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UNIVERSITY OF SWAZILAND
FINAL EXAMINATION PAPER

PROGRAMME: BSC AGRIC V (APH)

COURSE CODE: LUM 406 (Old Programme)

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) Discuss the any five (5) assumed conditions under which a pumping test is conducted for a well penetrating a confined aquifer (10 marks

(b) A 10-cm diameter well penetrates an 8-m thick water bearing strata underlain and overlain by impermeable beds. The well was operated with constant discharge rate of 100 litres per minute for 12 hours. The steady-state draw-downs were found to be 3 and 0.05 metres at distances 10 m and 50 m, respectively, from the centre of the well.

i. Using Dupuit-Thiem equation calculate the transmissivity and hydraulic conductivity of the aquifer. (30 marks)
ii. Assuming that the water bearing strata were not confined, calculate the hydraulic conductivity of the aquifer. (10 marks)

SECTION II: ANSWER TWO QUESTIONS FROM THIS SECTION

QUESTION 2

An open earth cannel (n = 0.025) with a trapezoidal section has a gradient of 0.09 % ha an excavated depth of 75 cm. The bottom width is 45 cm and the side slopes are 1.25 to 1. The cannel is to carry discharge that varies from 160 litres per second to 190 litres per second the maximum free board allowed is 25 cm. With the aid of appropriate calculations assess the capacity of the channel to carry the designated flows. You may use the formulae given in the attached Fig. 1. (30 marks)

QUESTION 3

Discuss the potentials and challenges of exploiting groundwater resources for human use in Swaziland. (30 marks)

QUESTION 4

Rural water supply schemes are one of the entry points improving access to adequate and clean water in rural areas. Discuss the main factors for successful water schemes and the challenges the country faces in developing such schemes (30 marks)

USEFUL EQUATIONS

Thiem's equation for confined aquifer

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

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)

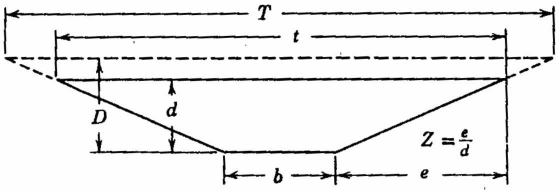
Thiem's equation for unconfined aquifer

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

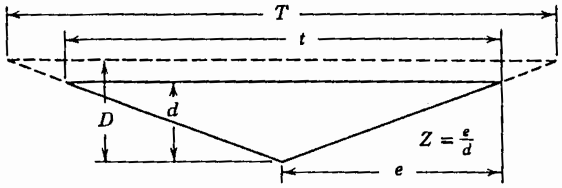
where

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)

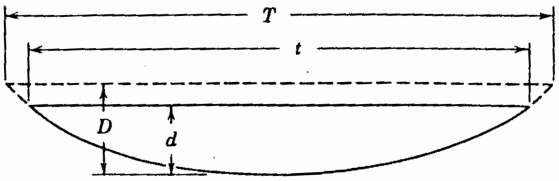
Note: Freeboard = $D-d$ for all sections



Trapezoidal cross section



Triangular cross section



Parabolic cross section

Cross-Sectional Area a	Wetted Perimeter, p	Hydraulic Radius $R=\frac{a}{p}$	Top Width
$bd + Zd^2$	$b + 2d\sqrt{Z^2+1}$	$\frac{bd + Zd^2}{b + 2d\sqrt{Z^2+1}}$	$t = b + 2dZ$ $T = b + 2DZ$
Zd^2	$2d\sqrt{Z^2+1}$	$\frac{Zd}{2\sqrt{Z^2+1}}$ or $\frac{d}{2}$ approx.	$t = 2dZ$ $T = \frac{D}{d}t$
$\frac{2}{3}td$	$t + \frac{8d^2}{3t}$	$\frac{t^2d}{1.5t^2 + 4d^2}$ or $\frac{2d}{3}$ approx.	$t = \frac{a}{0.67d}$ $T = t\left(\frac{D}{d}\right)^{1/2}$

Fig. 21 Channel cross section, wetted perimeter, hydraulic radius, and top width formulas.