EECS70A Spring 2008 **Midterm Exam #2** Name:_____

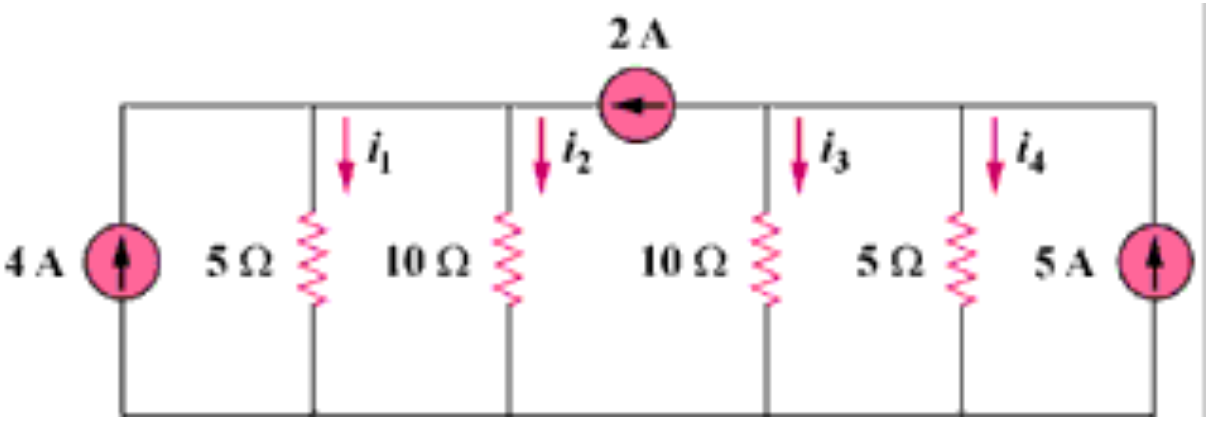
5/15/2008 11:00 to 12:20 pm ID no.:_____
Professor Peter Burke

1	2	3	4	5	6	Total
/20	/20	/20	/20	/10	/10	/100

DO NOT BEGIN THE EXAM UNTIL YOU ARE TOLD TO DO SO.

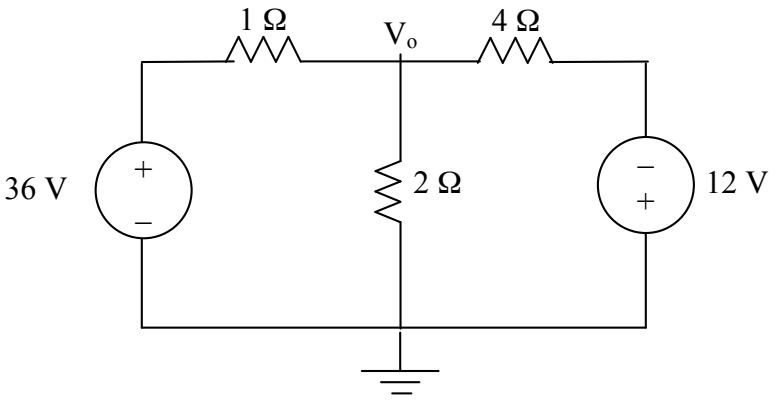
PROBLEM ONE: (20 points)

Given the circuit below, calculate the currents i_1 through i_4.



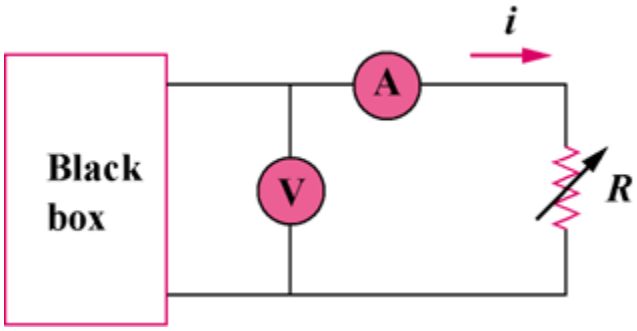
PROBLEM TWO(20 points):

Find V_o in the circuit below.



PROBLEM THREE(20 points):

A black box with a circuit in it is connected to a variable resistor. An ideal ammeter (with zero resistance) and an ideal voltmeter (with infinite resistance) are used to measure current and voltage as shown below. The results are shown in the table below.



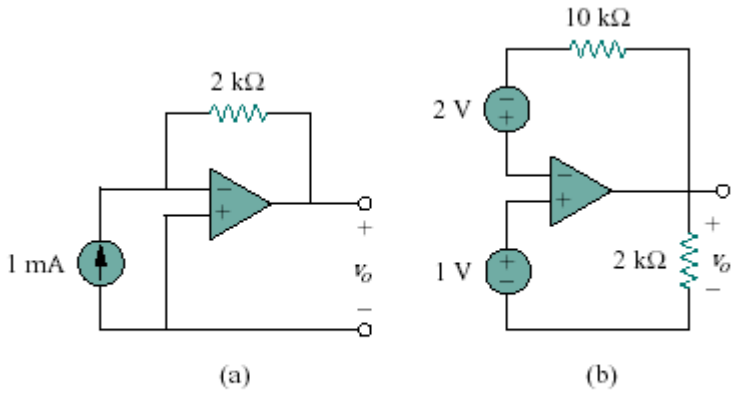
(a) Find ***i*** when ***R*** = 4 Ω.

(b) Determine the maximum power from the box.

R(Ω)	***V***(V)	***i***(A)
2	3	1.5
8	8	1.0
14	10.5	0.75

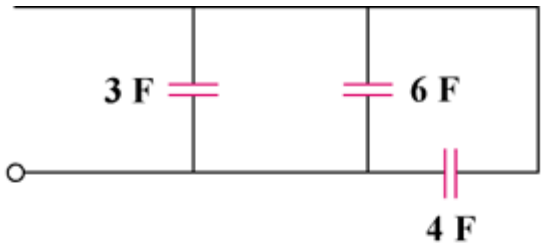
PROBLEM FOUR(20 points):

Obtain v_o for each of the op amp circuits below.



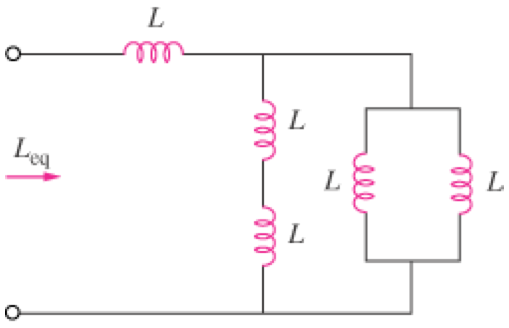
PROBLEM FIVE (10 points):

Determine the equivalent capacitance the circuit below.



PROBLEM SIX(10 points):

Find L_{eq} in the circuit below.



(a)

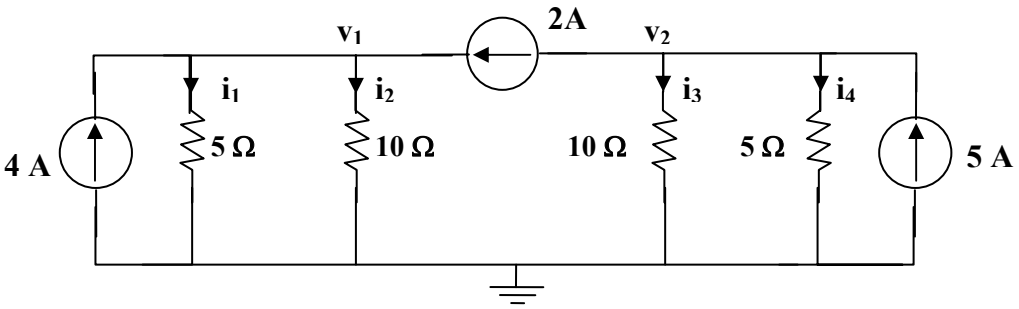
Spring 2008

EECS70A / CSE 70A Network Analysis I
Prof. Peter Burke

Midterm II solution

Grading criteria for all questions: no credits for answers without units and - 3pts for calculation error

Problem 1:



At node 1,

$4 + 2 = v_1/(5) + v_1/(10) \longrightarrow v_1 = 20$

At node 2,

$5 - 2 = v_2/(10) + v_2/(5) \longrightarrow v_2 = 10$

$i_1 = v_1/(5) = \underline{\mathbf{4\ A}}$, $i_2 = v_1/(10) = \underline{\mathbf{2\ A}}$, $i_3 = v_2/(10) = \underline{\mathbf{1\ A}}$, $i_4 = v_2/(5) = \underline{\mathbf{2\ A}}$

Grading criteria: 3pts for only KCL at ground or at one node
5pts for only KCL equation or mesh equation with wrong sign
10pts for correct KCL equation at V_1 and V_2 or mesh equation with incorrect answer

Problem 2:

At the top node, KVL gives

$$\frac{V_o - 36}{1} + \frac{V_o - 0}{2} + \frac{V_o - (-12)}{4} = 0$$

$$1.75V_o = 33V \quad \text{or} \quad V_o = 18.86V$$

Alternatively, mesh analysis can be used
i_1=17.14A, i_2=7.71A
V_0= 2(i_1-i_2)=18.86 V

Grading criteria: 5pts for only KCL or mesh equation with wrong sign
5pts for correct mesh current i_1 and i_2 on mesh analysis
10pts for correct KCL or mesh equation with incorrect answer

Problem 3:

We replace the box with the Thevenin equivalent.

When i = 1.5, v = 3, which implies that $V_{Th} = 3 + 1.5R_{Th}$ (1)

When i = 1, v = 8, which implies that $V_{Th} = 8 + R_{Th}$ (2)

From (1) and (2), R_{Th} = 10 ohms and V_{Th} = 18 V.

(a) When R = 4, $i = V_{Th}/(R + R_{Th}) = 18/(4 + 10) =$ **1.2857 A**

(b) For maximum power, $R = R_{TH}$

$$P_{max} = (V_{Th})^2/4R_{Th} = 18^2/(4x10) = \textbf{8.1 watts}$$
$$= i^2R_{Th} = (0.9)^2X10 = \textbf{8.1 watts}$$

Grading criteria: No credit for final answers without R_{Th}, V_{Th}
2pts for showing equivalent circuit in the box (R_{Th}, V_{Th})
3pts for correct i equation
3pts for correct power equation showing R= R_{Th}

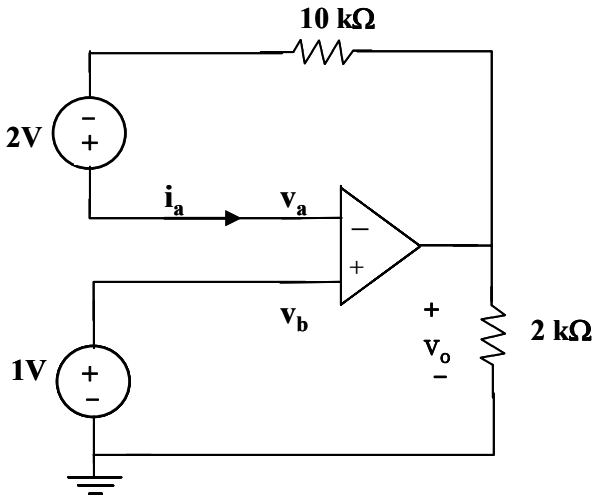
5pts for correct R_{Th} and V_{Th}

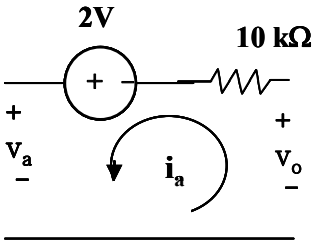
Problem 4:

(a) If v_a and v_b are the voltages at the inverting and noninverting terminals of the op amp.

$v_a = v_b = 0$

$$1\text{mA} = \frac{0 - v_0}{2\text{k}} \longrightarrow v_0 = \underline{\textbf{-2V}}$$





(a) (b)

Since $v_a = v_b = 1$V and $i_a = 0$, no current flows through the 10 kΩ resistor.
From Fig. (b),

$$-v_a + 2 + v_0 = 0 \longrightarrow v_0 = v_a - 2 = 1 - 2 = \underline{\textbf{-1V}}$$

Grading criteria: 3 pts for correct V_a and V_b for each question
5pts for correct KCL equation for (a) with wrong answer
-3pts for wrong sign of final answer with correct steps

Problem 5:

C_{eq} = 3F// 6F// 4F = 3+6+4= 13F

Grading criteria: 3pts for showing parallel connection with wrong answer
-3pts for calculation error

Problem 6:

L//L = 0.5L, L + L = 2L

$$L_{eq} = L + 2L // 0.5L = L + \frac{2Lx0.5L}{2L + 0.5L} = \underline{1.4L} = \mathbf{\underline{1.4\ L}}.$$

Grading criteria: 3pts for showing correct connections with wrong answer
-3pts for calculation error