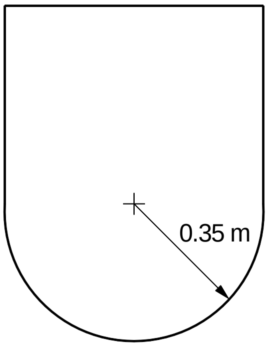
Hydraulics 3 Coursework **AUTUMN 2024**

Submission deadline: Thursday 7th November 2024 (18.00pm GMT)
Coursework should be submitted via Blackboard as a single PDF file. It may be typed or handwritten and scanned. **This must be entirely your own work.** No marks will be given if working is not shown or a scan is unreadable. Marks will be deducted for untidiness, excessive padding, inadequate working, units missing in final answers, non-single-PDF submission.

Question 1 (15 marks)



A sewer has the cross-section shown and streamwise slope 1.5×10^{-4}. The lining is rough brick, with Manning's $n = 0.016\ \mathrm{m^{-1/3}\ s}$. With depths measured from the invert, find the normal and critical depths at a flow rate of $0.12\ \mathrm{m^3\ s^{-1}}$.

Question 2 (15 marks)

The free-discharge equation for a V-notch weir of interior angle θ is

$$Q = \frac{8}{15} c_d \tan\left(\frac{\theta}{2}\right) \sqrt{2g} h_0^{5/2}$$

where h_0 is the freeboard relative to the point of the V and c_d is a discharge coefficient.

(a) When used for measurement or control what advantages might a V-notch weir have over, say, a sharp-crested rectangular weir?

Water is piped into a chamber with plan area $15\ \mathrm{m^2}$ at a rate of $250\ \mathrm{L\ s^{-1}}$. At sufficient depth it overflows a V-notch weir of interior angle 120° and discharge coefficient $c_d = 0.59$.

(b) What is the maximum depth of water in the chamber relative to the point of the V?

(c) If the inflow is terminated when the water depth is maximal, how long will it take for the overflow rate to be reduced to $1\ \mathrm{L\ s^{-1}}$?

Question 3 (20 marks)

Water flows at $6\ \mathrm{m^3\ s^{-1}}$ in a long rectangular channel of width 4 m and slope 0.02. The lining of the channel has Manning's $n = 0.025\ \mathrm{m^{-1/3}\ s}$. A smooth constriction is introduced to the channel at one point, narrowing the passage to 3 m.

(a) Show that a hydraulic transition will take place through the contraction.

(b) Will there be an upstream or downstream hydraulic jump as a result of the contraction? Explain your answer.

(c) Use two steps in the GVF equation to estimate the distance of the hydraulic jump from the constricted section.