UNIVERSITY OF SWAZILAND
FINAL EXAMINATION PAPER

PROGRAMME: DIPLOMA IN AGRICULTURE YEAR 3

COURSE CODE: LUM 302 M (OLD PROGRAMME)

TITLE OF PAPER: SOIL AND WATER CONSERVATION

TIME ALLOWED: TWO (2) HOURS

SPECIAL MATERIAL REQUIRED: NONE

INSTRUCTIONS: ANSWER QUESTION ONE AND ANY TWO OTHER QUESTIONS.

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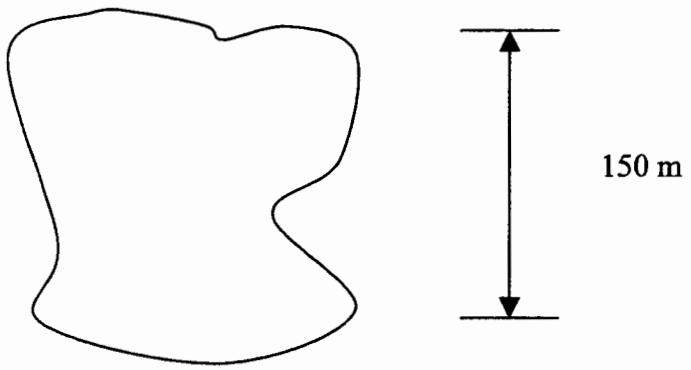
SECTION A. COMPULSORY QUESTION

Question One

a. Given that 35ha of the catchment area below was under **row crop** cultivation, **contoured, relatively flat** and **good soil** condition in group **B**, while 25 ha of the catchment area was clay loam, **hilly** and **fair soil** condition in group **C** with **woods**. Taking the rainfall intensity to be 100mm/hr, compute the peak run-off rate (m^3/s) using the rational formula, and run-ff volume (using the US. SCS (1972) for a 25year return period storm and the time of concentration, using Kirpich's method (1940). **25 marks**



Elevation difference 15 m

$$q = 0.0028\,CiA$$

$$Q = \frac{(I - 0.2S)}{(I + 0.8S)}$$

$$S = \frac{25400}{N} - 254$$

b. Describe one of the rainfall data analysis methods using a sketch mentioning its advantages.

15 marks

SECTION B. ANSWER ANY TWO QUESTIONS

Question two

a. Crop management is also used as a soil conservation technique. Describe the methods used in this technique

20 marks

b. Explain how surface culture influences the total amount of run-off water?

10 marks

Question three

a. 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 in filtration was 5mm/h, estimate the infiltration rate at cumulative infiltration of 100mm and 300mm using the **Green-Ampt Equation.**

15 marks

b. Describe the importance of mulching and minimum tillage in soil and water conservation.

15 marks

Question four

a. Describe how the following influence infiltration capacity of soil;
    a. Vegetation
    b. Soil texture and structure
    c. Soil additives
    d. Slope

20 marks

b. Describe the difference between volumetric water and permanent wilting point.

10 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).

Table 2.3 (Continued)

Land Use or Cover	Treatment or Practice	Hydrologic Condition	* Hydrologic Soil Group			
			A	B	C	D
Meadow (Permanent		Good	30	58	71	78
Woods		Poor	45	66	77	83
(Farm wood-lots)		Fair	36	60	73	79
		Good	25	55	70	77
		-	59	74	82	86
Right-of-way (hard surface		-	74	84	90	92

*Soil Group	Description	Final Infiltration rate (mm/h)
A	**Lowest Runoff Potential.** Includes deep sands with very little silt and clay, also deep, rapidly permeable loess.	8 - 12
B	**Moderately Low Runoff Potential.** Mostly sandy soils less deep than A, and loess less deep or less aggregated than A, but the group as a whole has above average infiltration after thorough wetting.	4 - 8
C	**Moderately High Runoff Potential.** Comprises shallow soils and soils containing considerable clay and colloids, though less that those of group D. The group has below average infiltration after pre-saturation.	1 - 4
D	**Highest Runoff Potential.** Includes mostly clays of high swelling percent, but the group also includes some shallow soils with nearly impermeable sub-horizons near the surface.	0 -1

Source: U.S. Soil Conservation Service, National Engineering Handbook, Hydrology, Section 4 (1972) and U.S. Dept. Agr. ARS 41 - 172 (1970). As Cited By Schwab et al (1981).