94	86
Depth to water (meters below surface)	86	74	61

- 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)

3. A soil sample was collected in the field and placed in a container with a volume of  $75.0 \text{ cm}^3$ . The mass of the soil at the natural moisture content was  $153.75 \text{ g}$ . The soil sample was then saturated with water and reweighed. The saturated mass was  $160.25 \text{ g}$ . The sample was then oven-dried to remove all the water and reweighed. The dry mass was  $137.05 \text{ g}$ . Note that masses were determined by weighing on a balance. All measurements were made at  $26^\circ\text{C}$ . (Consider that the density of water at  $26^\circ\text{C}$  is  $0.997 \text{ g/cm}^3$ )

- 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)

4. 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 ( $\text{kg/m}^3$ )	Elevation head (m)	Point-water head (m)
A	1000	55	56
B	1090	33	53
C	1210	6	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)