UNIVERSITY OF SWAZILAND
FINAL EXAMINATION PAPER

PROGRAMME: BSc AGRIC 4 (L&WM), BSc AGRIC ED 4 & BSc AGRIC V (APH)

COURSE CODE: LUM 406

TITLE OF PAPER: RURAL WATER SUPPLY

TIME ALLOWED: TWO (2) HOURS

SPECIAL MATERIAL REQUIRED: NONE

INSTRUCTIONS: ANSWER QUESTION ONE AND ANY TWO OTHER QUESTIONS.

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SECTION I: COMPULSORY QUESTION

QUESTION 1

A 25-cm diameter well penetrates a confined aquifer of coarse gravel 6.5 m thick and is screened throughout the thickness of the aquifer. Hydraulic conductivity measurements made in a well in the same region yield a value of 12.0 cm/min. Two observation wells are installed at radial distances of 25 m and 150 m from the pumped well. The well is to be tested by pumping at constant discharge of 40.0 l/s. If the drawdown in the well at 150 m distance is 1.5 m under steady state condition, determine the expected:

a) drawdown in the well at 25 m distance; (15 marks)
b) drawdown in the pumped well; (10 marks) and
c) area influenced by the well. (15 marks)

SECTION II: ANSWER TWO QUESTIONS FROM THIS SECTION

QUESTION 2

With the aid of clearly labelled diagrams, briefly but concisely, describe the following terms:

a) a flowing well; (6 marks)
b) an aquiclude; (6 marks)
c) a piezometer; (6 marks)
d) capillary fringe; (6 marks) and
e) specific yield of an aquifer. (6 marks)

QUESTION 3

Discuss some of the important factors that lead to the failure of rural water supply projects in Swaziland. (30 marks)

QUESTION 4

Discuss the major impacts of agriculture on the quality of water in Swaziland. (30 marks)

USEFUL EQUATIONS

Thiem's equation for confined aquifer

$$q = \frac{2 \pi K D (h_2 - h_1)}{\ln (r_2/r_1)} \quad (1)$$

where

q = the well discharge (m^3/d)
K = hydraulic conductivity (m/d)
D = aquifer thickness (m)
r_1 and r_2 = respective distances of the piezometers from the pumped well (m)
h_1 and h_2 = the respective steady-state elevations of the water levels (from the bottom of the pumped well) in the observation wells (m)

Thiem's equation for unconfined aquifer

$$q = \frac{\pi K (h_2^2 - h_1^2)}{\ln (r_2/r_1)} \quad (2)$$

where

q = the well discharge (m^3/d)
K = hydraulic conductivity (m/d)
r_1 and r_2 = the respective distances of the observation wells from the pumping well (m)
h_1 and h_2 = the respective steady-state elevations of the water levels (from the bottom of the pumped well) in the observation wells (m)