

UNIVERSITY OF SWAZILAND
Faculty of Health Sciences
Department of Environmental Health Sciences

BSc Environmental Health

MAIN EXAMINATION PAPER MAY 2011

TITLE OF PAPER : WATER DRAINAGE AND SEWERAGE

COURSE CODE : EHS:587

DURATION : 3 HOURS

MARKS : 100

INSTRUCTIONS : THERE ARE FIVE QUESTIONS IN THIS EXAM

: ANSWER ALL THE QUESTIONS

: EACH QUESTION CARRIES 20 MARKS

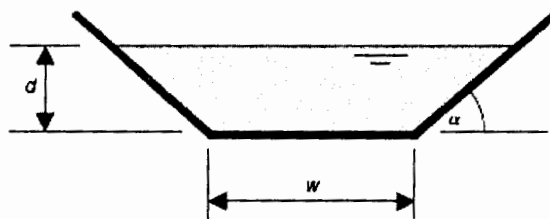
: NO PAPER SHOULD BE BROUGHT IN TO OR OUT OF THE
EXAMINATION ROOM

QUESTION ONE (20 Marks)

- A. Explain why a combined sewer system may not be appropriate for towns with rainfall intensities that are high and rainfall concentrated in few months like in monsoon climates.....[4 Marks]
- B. Define a) Infiltration and b) Inflow.....[4 Marks]
- C. Describe the advantages of open drainage compared to closed pipes.....[4 Marks]
- D. Describe the advantages and disadvantages of conventional closed drainage systems.....[4 Marks]
- E. Explain how a simplified sewerage (also called condominal sewerage) differs from a conventional sewerage system.....[4 Marks]

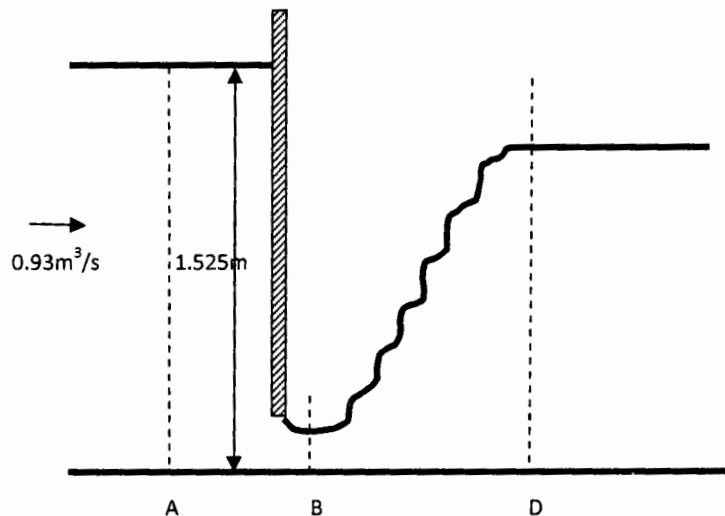
QUESTION TWO (20 Marks)

An unlined trapezoidal open channel (geometry shown in Figure below) is to be built alongside a road of gradient of 1:100. If the design storm water flow is estimated at 300 l/s, calculate the depth of flow in the channel and check its velocity. Use Manning's equation and assume a Manning's roughness of $n = 0.025$ and the side slope of the trapezoidal channel to be 1V:2H. The bottom width w is to be half of the water depth, d (i.e., $W=d/2$)



QUESTION THREE (20 Marks)

The rectangular channel shown in Figure below is nearly horizontal, and it carries $q = 0.93 \text{ m}^3/\text{sec-m}$. The flow depth upstream of the sluice gate is 1.525 m . A hydraulic jump occurs on the downstream side of the sluice gate. Determine the flow depth at Sections B and D, and the head loss due to the hydraulic jump.



QUESTION FOUR (20 Marks)

A sanitary sewer with a design flow of $0.284 \text{ m}^3/\text{sec}$ enters manhole A. The distance downstream to the next manhole B is 122 meters. The finished street surface elevation at manhole A is 50.72 m and that at manhole B is 50.11m. For Manning's $n = 0.013$ and using the partial flow diagram attached find;

- A. The nominal diameter of the pipe to carry the flow under full flow conditions....(5 Marks)
- B. The depth of flow and velocity at minimum flow which is equal to 25% of the design flow
.....(10 Marks)
- C. In both cases check if the range of velocities fall in the desirable range between 1m/sec and 1.5m/sec.....(5 Marks)

QUESTION FIVE (20 Marks)

A steep drainage channel drains in to an impounding reservoir whose water level behind the dam is 5 meters. The flow rate in the drainage channel is $100 \text{ m}^3/\text{sec}$. The channel slope is 5° . The channel is of rectangular cross section of width 10 meters throughout the channel length. The roughness height of the channel surface (K_s) is 5 mm. The Darcy-Weisbach friction factor can be taken as 0.015 and the flow is fully turbulent.

- A.** To which back water curve classification does this gradually varied flow of the channel belong?. Give reasons.(5 Marks)
- B.** Plot the back water curve profile from the reservoir (taking the depth of 5m) backwards to the point where a hydraulic jump occurs. Determine the position of the hydraulic jump measured from the reservoir position.....(15 Marks)

