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RE-SIT 2018

UNIVERSITY OF SWAZILAND

RE-SIT/ SUPPLEMENTARY EXAMINATION PAPER

PROGRAMME: BSC AGRICULTURAL EDUCATION III

COURSE CODE: ABE301/ ABE 301

TITLE OF PAPER: SOIL AND WATER CONSERVATION

TIME ALLOWED: TWO (2) HOURS

INSTRUCTIONS: ANSWER QUESTION ONE AND ANY TWO OTHER QUESTIONS.

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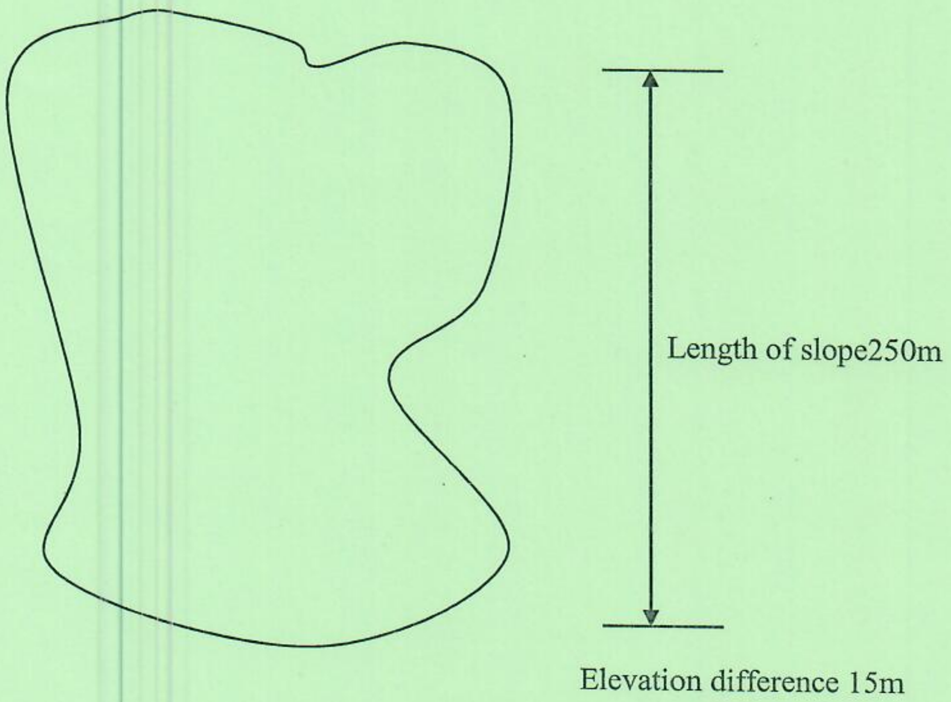
SECTION A. COMPULSORY QUESTION

Question One

Given that 25ha of the catchment area below was sandy loam, under permanemnt pasture management on soil group B, while 35ha of the catchment area was clay loam, under maize cultivation (row crop) on soil group D. Taking the rainfall intensity to be 100mm/hr, compute the peak run-off rate (m3/s) using the rational formula and the time of concentration, using Kirpich's method (1940).

30 marks



b. Describe the effect of the following on the rate of water erosion, using sketches where necessary.

i. soil density

ii. length of slope

10 marks

Question Two

a. Describe how the factors have an influence on soil erosion;

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i.	Contour strips	/5	
ii.	Length of Slope	/5	
iii.	Raindrop impact	/5	
iv.	Infiltration rate	/5	**20 marks**

b. Explain the effect of the following features in moisture conservation on arable land and state the environmental conditions where they are most applicable.

i.	Tied ridges	/5	
ii.	Mulching	/5	**10 marks**

Question Three

a. Design a parabolic waterway to convey the peak runoff $6m^3/s$ if the slope of the field is 2%, permissible velocity 1.2m/s and the roughness coefficient is 0.34. Allow a 20 % freeboard.

20 marks

b. Give a brief description of how waterways prevent soil erosion on arable land and how they are managed to remain effective. **10 marks**

Question Four

a. Describe the influence of the following conditions on the amount of surface runoff water.

i.	Grassland	/7
ii.	Cropped land	/8

15 marks

b. The infiltration rate under shallow ponding was monitored as a function of cumulative rainfall and found to be 20mm/hr when a total of 100mm had infiltrated. If the eventual steady rate of infiltration was 5mm/h, estimate the infiltration rate at cumulative infiltration of 100mm and 300mm using the Green-Ampt Equation.

15 marks

Cover and hydrologic condition	Coefficient C for rainfall rates of:		
	25 mm/h (1 iph)	100 mm/h (4 iph)	200 mm/h(8 iph)
Row crop, poor practice	0.63	0.65	0.66
Row crop, good practice	0.47	0.56	0.62
Small grain, poor practice	0.38	0.38	0.38
Small grain, good practice	0.18	0.21	0.22
Meadow, rotation, good	0.29	0.36	0.39
Pasture, permanent, good	0.02	0.17	0.23
Woodland, mature, good	0.02	0.10	0.15

Table 2.1 : Runoff Coefficient "C" for Agricultural Watersheds (Soil Group B)
Source : Horn and Schwab (1963) As Cited by Schwab et al (1981).

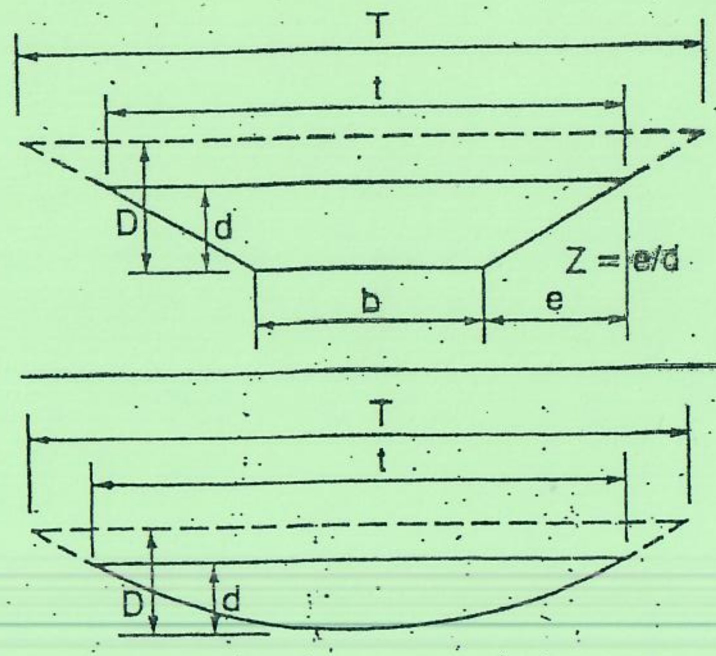
Cover and hydrologic condition	Factors for converting the runoff coefficient C from group B soils to:		
	Group A	Group C	Group D
Row crop, poor practice	0.89	1.09	1.12
Row crop, good practice	0.86	1.09	1.14
Small grain, poor practice	0.86	1.11	1.16
Small grain, good practice	0.84	1.11	1.16
Meadow, rotation, good	0.811	1.13	1.18
Pasture, permanent, good	0.64	1.21	1.31
Woodland, mature, good	0.45	1.27	1.40

Factors were computed from table 2.3 by dividing curve number for the desired soil group by the curve number for group B.

Table 2.2 : Hydrologic Soil Group Conversion Factors
Source : Horn and Schwab (1963) As Cited by Schwab et al (1981).

Approach

The design procedures are based on the principles of open-channel hydraulics. The method presented here represents an application of the Manning equation of flow velocity (Eq. 2.13). The cross-section of the waterway may be triangular, trapezoidal or parabolic. Triangular sections are not recommended because of the risk of scour at the lowest point. Since channels which are excavated as a trapezoidal section tend to become parabolic in time, the procedure described here is for a parabolic section.



Area	$bd + Zd^2$
Wetted perimeter	$b + 2d\sqrt{1 + Z^2}$
Hydraulic radius	$\dfrac{bd + Zd^2}{b + 2d\sqrt{1 + Z^2}}$
Top width	$t = b + 2dZ$ $T = b + 2DZ$
Area	$\frac{2}{3}td$
Wetted perimeter	$t + \dfrac{8d^2}{3t}$
Hydraulic radius	$\dfrac{t^2 d}{1{\cdot}5t^2 + 4d^2}$ (approx.) $\dfrac{2d}{3}$
Top width	$t = \dfrac{3a}{2d}$ $T = t(\dfrac{D}{d})^{1/2}$

Basic dimensions of common channel sections