



Uva Wellassa University, Sri Lanka  
Faculty of Science and Technology  
Mineral Resources and Technology Degree Programme  
1<sup>st</sup> Semester Examination – March/April 2013



MRT 352-2 Principles of Hydrogeology

Instructions to candidates

Total 04 (four) questions.

Answer all questions.

Time allocation: Two (02) hours

Draw sketch diagrams where necessary.

Semi-log paper and Piper plot are provided with the paper.

Marks allocated: 100

Index No. :

*Density of water = 998.2 kg/m<sup>3</sup> at 25° C, Dynamic viscosity of water = 1.005 x 10<sup>-3</sup> kg/ms at 25° C*

1.

- a. Distinguish between hydraulic conductivity and transmissivity. (3 marks)
- b. Critically discuss the average linear velocity. (7 marks)
- c. What are the conditions where Darcy's law cannot be applied? Explain how those conditions affect. (5 marks)
- d. Following data were obtained from two dug wells located 1 km apart in a 2 km wide unconfined aquifer.
  - Porosity = 0.22
  - Aquifer saturated thickness = 20 m
  - Static water level in well 1 = 83.4 m
  - Static water level in well 2 = 82.9 m
  - K = 0.25 m/day
  - Effective grain size is 0.15 mm
  - i. Determine the discharge across the aquifer.
  - ii. State your assumptions for part (i.).
  - iii. Is this flow Darcian? (10 marks)

2.

a. Plot the following data on the Piper plot given on the page 5 and interpret the water type. (It is not necessary to calculate the electro-neutrality) (10 marks)

b. What is the category of ions plotted on a Piper plot? Explain the reasons. (5 marks)

Constituent	Concentration (mg/L)
Na	35.5
K	4.9
Ca	23.8
Mg	4.7
Mn	0.087

Constituent	Concentration (mg/L)
Cl <sup>-</sup>	9.5
HCO <sub>3</sub> <sup>-</sup>	175.0
SO <sub>4</sub> <sup>2-</sup>	5.0
NO <sub>3</sub> <sup>-</sup>	0.0401
PO <sub>4</sub> <sup>2-</sup>	0.733

Atomic weight of elements: Na – 22.99, K – 39.10, Ca – 40.08, Mg – 24.31, H – 1.01, O – 16.00, C – 12.01, Fe – 55.85, Mn – 54.94, S – 32.06, Cl – 35.45, H – 1.008, N – 14.007, and P – 30.97

c. What are the other multi-element plots (except pie charts and Collins diagram) that can be employed for water quality data presentation? What are the differences of those plots with respect to Piper plot? (10 marks)

3.

a. Describe the head of an aquifer that has water of different densities. (5 marks)

b. How are the underground conditions interpreted with the help of results of a packer test? Explain with examples. (5 marks)

c. What strategies would you employ in planning a laboratory assessment for measuring the hydraulic conductivity of a particular soil type? (5 marks)

d. The water level in a well with respect to the depth is different at topographic highs and lows. Explain it using flow nets. (10 marks)

4.

- a. Describe the Hvorslev shape factor. (5 marks)
- b. What are the drawbacks of the Hvorslev method of slug test? Explain how other authors addressed those drawbacks. (10 marks)
- c. Following data were obtained from a slug test (slug method). Use the semi-log paper on the page 4. Water level raised by 0.52 m from the equilibrium water level. Determine the hydraulic conductivity of the aquifer. State your assumptions very clearly. (10 marks)

$$F = \frac{r^2 \ln\left(\frac{L}{R}\right)}{2L}$$

$R = 5.6 \text{ cm}$   
 $r = 8.8 \text{ cm}$   
 $L = 5 \text{ m}$

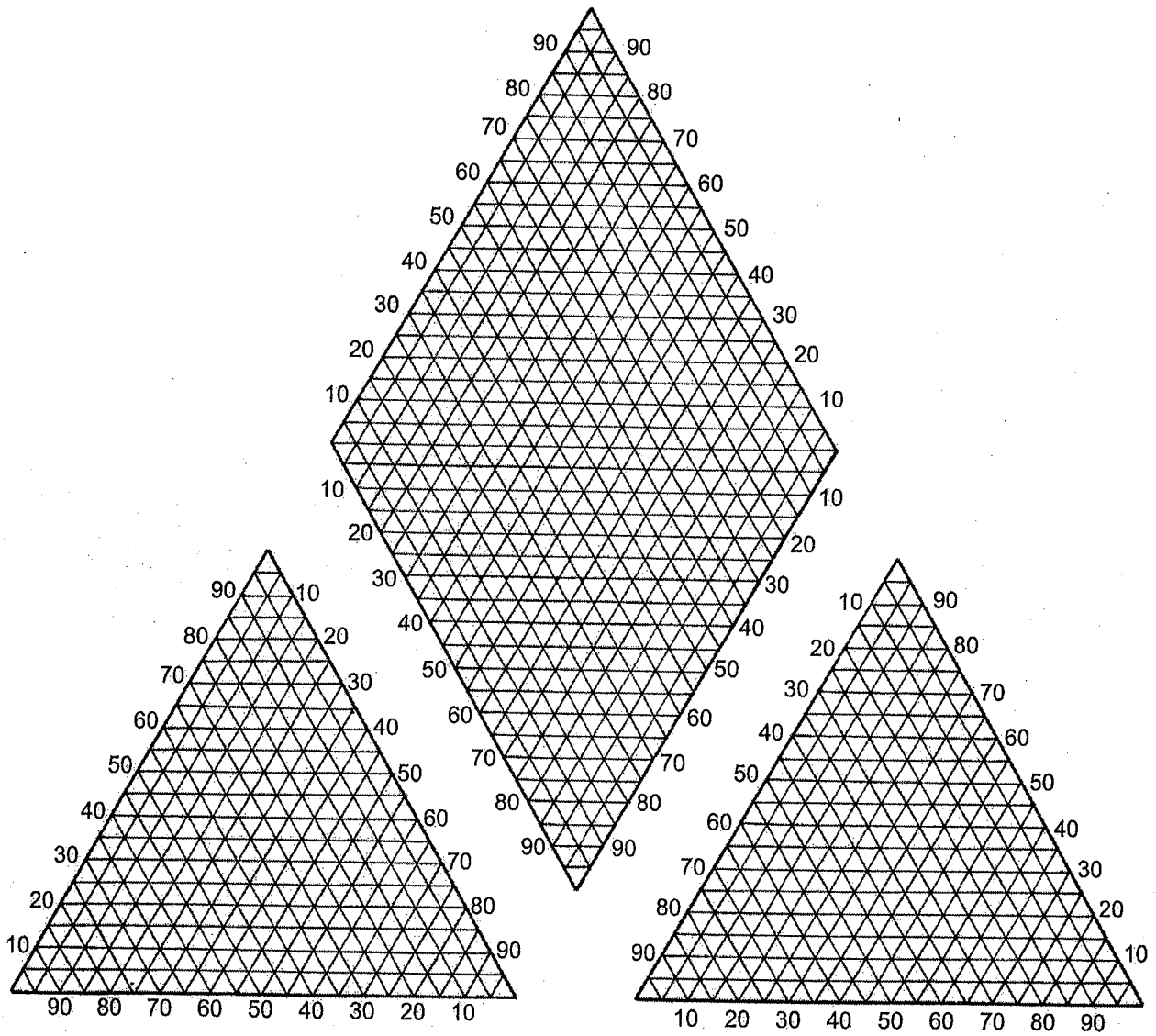
$$K = \frac{A}{F(t_2 - t_1)} \ln\left(\frac{H_1}{H_2}\right)$$

$F$  - Shape factor  
 $K$  - Hydraulic conductivity  
 $A, L, R, r$  and  $t$  are conventional notations

Time (s)	Drawdown (m)	Time (s)	Drawdown (m)
2	0.520	150	0.320
4	0.510	200	0.290
6	0.508	250	0.250
8	0.500	300	0.220
10	0.490	400	0.170
20	0.480	500	0.140
30	0.460	800	0.070
50	0.430	100	0.060
80	0.400		
100	0.370		
120	0.350		







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