EAS 361 Quiz 2 16 November 2006

Print Your Name: ______________________________

Sign Your Name: ______________________________

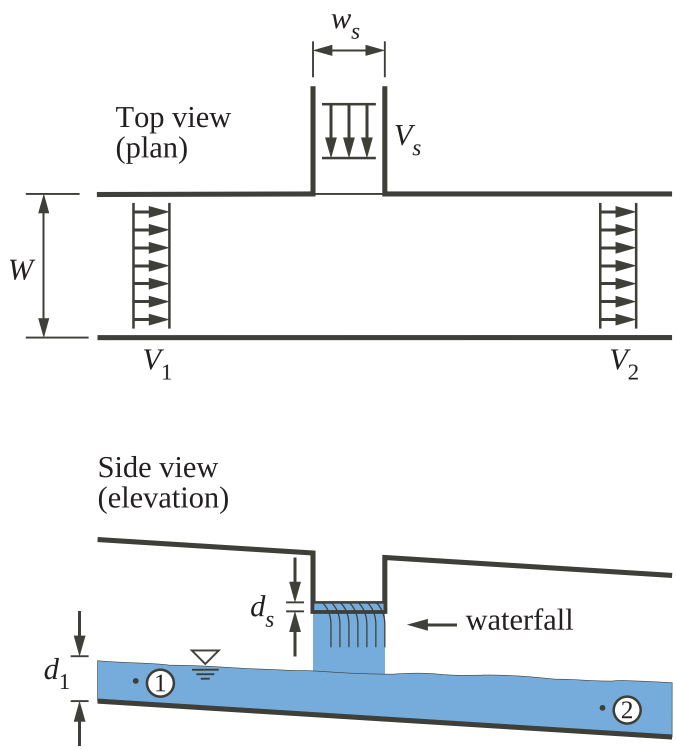
This exam booklet contains

1. This cover sheet.
2. A double-sided, single sheet of paper with three quiz questions.

Do not open the exam booklet until you are instructed to do so.

You will have 15 minutes to complete the quiz.

The sketch depicts a concrete drainage ditch with perfectly straight walls and a perfectly flat (but sloped) bottom. Water in the ditch flows freely downhill. The top surface of the water is open to the atmosphere. At the upstream station 1, the average velocity is V_1 and the water depth is d_1. Flow from a side channel enters the drainage ditch with average velocity V_s and depth d_s.

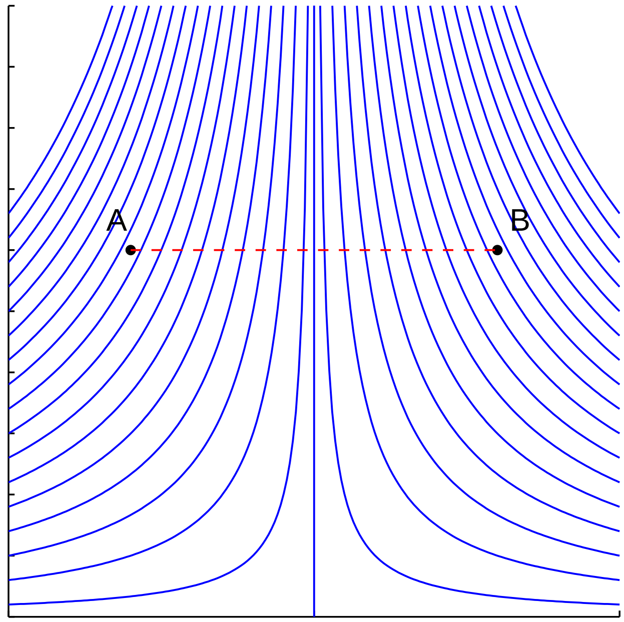


You have paid a consultant to perform some measurements on the water velocity in the ditch. The consultant reports that the velocity at station 2 is the same as station 1, i.e. $V_2 = V_1$. A co-worker tells you that because of the flow from the side channel, V_2 cannot be equal to V_1.

1. [**5 points**] Is there a plausible explanation for $V_2 = V_1$ when $V_s \neq 0$? In other words is it *physically possible* that V_2 can be equal to V_1 when $V_s \neq 0$? (Your answer should be either "yes" or "no"). Assume that the velocity profiles are uniform everywhere in this flow.

2. [**15 points**] If you answered "yes" to question 1, then explain how the consultant's measurements can be consistent with the laws of fluid mechanics. If you answered "no" then why is there no chance that the consultant's measurement could be correct?

   Use equation(s) and symbols from the sketch to explain your reason. Introduce additional equations as necessary.



3. **[20 points]** The diagram shows the streamlines of a stagnation point flow. The velocity field is $\vec{V} = \hat{\boldsymbol{\imath}}u + \hat{\boldsymbol{\jmath}}v$ where $u = 2x$, and $v = -2y$. Assume that the flow field has a depth b into the page. Given the formulas for u and v, what is the formula for computing the *downward volumetric flow rate* between point A and point B? Let points A and B have the coordinates (x_A, y_A) and (x_B, y_B), respectively. Your answer should start with a basic expression for (or definition of) the volumetric flow rate and end with a formula that does not have the symbols u or v.