

ECSE 2010  
Electric Circuits  
Exam 1  
Fall 2005

Name Solutions - Dr

Section Number (please circle one)

**1**

MR  
10-12

**2**

MR  
12-2

**3**

MR  
4-6

Problem No.	Pts.	Score
1	20pts	Stephanie
2	20pts	Yi
3	20pts	Arshonika
4	20pts	Rajanish
5	20pts	Rajanish
Total	100pts	4/100

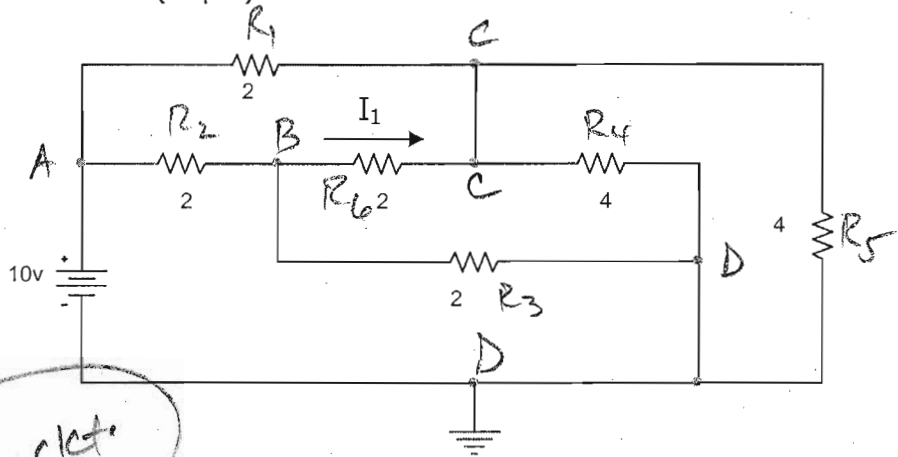
Please Note:

- \* Place all your answers in the spaces provided.
- \* You MUST show your work to receive any credit.

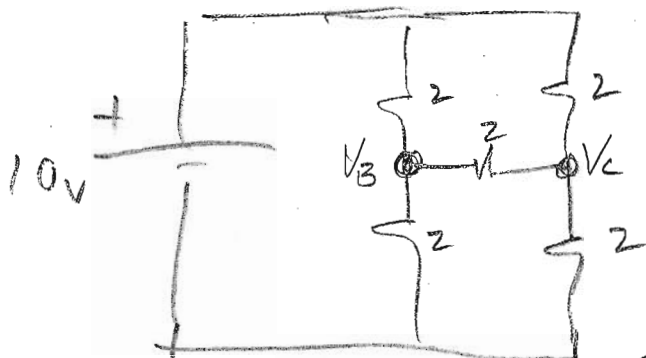
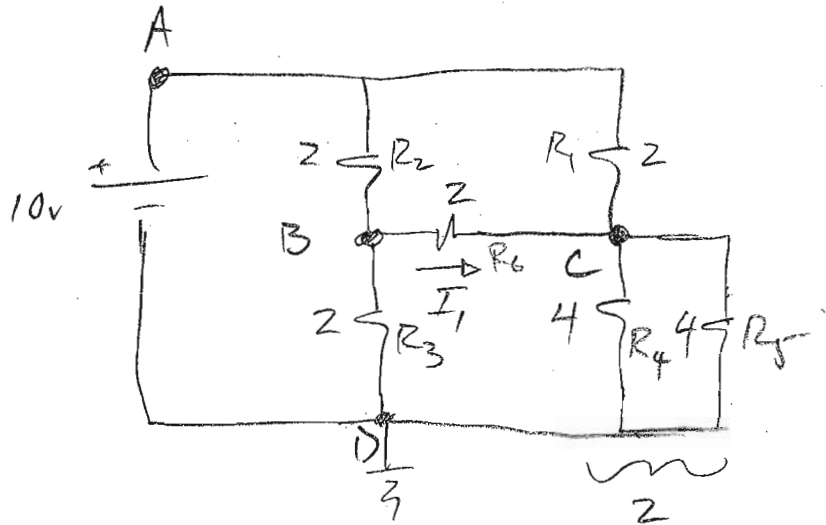
Problem 1 (20pts)

Name Solutions

a.) Find  $I_1$  for the circuit shown. (10pts)



5pts - redrawing ckt.  
5pts - solving



$$\frac{10 - V_B}{2} = \frac{V_B - V_C}{2} + \frac{V_B}{2}$$

$$\frac{10 - V_C}{2} = \frac{V_C - V_B}{2} + \frac{V_C}{2}$$

$$\begin{aligned} 3V_B - V_C &= 10 \\ -3V_B + 9V_C &= 30 \end{aligned}$$

$$\begin{aligned} 8V_C &= 40 \\ V_C &= 5 \\ V_B &= 5 \end{aligned}$$

$$I_1 = \frac{V_B - V_C}{2} = 0$$

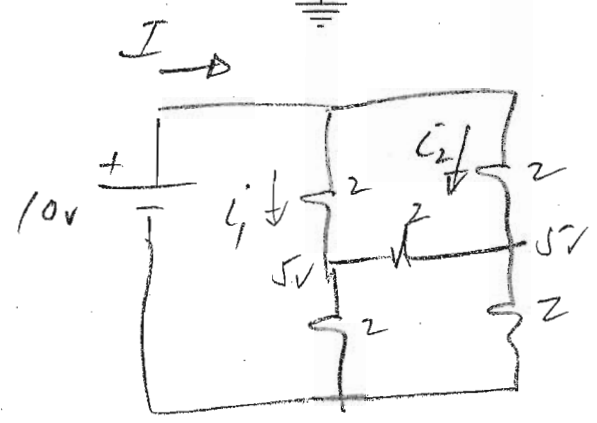
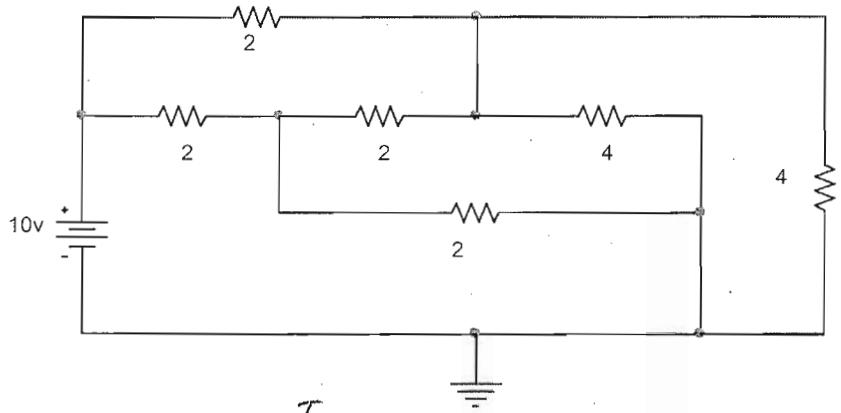
$I_1$	0
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10pts

Problem 1 (cont)

Name Solutions - Jim

b.) Find the power supplied by the 10v source in the circuit shown. (10pts)



$$I = I_1 + I_2 ; I_1 = I_2 = \frac{10-5}{2} = \frac{5}{2}$$

$$I = \frac{5}{2} + \frac{5}{2} = \frac{10}{2} = 5A$$

$$P = VI = 10 \cdot 5 = 50W$$

$P_{source}$	50W
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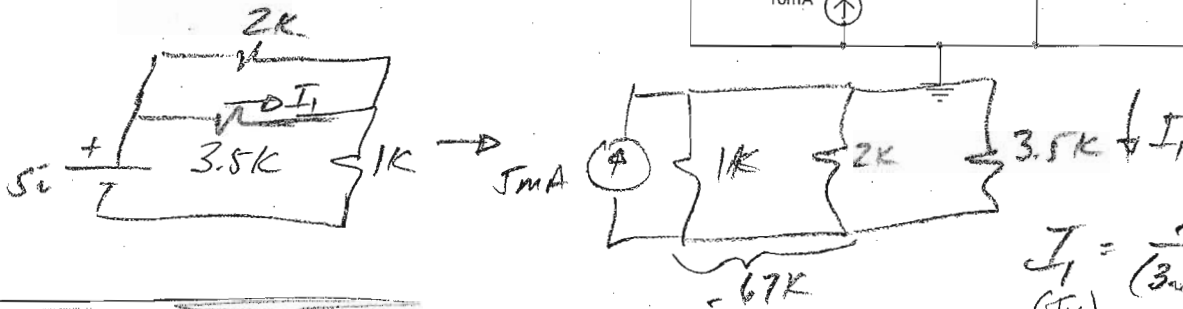
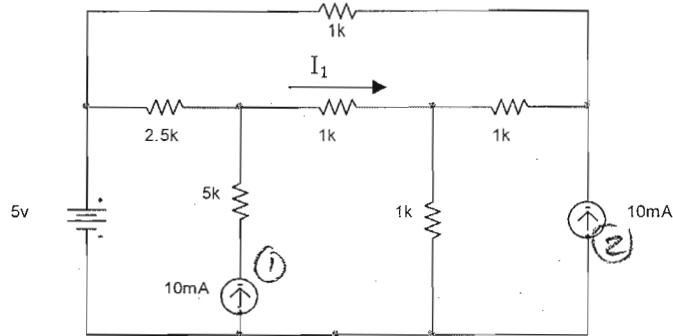
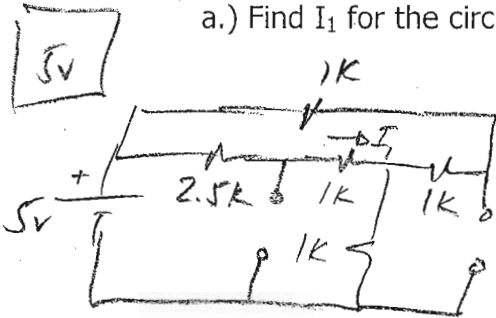
10pts

Problem 2 (20pts)

Name

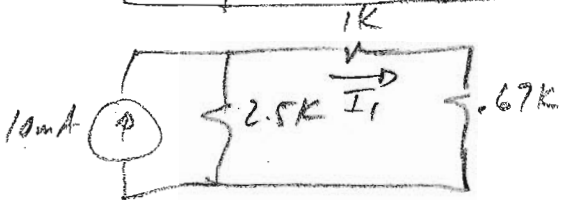
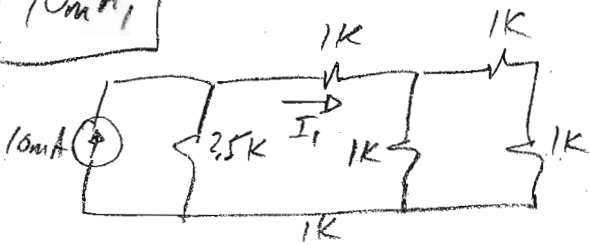
Solutions

a.) Find  $I_1$  for the circuit shown. (10pts)



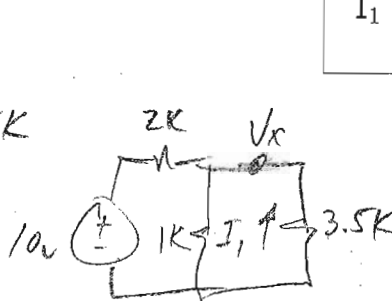
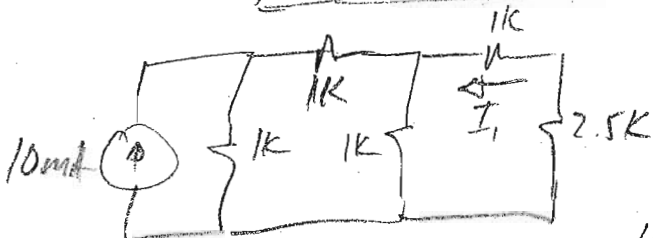
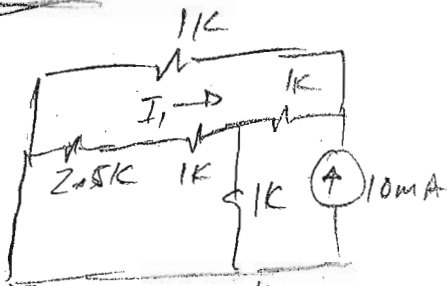
$$I_1 = \frac{.67}{(3.5 + .67)} \times 5 = .8 \text{ mA}$$

10mA<sub>1</sub>



$$I_1 = 10 \text{ mA} \frac{2.5 \text{ k}}{2.5 \text{ k} + 1.67 \text{ k}} \approx \underline{6 \text{ mA}}$$

10mA<sub>2</sub>



$$V_x = -10 \frac{\frac{3.5}{4.5}}{\frac{3.5}{4.5} + 2} = -2.8$$

$$I_1 = \frac{-2.8}{3.5} = -.8$$

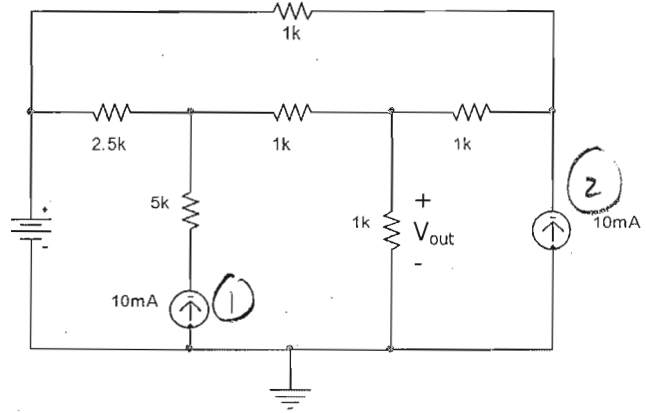
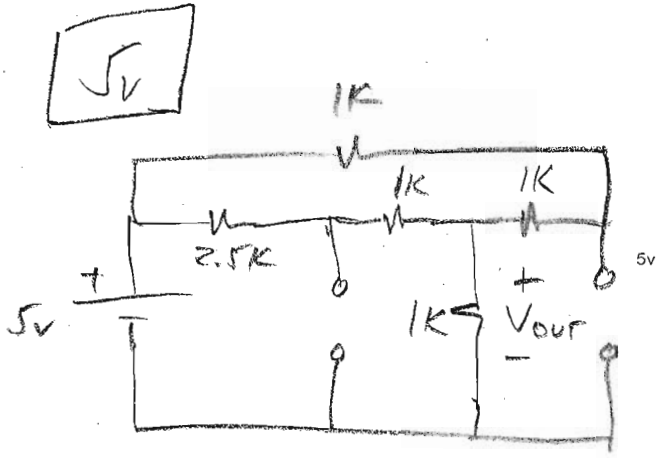
$I_1 = .8 + 6 - .8 = 6 \text{ mA}$

$I_1$	6 mA	10pts
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Problem 2 (cont)

Name Solutions - [Signature]

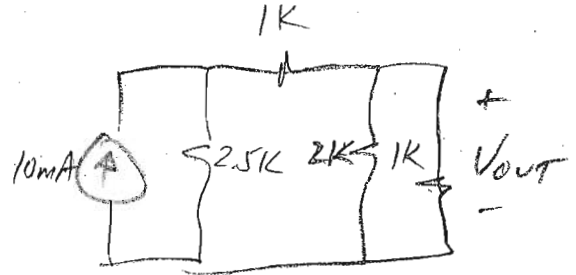
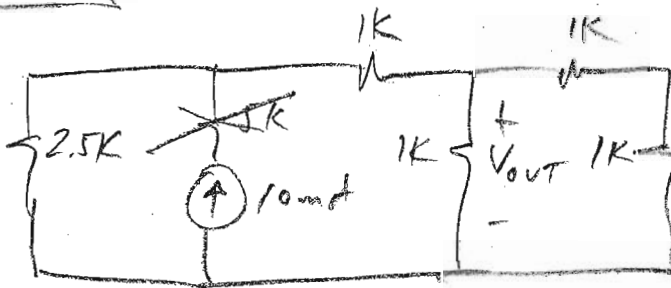
b.) Find  $V_{out}$  in the circuit shown. (10pts)



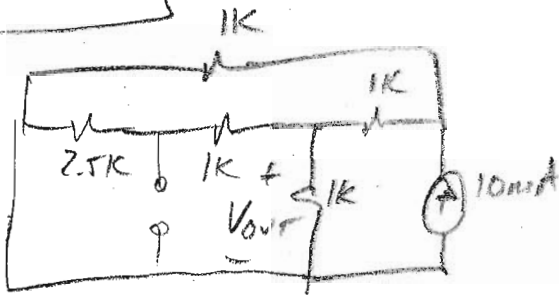
$$V_{out} = 5V \frac{1K}{1K + (2.5K \parallel 3.5K)} \approx \underline{\underline{2.2V}}$$

1.27K

10mA<sub>1</sub>



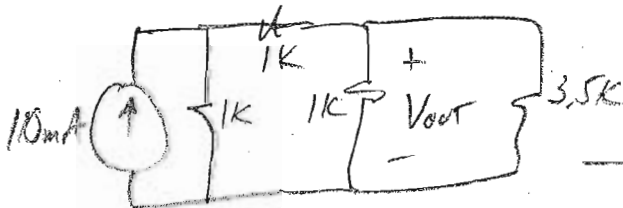
10mA<sub>2</sub>



$$V_{out} = 25 \frac{.67}{3.5K + .67K} \approx \underline{\underline{4V}}$$


$$V_{out_{TOT}} = 2.2 + 4 + 2.8$$

$V_{out}(t)$	9V	10pts
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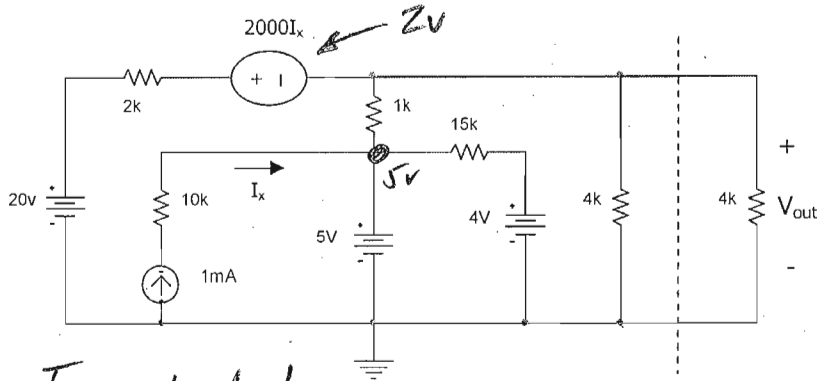


$$V_{out} = 10 \frac{.78}{1K + \frac{3.5K}{4.5K}} \approx \underline{\underline{2.8V}}$$

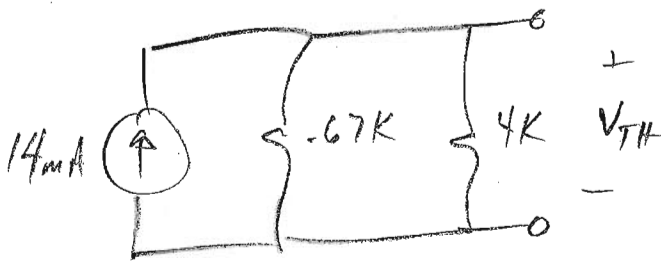
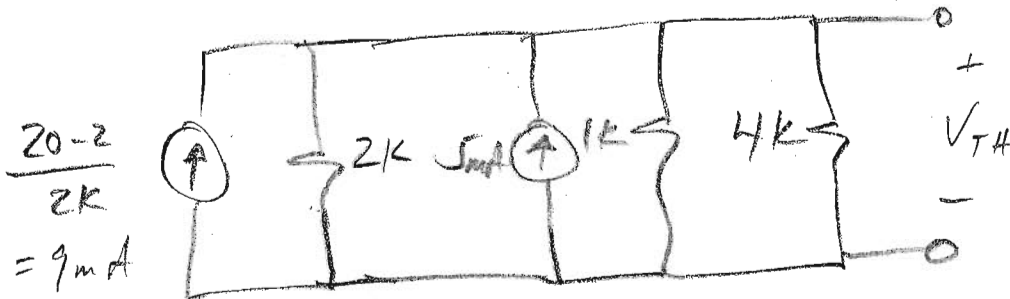
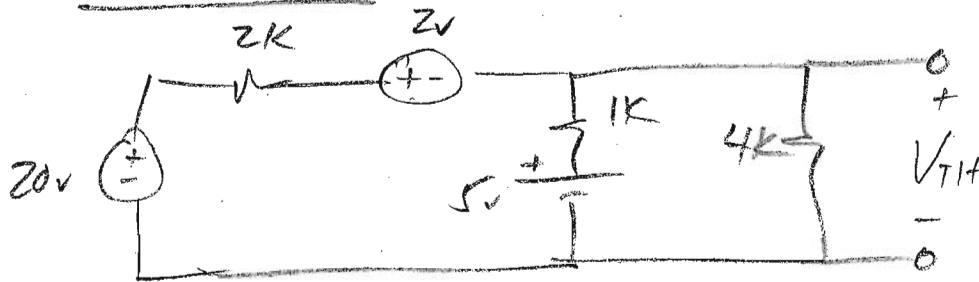
Problem 3 (20pts)

Name SOLUTIONS 

Find the Thevenin equivalent (to the left of the dashed line) for the circuit shown below and then use it to find  $V_{out}$ .



$I_x = 1mA!$



$V_{TH} = 14mA \cdot (.67k // 4k) \approx 8V$

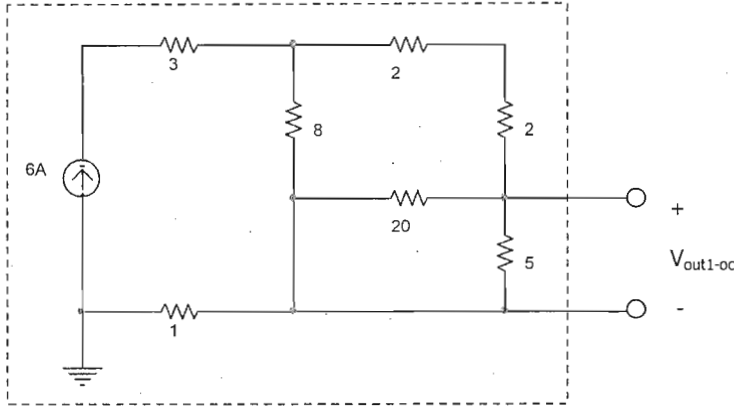
$R_{TH} = .67k // 4k = .571k$ ;  $V_{out} = \frac{4k}{4.571k} \times 8V \approx 7V$

$V_{th}$	8V	10pts
$R_{th}$	.571K	5pts
$V_{out}$	7V	5pts

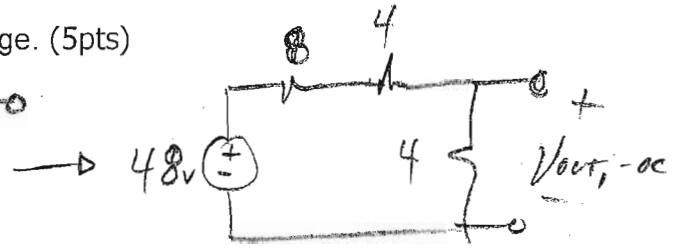
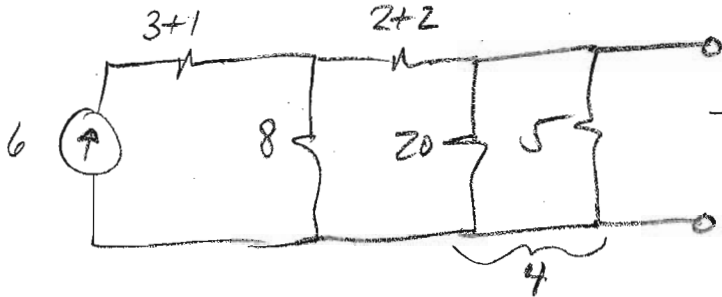
Problem 4 (20pts)

Name Solutions - JCB

Given the following circuit:



a.) Find  $V_{out1-oc}$ , the open circuit output voltage. (5pts)

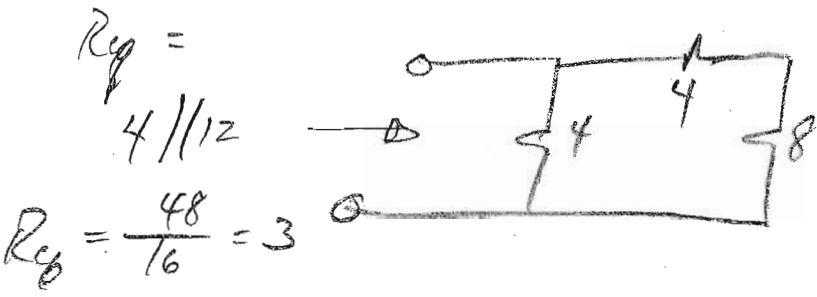
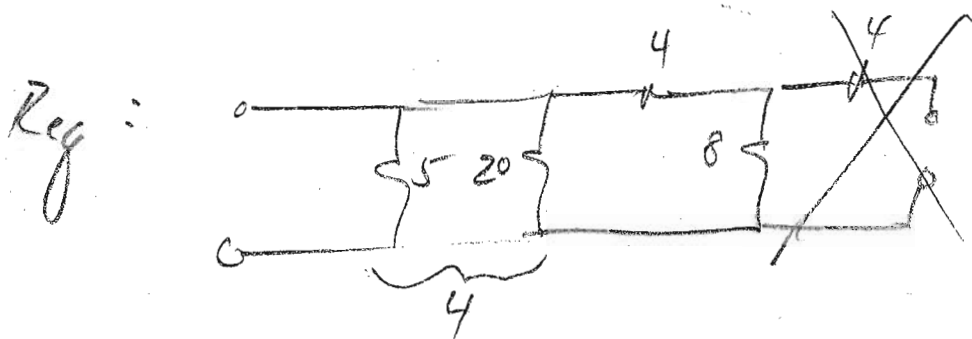


$$V_{oc} = \frac{4}{16} \times 48 = \frac{48}{4} = 12$$

$V_{out1-oc}$	12v
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10pts

b.) Find the equivalent resistance ( $R_{th}$ ) that a meter would read across the two wires that exit the box. (5pts)

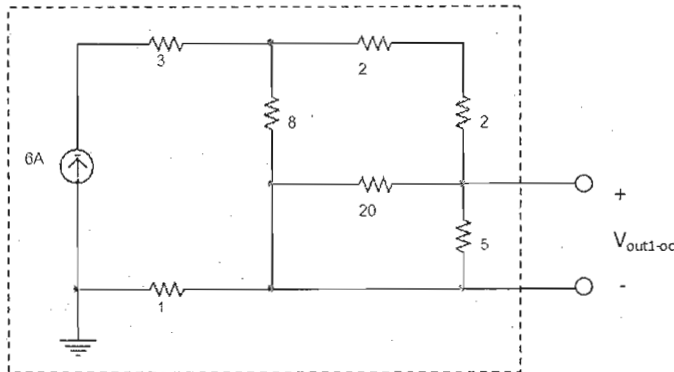


$R_{th}$	3
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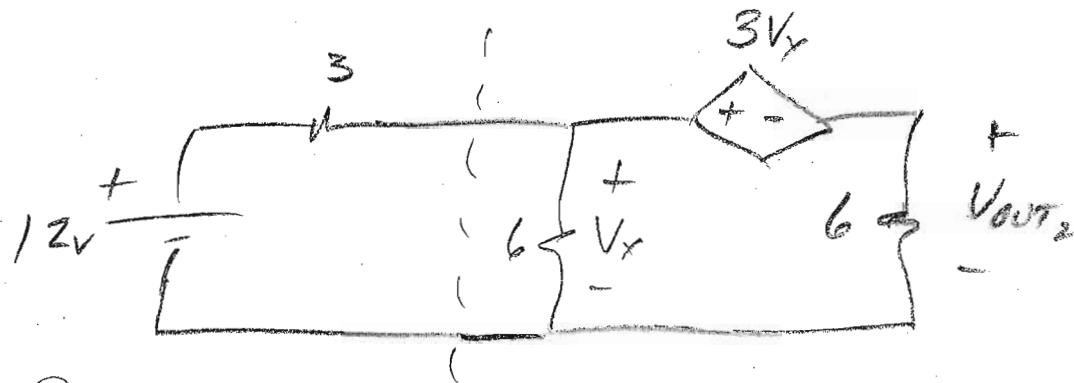
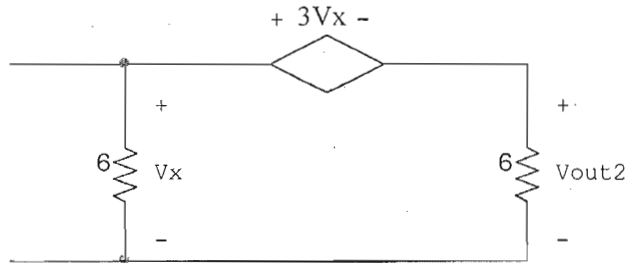
JCB

Problem 4 (cont.)

Name Solutions - Du



c.) Find  $V_{out2}$  if the following load network is added to the output of the above circuit. (10pts)



a)  $V_x$ :

$$\frac{12 - V_x}{3} = \frac{V_x}{6} + \frac{V_x - 3V_x}{6}$$

$$24 - 2V_x = 2V_x - 3V_x$$

$$V_x = 24V$$

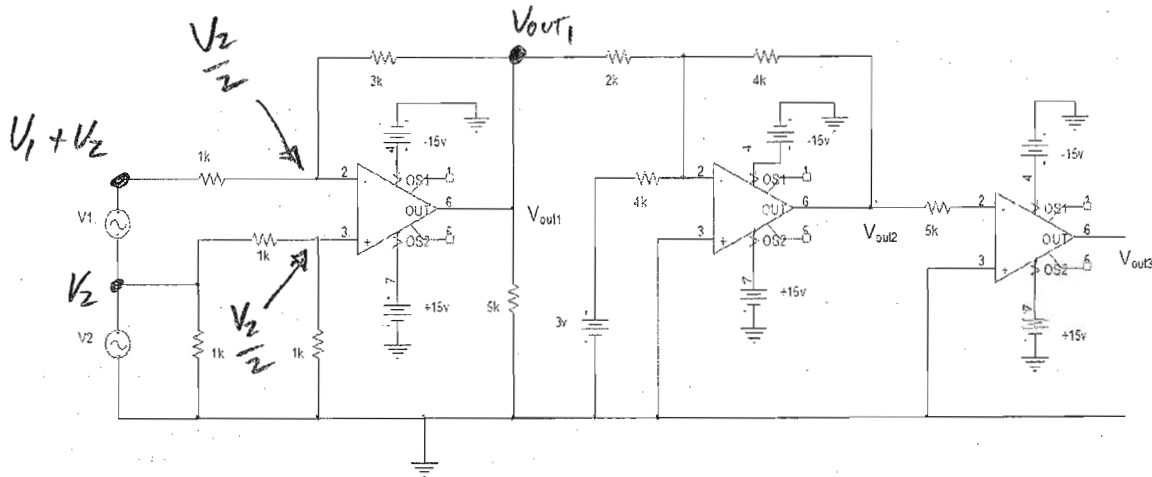
$V_{out2}$	24V
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5pts

Problem 5 (20pts)

Name Solutions for

For the following circuit (assume that all the Op Amps use  $\pm 15$  Volt supplies):



a.) Find  $V_{out1}$  in terms of  $V_1$  and  $V_2$  in the form  $V_{out1} = (A \times V_1) + (B \times V_2) + (C)$ . Find the constant terms A, B, & C in the equation for  $V_{out1}$ . (5pts)

Diff Amp:

$$\frac{(V_1 + V_2) - \frac{V_2}{2}}{1K} = \frac{\frac{V_2}{2} - V_{out1}}{3K}$$

$$3(V_1 + V_2) - \frac{3}{2}V_2 = \frac{V_2}{2} - V_{out1}$$

$$V_{out1} = \frac{V_2}{2} - 3V_1 - 3V_2 + \frac{3}{2}V_2$$

$V_{out1}$	$-3V_1 - V_2$	5pts
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b.) Find the expression relating  $V_{out2}$  to  $V_{out1}$ . (5pts)

$$\frac{V_{out1} - 0}{2K} + \frac{3V - 0}{4K} = \frac{0 - V_{out2}}{4K}$$

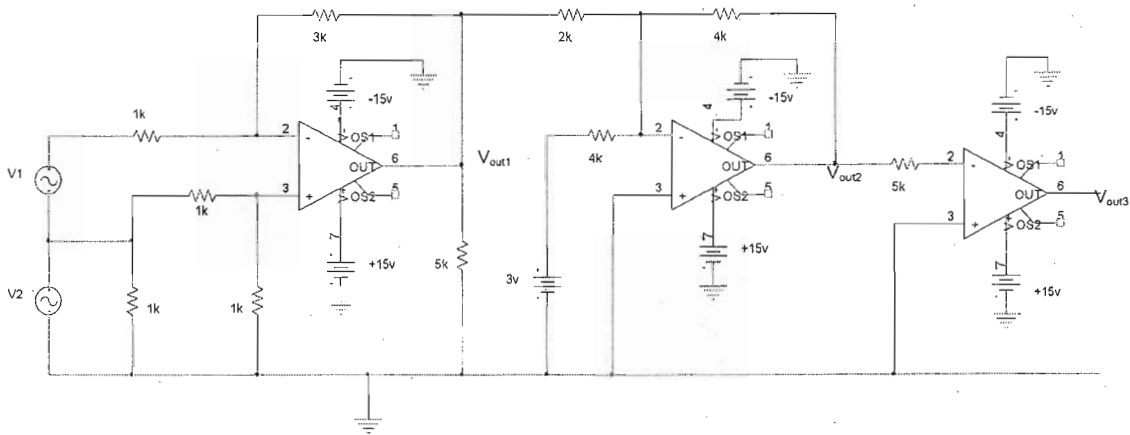
$$V_{out2} = -4K \left( \frac{V_{out1}}{2K} + \frac{3V}{4K} \right) = -2V_{out1} - 3V$$

$V_{out2}$	$-2V_{out1} - 3V$	5pts
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Problem 5 (cont.)

Name

*Solutions*



c.) Find  $V_{out2}$  in terms of  $V_1$  and  $V_2$ ; in the form  $V_{out2} = (A \times V_1) + (B \times V_2) + (C)$ . (5pts)

$$V_{out2} = -2 \underbrace{(-3V_1 - V_2)}_{V_{out1}} - 3v = 6V_1 + 2V_2 - 3v$$

$V_{out2}$	$6V_1 + 2V_2 - 3v$
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5pts

d.) With  $V_1 = +1v$  and  $V_2 = -1.0v$ , find the value of  $V_{out3}$ . Please justify your response. (5pts)

*open loop gain*

$$V_{out3} = (-\infty) \cdot (V_{out2})$$

$$V_{out3} = (-\infty) \cdot (6 + 2(-1) - 3) = (-\infty)(+1)$$

$$V_{out3} = -\infty$$

$V_{out3}$	$-15v$
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5pts

*SATURATES @ -15v!*