

Name \_\_\_\_\_ Section \_\_\_\_\_



Ho Ho Ho



**ES201**  
Examination I  
December 19, 1997

Problem	Score
1	/20
2	/20
3	/30
4	/30
Total	/100

Show all work for credit (system, principle, etc.)

AND

Turn in your signed help sheet

And

Remain in your seat for the entire exam



**Merry Christmas! Frohe Weihnachten!**

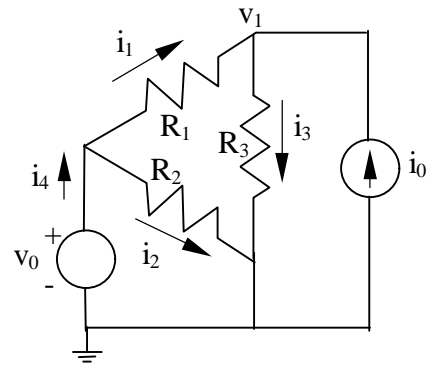


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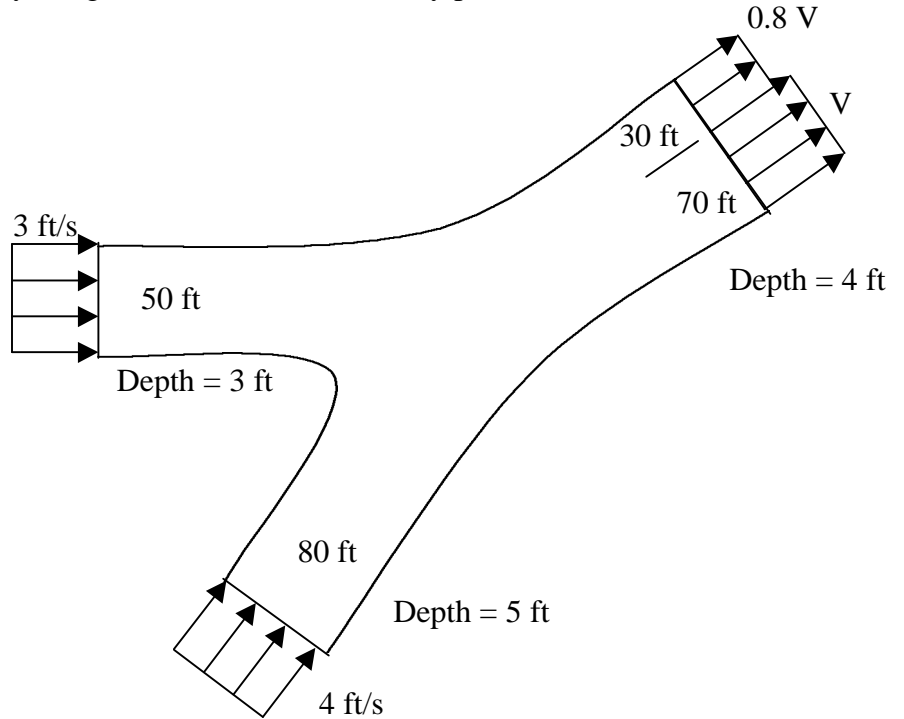
**Problem 1**

20 pts  
Dec. 19, 1997

In the circuit shown  $v_0$ ,  $i_0$ ,  $R_1$ ,  $R_2$  and  $R_3$  are all known. Write the equations necessary to solve for  $i_1, i_2, i_3, i_4$  and  $v_1$ . **DO NOT SOLVE THESE EQUATIONS BUT CLEARLY NUMBER THEM.** Be sure to include some text telling me what you're doing.



Two rivers merge to form a larger river as shown. At a location down stream from the junction (before the two streams completely merge), the nonuniform velocity profile is as shown. Determine the value  $V$ .



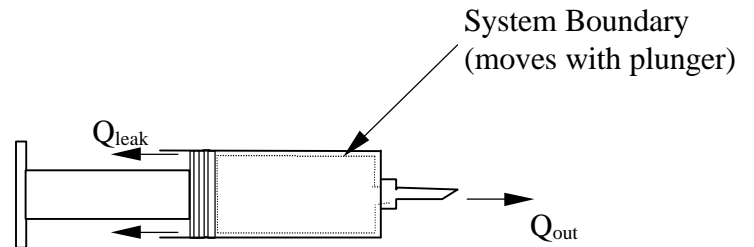
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**Problem 3**

30 pts  
Dec. 19, 1997

A hypodermic syringe is used to apply a vaccine. The inside diameters of the syringe and the needle are 20 mm and 0.7 mm. If the plunger is moved forward at the steady rate of 20 mm/s and if vaccine leaks past the plunger at 0.1 of the volumetric flowrate out the needle opening determine the average velocity of the needle exit flow **using the system shown**.

NOTE: FOR MORE THAN A 70%  
GRADE ON THIS PROBLEM you must  
clearly show how you modeled the system  
using the given information, the  
fundamental laws and basic concepts of this  
course, and any additional assumptions.



A reverse osmosis cell is used in a process to desalinate sea water, as shown in the figure. The feed  $F$  to the process is 100 (kg/hr) of 3.0% NaCl, the product desalinated water  $P$  is 0.04% NaCl, and the waste brine stream  $B$  is 5.15% NaCl. A recycle stream  $R$  increases the concentration of the stream entering the reverse osmosis cell to 3.8%. All this information is given in the table below. Determine

- all the mass fractions of water in each of the streams
- equations that could be used to solve for the unknown mass flow rates of each of the streams (DO NOT SOLVE THESE EQUATIONS).

	F	G	R	B	P
$\dot{m}$ (kg/hr)	100				
$mf_{NaCl}$	0.03	0.038	0.0515	0.0515	0.0004
$mf_{H_2O}$					

