

# 6.01 Midterm 2: Fall 2010

<b>Name:</b>	<b>Section:</b>
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**Enter all answers in the boxes provided.**

During the exam you may:

- read any paper that you want to
- use a calculator

You may not

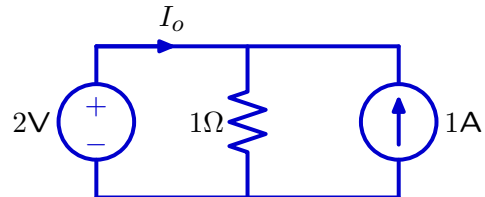
- use a computer, phone or music player

For staff use:

1.	/14
2.	/16
3.	/13
4.	/16
5.	/14
6.	/15
7.	/12
total:	/100

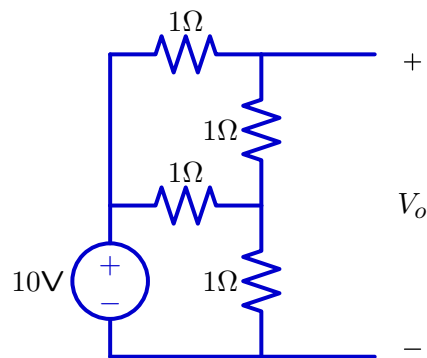
## 1 Analyzing Circuits (14 points)

Determine the indicated parameter for each of the following circuits. Write your answers (either a number or numerical expression) in the box provided. For partial credit, you may also provide a brief explanation of your reasoning.



$$I_o =$$

Reasoning:

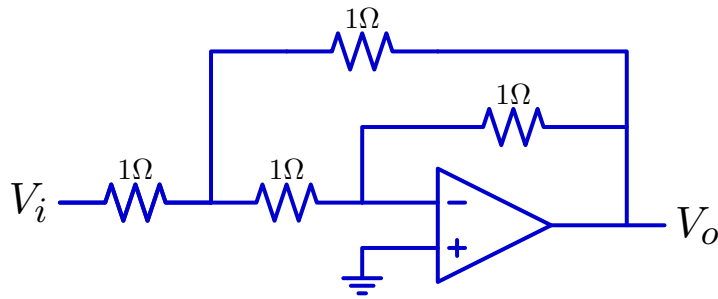


$$V_o =$$

Reasoning:

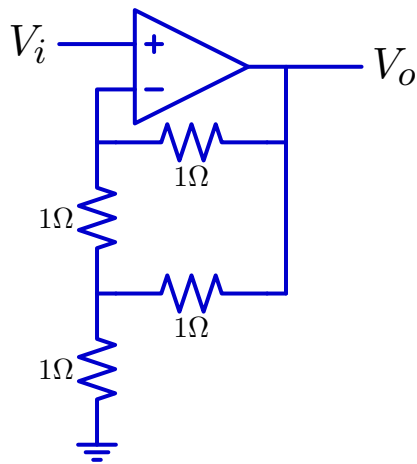
## 2 Op Amps (16 points)

Determine the indicated parameter for each of the following circuits. You may assume the ideal op-amp model. Write your answers (either a number or numerical expression) in the box provided. For partial credit, you may also provide a brief explanation of your reasoning.



$$\frac{V_o}{V_i} =$$

Reasoning:



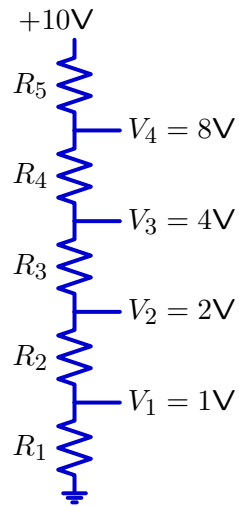
$$\frac{V_o}{V_i} =$$

Reasoning:

### 3 Designing Circuits (13 points)

Determine the indicated parameters for each of the following circuits. Write your answers (either a number or numerical expression) in the box provided. For partial credit, you may also provide a brief explanation of your reasoning.

Part a. Determine values of  $R_1$ ,  $R_2$ ,  $R_3$ ,  $R_4$ , and  $R_5$  so that  $V_1 = 1\text{V}$ ,  $V_2 = 2\text{V}$ ,  $V_3 = 4\text{V}$ , and  $V_4 = 8\text{V}$ . The answer to this part is not unique. You will get full credit for any valid solution.



$$R_5 =$$

$$R_4 =$$

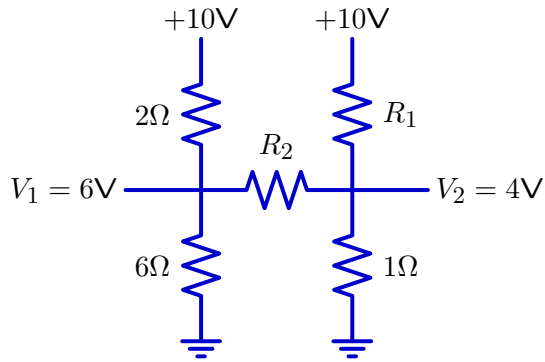
$$R_3 =$$

$$R_2 =$$

$$R_1 =$$

Reasoning:

Part b. Determine values of  $R_1$  and  $R_2$  so that  $V_1 = 6V$  and  $V_2 = 4V$ .



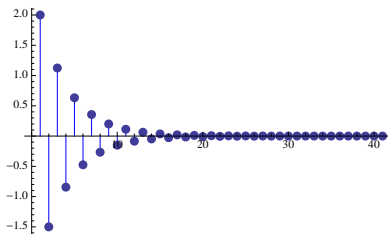
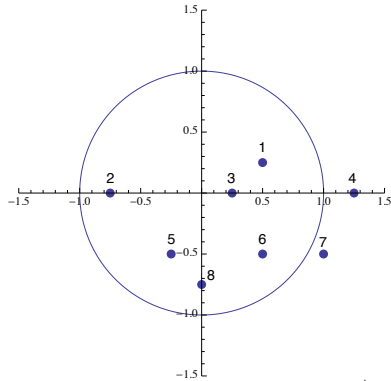
$$R_1 =$$

$$R_2 =$$

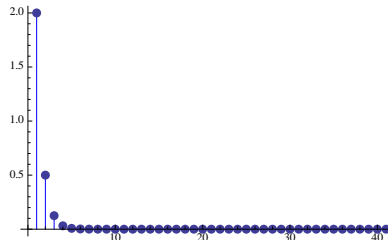
Reasoning:

### 4 Pole Position (16 points)

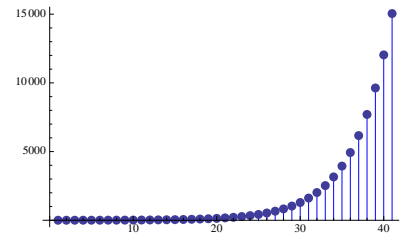
Consider eight poles located at the following locations in the z plane. The plots below show the unit-sample responses of eight linear, time-invariant systems. Match them with the dominant pole for each system (remember thta the system may have more than just one pole).



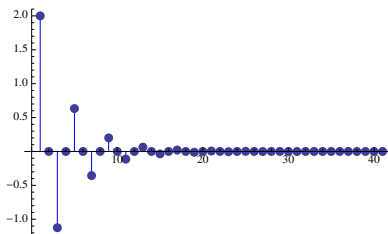
A =



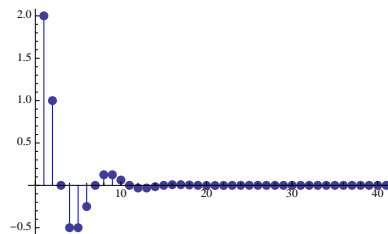
B =



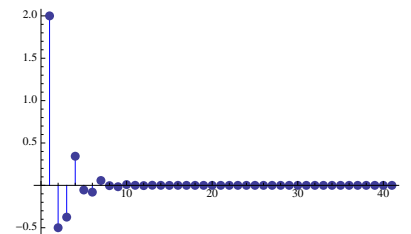
C =



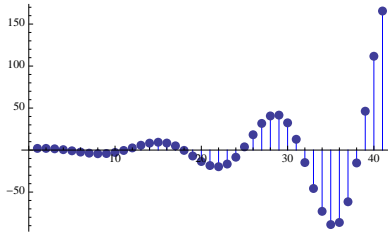
D =



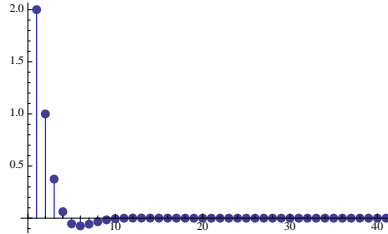
E =



F =



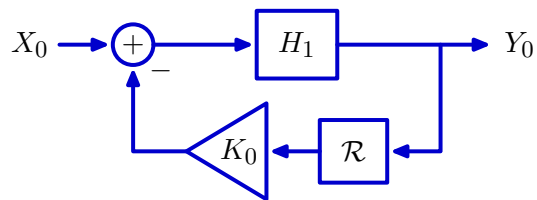
G =



H =

## 5 System functions (14 points)

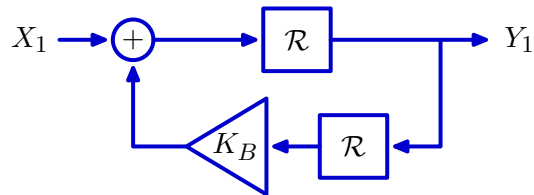
Let  $H_1$  represent a subsystem that is part of the larger system shown below.



The system function for the larger system can be written as

$$H_0 = \frac{Y_0}{X_0} = \frac{H_1}{1 + K_0 R H_1}.$$

Assume that  $H_1 = H_{1B} = \frac{Y_1}{X_1}$  as shown below.



What is the system function for  $H_{1B}$ ?

$$H_{1B} =$$

Determine the system function  $H_0$  for the larger system when  $H_1 = H_{1B}$ .

$$H_0 =$$

Under what conditions on  $K_0$  and  $K_B$  is this system stable? Explain.

Under what conditions on  $K_0$  and  $K_B$  does the unit-sample response decay monotonically? Explain.



## 6 State machines (15 points)

You are going to design a state machine that takes a string of characters as input, and outputs at each time step the largest number of times a character is repeated in a row in the sequence as observed so far. The state variable will have the following form:

```
[lastCharacter, timesSeenConsecutively, best]
```

that is, the state will be a list of the previous input character (except for the first time step, see below), the number of times that character has occurred consecutively up to this point, and the length of the longest sequence of repeated characters observed so far.

Complete the following definition:

```
Class SubSeq(sm.SM):
    startState = None
    def getNextValues(self, state, inp):
        if state == None:
            #part 1
        elif state[0] == inp:
            #part 2
        else:
            #part 3
```

so that it has the following example behavior:

```
>>> test = SubSeq()
>>> test.transduce('abaabcdccccc')
[1, 1, 1, 2, 2, 2, 2, 2, 2, 3, 4, 5]
```

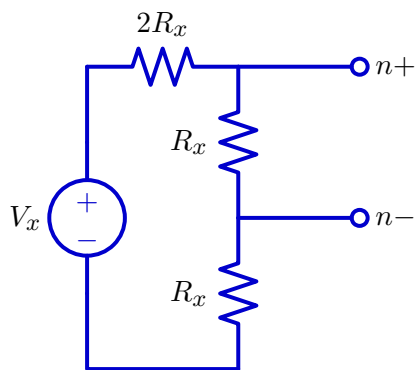
Supply the code for part 1:

Supply the code for part 2:

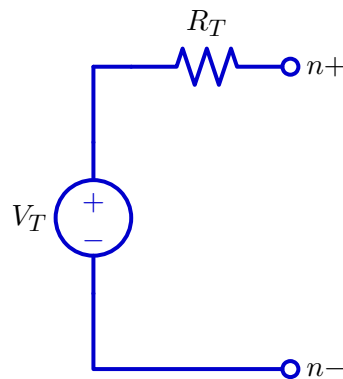
Supply the code for part 3:

## 7 Equivalent Circuits (12 points)

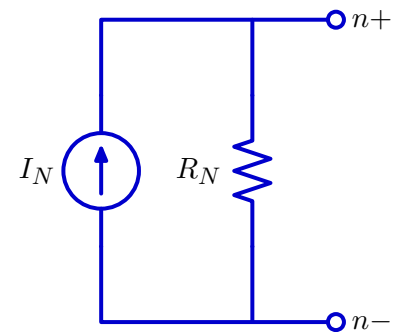
Find the Thevenin and Norton equivalent circuits for the circuit shown in the lower left panel, looking into the port labeled  $n+$  and  $n-$ . Determine values for  $V_T$ ,  $R_T$ ,  $I_N$  and  $R_N$  in terms of  $V_x$  and  $R_x$ . For partial credit, you may also provide a brief explanation of your reasoning.



Original



Thevenin



Norton

$$V_T =$$

$$I_N =$$

$$R_T =$$

$$R_N =$$

Reasoning:

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6.01SC Introduction to Electrical Engineering and Computer Science  
Spring 2011

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