Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Department of Science and Technology
300 Level 1st Semester Examination – June/July 2017
MRT 378-2 Advanced Hydrogeology

Uva Wellassa University

Instructions
Duration: 02 hours
Number of questions: 04
Answer All questions
Mark allocation: 100 marks
Illustrate your answers with sketches/diagrams where necessary. Additional graph sheets are not provided

Index Number:-

1.

a. i. What is a zero flux plane? (5 marks)

ii. If an area received a rainfall after a drought period and followed by another longer dry period and a rainfall, draw unsaturated zone (assuming permeable) soil water potential curve for the entire period and label each event. (5 marks)

b. What is explained by hysteresis? (5 marks)

c. Compare the saturated and unsaturated hydraulic conductivities with their associated parameters. (5 marks)

d. Explain the following with proper illustrations (5 marks)
   i. Matrix Suction vs. Volumetric Moisture Content of a draining fractured sandstone
   ii. Matrix Suction vs. Volumetric Moisture Content of a draining clay

e. Describe the soil water potential/hydraulic head variation from the surface to the bottom of saturated zone of an unconfined aquifer. Show the soil water/groundwater movement direction in each section and explain the reasons. (5 marks)

2. a. Discuss the following.

i. Major differences between Theim and Theis solutions. (5 marks)

ii. Development of Cooper–Jacob solutions from Theis solutions. (5 marks)

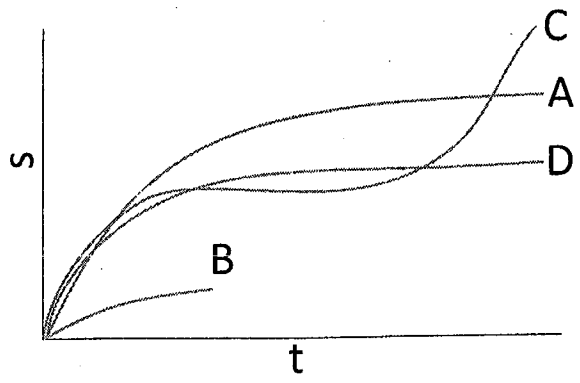
iii. Why the parameter "r" is important in estimating "S" of an aquifer (5 marks)

iv. Why the Storativity cannot be measured of an aquifer that is at steady sate (5 marks)

84
(56)

b. Identify the following time vs drawdown curves and justify your answer.

(5 marks)



3. In a test of a confined aquifer, the pumping rate was 1000 m^3day^{-1}. Drawdown data were collected at an observation well that is 45 m away.

i. Calculate Transmissivity and Storativity based on Cooper – Jacob solutions using time and drawdown data given below. (10 marks)

ii. What are the additional assumptions you should make? (5 marks)

iii. Prove the assumptions made in part (ii.) are correct or not. (5 marks)

$$T = \frac{2.3Q}{4\pi\Delta s}, S = \frac{2.25Tt_0}{r^2} \text{ and } (u = \frac{rS}{4Tt}, \text{ if necessary})$$

N. B. All above are conventional notations

Time (min)	Drawdown (m)	Time (min)	Drawdown (m)	Time (min)	Drawdown (m)
0	0.00	10	0.57	120	1.00
1	0.20	12	0.60	150	1.04
1.5	0.27	14	0.63	180	1.07
2	0.30	18	0.67	210	1.10
2.5	0.34	24	0.76	240	1.12
3	0.37	30	0.81		
4	0.41	40	0.85		
5	0.45	50	0.90		
6	0.48	60	0.93		
8	0.53	100	0.96		

4. Hvorslev's slug test was carried out for an unconfined aquifer to estimate its hydraulic conductivity. Given below are the configuration of a well and water level changes with respect to time. All equations and notations carry conventional meanings. Note that well casing and screen have the same radius.

R = 7.6 cm, L = 98 m (an open hole)

$$K = \frac{A}{F}\frac{1}{t_2 - t_1}\ln\frac{H_1}{H_2} \qquad F = \frac{2\pi L}{\ln(L/R)}$$

a. Calculate the hydraulic conductivity of the aquifer.

b. Describe are the precautions to be taken during a slug or bail test.

c. Describe the principles of Hvorslev and Bouwer-Rice slug tests and their capabilities

Time (s)	Drawdown (m)
0	0.560
3	0.457
6	0.392
9	0.345
12	0.308
15	0.280
18	0.252
21	0.224
24	0.205
27	0.187
30	0.168
33	0.149
36	0.140
39	0.131
42	0.112
45	0.108
48	0.093
51	0.089
54	0.082
57	0.075
60	0.071
63	0.065