



MASENO UNIVERSITY
UNIVERSITY EXAMINATIONS 2013/2014

THIRD YEAR FIRST SEMESTER EXAMINATIONS FOR THE
DEGREE OF BACHELOR OF SCIENCE IN EARTH SCIENCE WITH
INFORMATION TECHNOLOGY

(MAIN CAMPUS)

NGA 302: GROUNDWATER HYDROLOGY

Date: 19th November, 2013

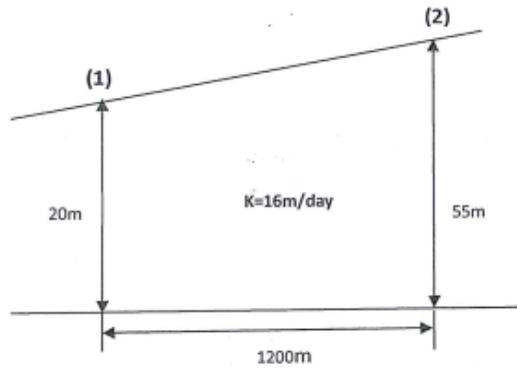
Time: 11.00 a.m. - 1.00 p.m.

INSTRUCTIONS:

- Answer Question ONE and any other TWO questions.
- Sketch maps and diagrams should be used whenever appropriate.

NGA 302: GROUNDWATER HYDROLOGY

1. a) Explain Darcy's law and its application in groundwater flow. (6 marks)
 - b) Examine factors that affect porosity in sedimentary rocks. (6marks)
 - c) Differentiate the following terms as applied in groundwater hydraulics
 - i) Isotropic aquifer and Anisotropic aquifer (4 marks)
 - ii) Primary porosity and Secondary porosity (4 marks)
 - iii) Perched aquifer and Leaky aquifer (4 marks)
 - d) The specific storage of a 45m thick confined aquifer is $3.0 \times 10^{-5} \text{ m}^{-1}$. How much water would the aquifer produce if the piezometric surface is lowered by 10m over an area of 1km^2 ? (6 marks)
2. a) Explain the importance of transmissivity and storage coefficients in groundwater studies. (10 marks)
 - b) Estimate the average drawdown over an area where 25 million m^3 of water has been pumped through a number of uniformly distributed wells. The area is 150km^2 and the specific yield of the unconfined aquifer is 25%. (10 marks)
3. a) Discuss the vertical groundwater flow from the ground surface to the saturated part of the geohydrological system. (10 marks)
 - b) A confined aquifer with a horizontal bed has a varying thickness as shown in the figure below. Assuming the flow in the aquifer is essentially horizontal, determine the flow rate if the piezometric heads at section (1) and (2) are 23.7m and 27.1m respectively. (10 marks)



4. a) Write explanatory notes on the following:
- i) Intrinsic permeability (3 marks)
 - ii) Groundwater flow nets (3 marks)
 - iii) Specific yield (3 marks)
 - iv) Recharge zone (3 marks)
- b) Using the Thiem-Dupuits method show from basic principles that the coefficient of Transmissivity is given by the equation,

$$T = \frac{Q \log_{10} \left(\frac{r_1}{r_2} \right)}{2.72(S_1 - S_2)}$$

where

r_1 and r_2 = radial distances of observation wells from test borehole

s_1 and s_2 = drawdowns in the observation wells

Q = yield of the well (8 marks)

5. a) Discuss geo-hydrological factors affecting groundwater distribution in Kenya and their effect on groundwater exploitation (10 marks)
- b) A borehole fully penetrates a 25m thick confined aquifer. After a long period of pumping at a constant rate of 0.05m/s, the drawdown at a distance of 50m and 150m from the borehole were observed to be 3m and 1.2m respectively.
- i) Compute the hydraulic conductivity of the aquifer (6 marks)
 - ii) Determine the transmissivity of the aquifer (4 marks)

6. a) Discuss the importance of establishing groundwater monitoring networks. (10marks)

b) An unconfined aquifer consists of three horizontal layers, each individually isotropic. The top layer has a thickness of 10m and a hydraulic conductivity of 11.6m/day. The middle layer has a thickness of 4.4m and a hydraulic conductivity of 4.5m/day. The bottom layer has a thickness of 6.2m and a hydraulic conductivity of 2.2m/day. Compute the equivalent horizontal and vertical hydraulic conductivities.

(10 marks)