UNIVERSITY OF SWAZILAND

FINAL EXAMINATION PAPER

PROGRAMME: BSC AGRIC III (LWM)

COURSE CODE: LUM 304

TITLE OF PAPER: RURAL WATER SUPPLY AND HYDROLOGY

TIME ALLOWED: TWO (2) HOURS

INSTRUCTIONS: ANSWER QUESTION ONE AND ANY TWO OTHER QUESTIONS.

DO NOT OPEN THIS PAPER UNTIL PERMISSION HAS BEEN GRANTED BY THE CHIEF INVIGILATOR

SECTION I: COMPULSARY

QUESTION 1

A) A borehole abstracts groundwater at a rate of 100 m^3/day from an aquifer with a transmissivity of 150 m^2/day and a storage coefficient of 0.05. Using Jacob's equation (1), predict the drawdown in a well at a distance of 100 m from the borehole after 100 days of pumping.

$$s = \left[\frac{2.303Q}{4\pi T}\right] \bullet \log_{10}\left(\frac{2.25Tt}{r^2 S}\right)$$

(1)

[8 marks]

B) The steady state drawdown in a borehole discharging 0.01 m^3/s is 110 cm. Use Logan's equations (2) to estimate the aquifer transmissivity in m^2/day. **[8 marks]**

$$T = 1.22Qs/Sw \qquad \textbf{(2)}$$

With increasing temperatures due to the global warming phenomena, evaporation losses are bound to increase in surface reservoirs. Using an aquifer as a reservoir would result in minimal evaporation losses. Where transmissibility allows, the aquifer may be recharged artificially. Discuss possible methods that could be employed to achieve such.

[8 marks]

C) Describe the concept of specific yield in aquifers and explain how it is affected by soil texture. **[6 marks]**

D) As part of a site investigation of the area shown in Figure 1, 13 boreholes have been drilled. The area is underlain by a sand aquifer, above part of which is low permeability clay. Figure 1 also shows contours of the elevation (or altitude) of the contact surface between the sand and the upper clay. Three of the boreholes were deep enough to prove the existence of second low permeability clay beneath the sand. The hydraulic conductivity of the sand is estimated at 1 m/day.

Mark the extent of the (1) recharge area, (2) discharge area, (3) unconfined and (4) confined parts of the sand aquifer on the map. **[10 marks]**

Examination N0.:.....

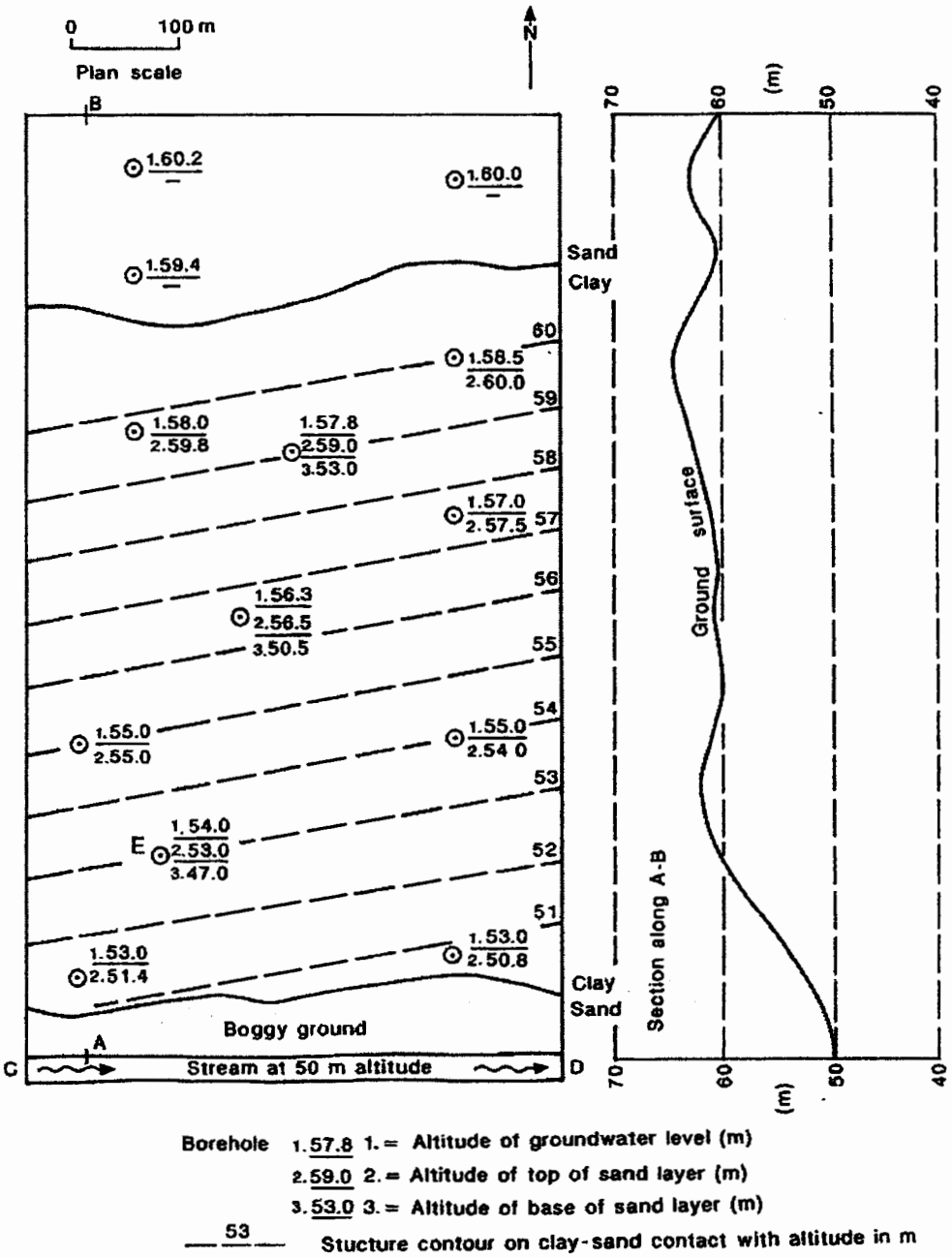

Figure 1: A map showing a site being investigated for water drilling potential

SECTION II: ANSWER ANY TWO QUESTIONS

QUESTION 2

A) Discuss briefly the information that you would require to determine the water demand requirements for a small rural community. **[15 marks]**

B) A small rural community of 10 000 people in the Lowveld of Swaziland had water requirements of 40l/h/d with a peak day factor (PDF) of 1.2. Calculate the design capacity for this community in m^3/day and m^3/ h. **[10 marks]**

C) What kind of material would you recommend to be used for the construction of the water storage tank for the community water supply? **[5 marks]**

QUESTION 3

A) Briefly discuss the six specifications or things that ought to be achieved in borehole design. **[15 marks]**

B) Discuss in **detail** why most NGO erected boreholes are reported to be failing in some rural areas in Swaziland. **State** how you can reduce the rate of failure. **[15 marks]**

QUESTION 4

A) Name any three (3) methods for the determination of reservoir capacity for water storage other than the spot height method. **[6 marks]**

B) Figure 1 shows spot heights of a levelling grid for an excavated water reservoir site intended for use as a pond for water storage.

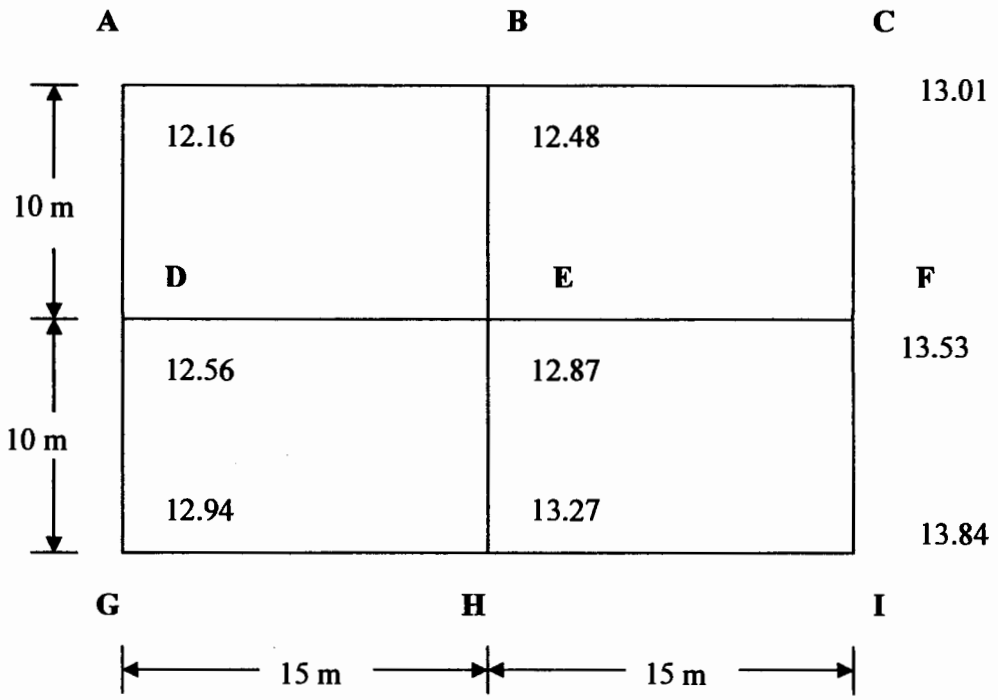

Figure 2. Reservoir spot heights for a levelling grid

i. If the excavated reservoir is to have a uniform depth of 8.0 m above datum, calculate the mean level using Equation 3 and a table similar to Table 1. **[8 marks]**

$$\text{Mean level} = \frac{\Sigma(\text{RL x n})}{\Sigma n} \qquad (3)$$

Table 1. Volume calculation from spot height levelling grid

Station	Reduced level (RL) (m)	Number of Times RL is used (n)	Product (RL x n) (m)
Total			

ii. Calculate the depth of excavation. **[8 marks]**

iii. Calculate the volume of excavation. **[8 marks]**