United States Naval Academy
Electrical and Computer Engineering Department
EE 221
Exam 1
27 September 2010

1. You must present your work completely and legibly to receive partial credit. You must show sufficient steps to justify intermediate results as well as final answers.
2. Put all your work on the exam. If you need more space than that provided, ask your instructor for paper. Write your answer clearly and use appropriate units. You have 50 minutes to work this examination.
3. **You are not permitted to discuss the contents of this exam until after 6th period today.**

Page	Value	Score
1	15	
2	20	
3	15	
4	25	
5	25	
Total	100	

Name_____

I have neither given nor received assistance while completing this exam.

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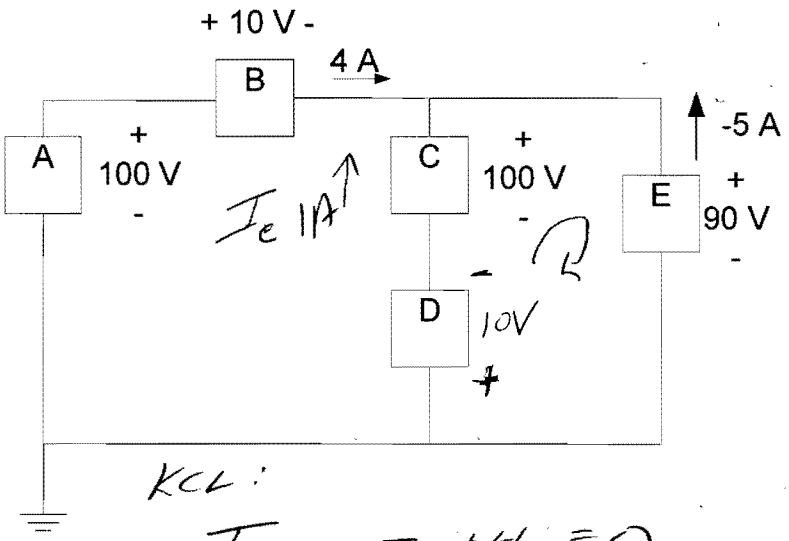
Signed and Dated

(1) (15 points) Using the circuit below, determine the value of the power either provided or absorbed by each of the circuit elements. CIRCLE EITHER SOURCE **OR** LOAD FOR **EACH** ELEMENT



KCL:

$I_c - 5 + 4 = 0$

$I_c = 1A$

KVL:

$-V_D + 100 - 90 = 0$

$V_D = 10V$

$P = VI$

Circle one

A: P = 400 W (source) / load

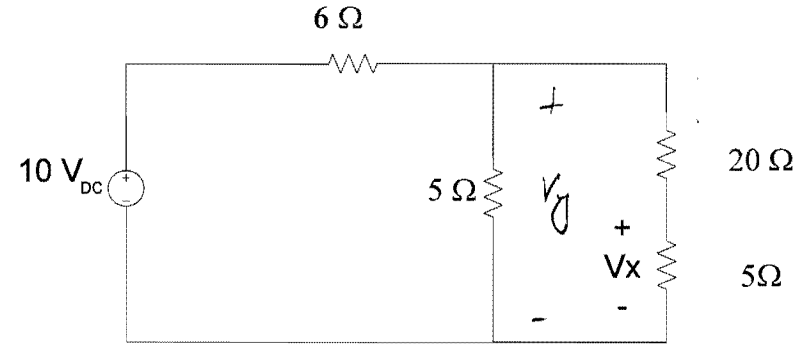
B: P = 40 W source / (load)

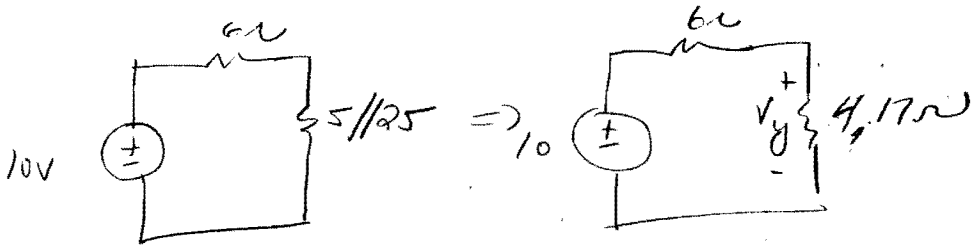
C: P = 100 W (source) / load

D: P= 10 W source / (load)

E: P = 450 W source / (load)

(2) (10 pts) Use the voltage divider rule **TWICE** to find Vx in the circuit below. **Show all of your work for full credit!**



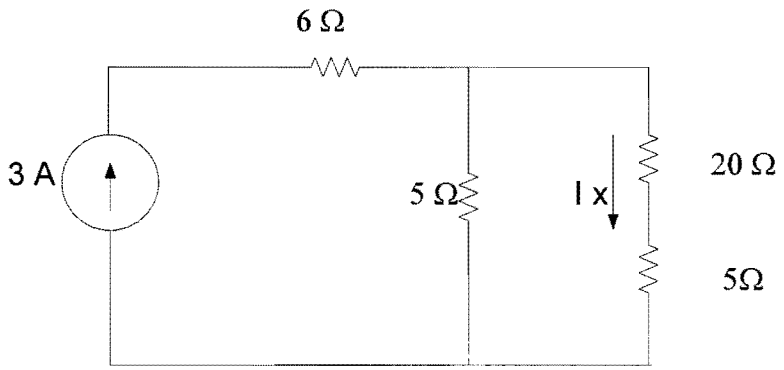


$V_y = \left(\frac{4.17}{6+4.17}\right)10$ 4.098 ≈ 4.1V

$V_x = \left(\frac{5}{20+5}\right)(V_y) = 0.8197 \approx 0.82V$

Vx = 0.82V

(3) (10 pts) Use the current divider rule to find Ix in the circuit below. **Show all of your work for full credit!**



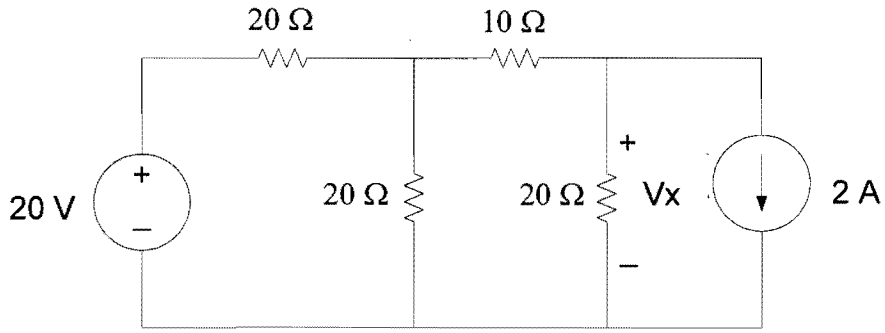
$I_x = \frac{25//5}{25}(3) = 500\,mA$

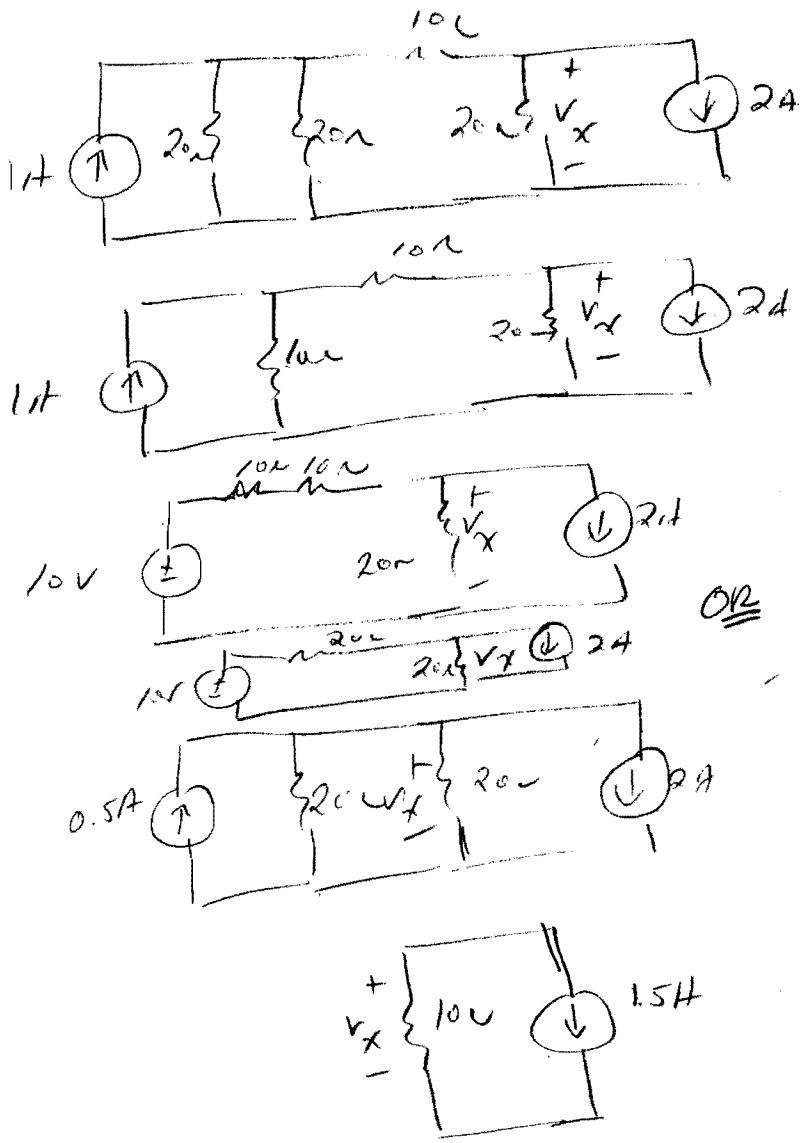
CIZ

$I_x = \left(\frac{5}{30}\right)(3) = 500\,mA$

Ix = 500 mA

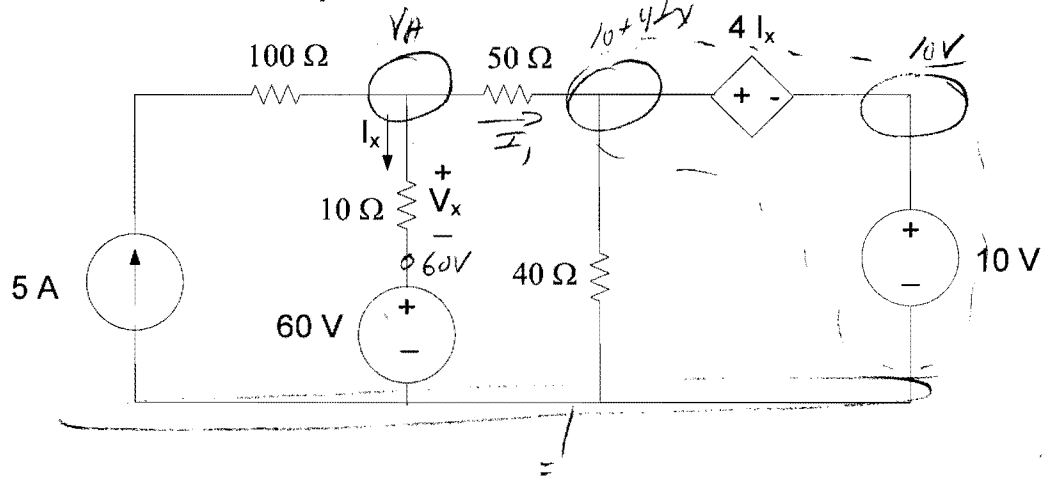
(4) (15 pts) Given the circuit shown below, determine the value of Vx using **SOURCE TRANSFORMATION. Show all of your work.**





Vx = −15V

(5) (25 points) Given the circuit shown below, determine the value of Vx using **NODAL ANALYSIS. Show all of your work.**



$$5 = I_x + I_1$$

$$5 = \frac{V_A - 60}{10} + \frac{V_A - (10 + 4I_x)}{50}$$

$$5 = \frac{V_A - 60}{10} + \frac{V_A - 10 + 4\left(\frac{V_A - 60}{10}\right)}{50}$$

$$250 = 5V_A - 300 + V_A - \left(10 + \tfrac{4}{10}V_A - \tfrac{4}{10}(60)\right)$$

$$550 = 6V_A - 10 - \tfrac{4}{10}V_A + 24$$

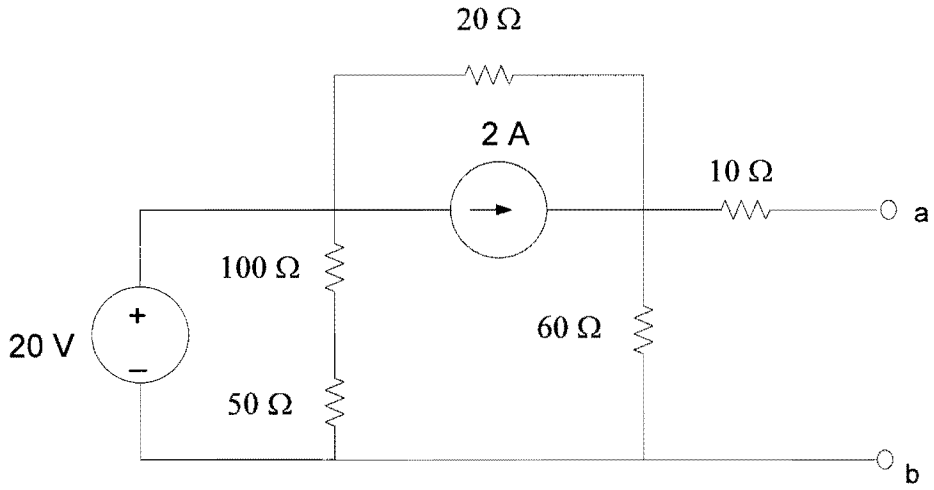
$$536 = 6V_A - \tfrac{4}{10}V_A$$

$$V_A = 95.7\ V$$

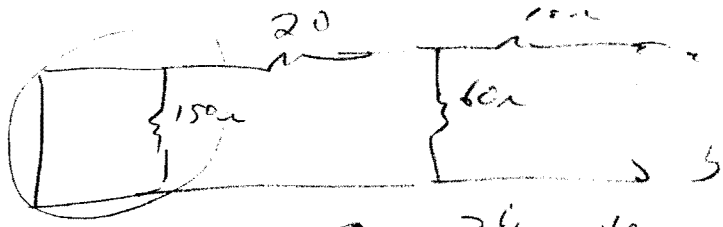
$$V_x = V_A - 60 = 95.7 - 60 = 35.7\ V$$

Vx = 35.7 V

(6) (25 points) Find the Thevenin Equivalent of the circuit shown below from the point of view of terminals a-b. **DRAW THE THEVENIN"S CIRCUIT**. What load resistor value would provide maximum power to the load? What is the maximum power that can be provided to the load?



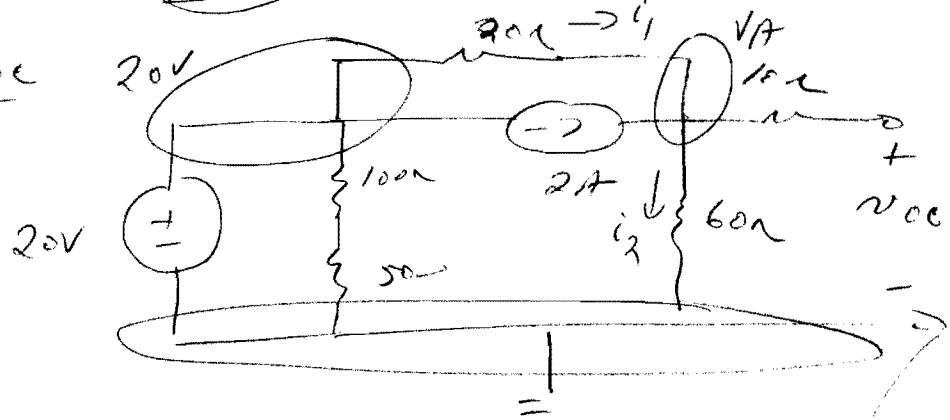
R_{TH} =



$R_{TH} = (20 \| 60) + 10$

$= 25\Omega$

V_{oc}



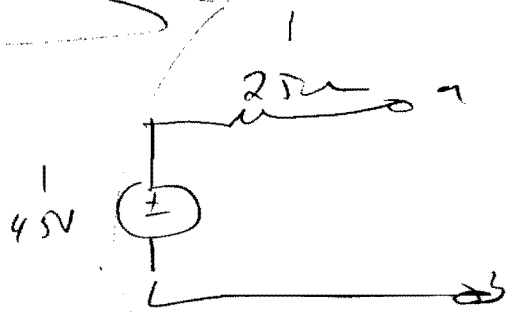
$i_1 + 2 = i_2$

$\frac{20 - V_A}{20} + 2 = \frac{V_A}{60}$

$60 - 3V_A + 120 = V_A$

$180 = 4V_A$

$45V = V_A$



$P = \frac{(45/2)^2}{25} = 20.25W$

$R_{LOAD} = 25\Omega$

$P_{MAX} = 20.25W$