

Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Department of Science and Technology
300 Level 1st Semester Examination – Sep/Oct 2015
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 soil sample was collected in the field and placed in a container with a volume of 85.0 cm^3 . The mass of the soil at the natural moisture content was 153 g. The soil sample was then saturated with water and reweighed. The saturated mass was 164 g. The sample was then oven-dried to remove all the water and reweighed. The dry mass was 127 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)	250	225	240
Depth of piezometers (meters)	145	95	85
Depth to water (meters below surface)	85	75	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. (9 mark)

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	54	55
B	1100	32	52
C	1200	5	50

- 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. (10 mark)
 - 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. (10 mark)
 - 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. (10 mark)
4. For a watershed from 1994 to 2014, the precipitation is 994 mm/yr, average stream flow is $5.2 \text{ m}^3/\text{sec}$, and the watershed area is 477 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) (15 mark)