



**UNIVERSITY OF SWAZILAND
FINAL EXAMINATION PAPER**

PROGRAMME: BSC LWM 3 AND BSC AG ED 3

COURSE CODE: LUM 301 M

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.

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

SECTION A. COMPULSORY QUESTION**Question one**

- a. Describe any two agronomic soil conservation measures you would apply in terraced plots to reduce surface runoff that would damage the terraces.

10 marks

- b. Using the Zimbabwe method, determine the recommended spacing between terraces constructed on highly erodible soils (5.0) with an average slope of 2°. Express your answer in metres when: 1ft = 0.3048m.
- c. If the length of the field is 3500m, estimate the peak run of from the field when rain intensity is 98mm/hr and roughness coefficient of the field is 0.41.
- d. Design a grassed waterway (using Manning's formula) to convey the peak runoff at flow velocity of 1.2m/s, when roughness co-efficient is 0.032. Allow 20% freeboard.

$$V = \frac{R^{2/3} S^{1/2}}{n}$$

30 marks**SECTION B. ANSWER ANY TWO QUESTIONS****Question two**

- a. Describe the influence of the following on the amount of runoff water:
- land use
 - watershed conditions

15 marks

- b. Explain what time of concentration is? **5 marks**
- c. Given a rainfall intensity of 105mm/hr and a watershed with elevation of difference of 12m from the highest to the lowest point. Estimate the time of concentration if the length of the furthest point from the discharge area is 124m long. **10 marks**

Question three

- a. Explain the effect of the following factors in soil erosion (detachment and transportation):
- transporting agents
 - kinetic energy and potential energy

15 marks

- b. Calculate the water storage capacity of a soil when the following conditions prevail:

- soil porosity 0.35m
- soil bulk density 1.3g/cm³
- depth 1.2 m
- water @ pwp 0.18

15 marks**Question four**

- a. Fully describe what waterways are and their importance using the following subtitles:
- definition and the main functions of waterways
 - locations and conditions for use
 - design specifications
 - estimation of run-off
 - operation and management

20 marks

- b. The infiltration rate under shallow ponding was monitored as a function of cumulative rainfall and found to be 25 mm/hr when a total of 110mm had infiltrated. If the eventual steady rate of infiltration was 12mm/h, estimate the infiltration rate at cumulative infiltration of 300mm and 410mm using the **Green-Ampt Equation.**

10 marks

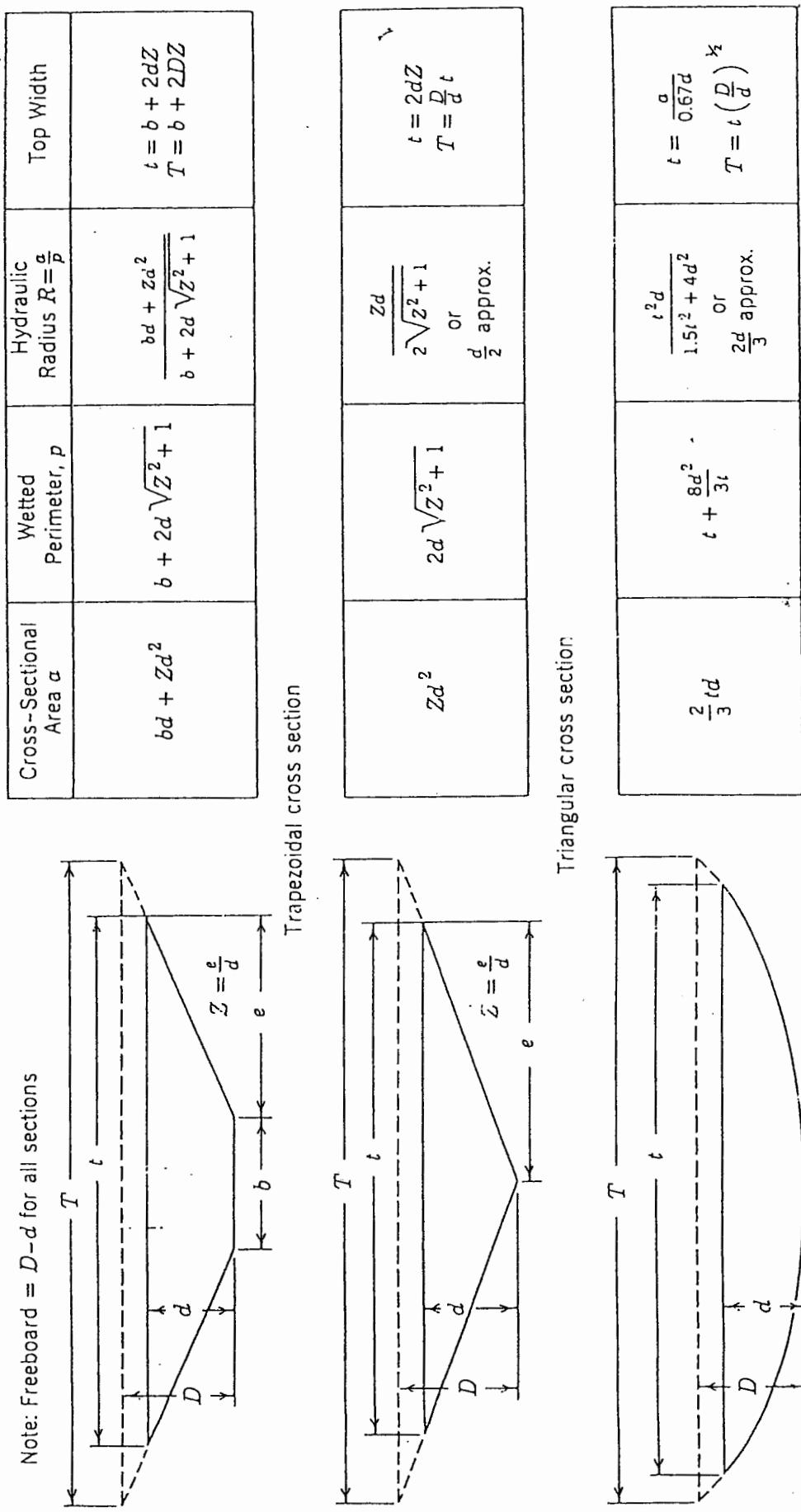


Fig. 7.1. Channel cross section, wetted perimeter, hydraulic radius, and top width formulas.

Table 1. Saturated vapour pressure as a function of temperature t (negative values of t refer to conditions over ice: 1 mm Hg = 1.33 mbar).

t (°C)	e_s									
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
-10	2.15									
-9	2.32	2.30	2.29	2.27	2.26	2.24	2.22	2.21	2.19	2.17
-8	2.51	2.49	2.47	2.45	2.43	2.41	2.40	2.38	2.36	2.34
-7	2.71	2.69	2.67	2.65	2.63	2.61	2.59	2.57	2.55	2.53
-6	2.93	2.91	2.89	2.86	2.84	2.82	2.80	2.77	2.75	2.73
-5	3.16	3.14	3.11	3.09	3.06	3.04	3.01	2.99	2.97	2.95
-4	3.41	3.39	3.37	3.34	3.32	3.29	3.27	3.24	3.22	3.18
-3	3.67	3.64	3.62	3.59	3.57	3.54	3.52	3.49	3.46	3.44
-2	3.97	3.94	3.91	3.88	3.85	3.82	3.79	3.76	3.73	3.70
-1	4.26	4.23	4.20	4.17	4.14	4.11	4.08	4.05	4.03	4.00
-0	4.58	4.55	4.52	4.49	4.46	4.43	4.40	4.36	4.33	4.29
0	4.58	4.62	4.65	4.69	4.71	4.75	4.78	4.82	4.86	4.89
1	4.92	4.96	5.00	5.03	5.07	5.11	5.14	5.18	5.21	5.25
2	5.29	5.33	5.37	5.40	5.44	5.48	5.53	5.57	5.60	5.64
3	5.68	5.72	5.76	5.80	5.84	5.89	5.93	5.97	6.01	6.06
4	6.10	6.14	6.18	6.23	6.27	6.31	6.36	6.40	6.45	6.49
5	6.54	6.58	6.54	6.68	6.72	6.77	6.82	6.86	6.91	6.96
6	7.01	7.06	7.11	7.16	7.20	7.25	7.31	7.36	7.41	7.46
7	7.51	7.56	7.61	7.67	7.72	7.77	7.82	7.88	7.93	7.98
8	8.04	8.10	8.15	8.21	8.26	8.32	8.37	8.43	8.48	8.54
9	8.61	8.67	8.73	8.78	8.84	8.90	8.96	9.02	9.08	9.14
10	9.20	9.26	9.33	9.39	9.46	9.52	9.58	9.65	9.71	9.77
11	9.84	9.90	9.97	10.03	10.10	10.17	10.24	10.31	10.38	10.45
12	10.52	10.58	10.66	10.72	10.79	10.86	10.93	11.00	11.08	11.15
13	11.23	11.30	11.38	11.75	11.53	11.60	11.68	11.76	11.83	11.91
14	11.98	12.06	12.14	12.22	12.96	12.38	12.46	12.54	12.62	12.70
15	12.78	12.86	12.95	13.03	13.11	13.20	13.28	13.37	13.45	13.54
16	13.63	13.71	13.80	13.90	13.99	14.08	14.17	14.26	14.35	14.44
17	14.53	14.62	14.71	14.80	14.90	14.99	15.09	15.17	15.27	15.38
18	15.46	15.56	15.66	15.76	15.96	15.96	16.06	16.16	16.26	16.36
19	16.46	16.57	16.68	16.79	16.90	17.00	17.10	17.21	17.32	17.43
20	17.53	17.64	17.75	17.86	17.97	18.08	18.20	18.31	18.43	18.54
21	18.65	18.77	18.88	19.00	19.11	19.23	19.35	19.46	19.58	19.70
22	19.82	19.94	20.06	20.19	20.31	20.43	20.58	20.69	20.80	20.93
23	21.05	21.19	21.32	21.45	21.58	21.71	21.84	21.97	22.10	22.23
24	22.27	22.50	22.63	22.76	22.91	23.05	23.19	23.31	23.45	23.60
25	23.75	23.90	24.03	24.20	24.35	24.49	24.64	24.79	24.94	25.08
26	25.31	25.45	25.60	25.74	25.89	26.03	26.18	26.32	26.46	26.60
27	26.74	26.90	27.05	27.21	27.37	27.53	27.69	27.85	28.00	28.16
28	28.32	28.49	28.66	28.83	29.00	29.17	29.34	29.51	29.68	29.85
29	30.03	30.20	30.38	30.56	30.74	30.92	31.10	31.28	31.46	31.64
30	31.82	32.00	32.19	32.38	32.57	32.76	32.95	33.14	33.33	33.52