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FACULTY OF ENGINEERING
& ARCHITECTURE

SPRING TERM 2003-04

Name:......................................

March 24, 2004

(EECE210) ELECTRIC CIRCUITS & ELECTRONICS.

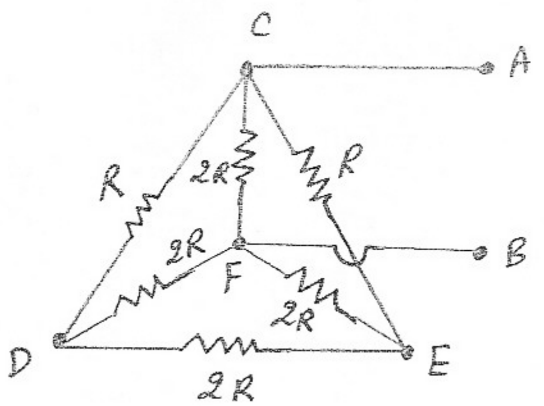
CLOSED BOOK (1 ½ HRS)

Programmable Calculators are not allowed
Provide your answers on the computer's card only
Return the computer's card attached to the question sheet
Mark with a pencil your last name, first name initial (FI) and father's name initial (MI).
Mark your AUB ID NO. in the box titled "Social Security No."
The test ID No. is your exam version. Mark it in the box titled ' Test ID".
Use pencil for marking your answers
When using eraser, be sure that you have erased well

!! PENALTY IS 7 TO 1 !!

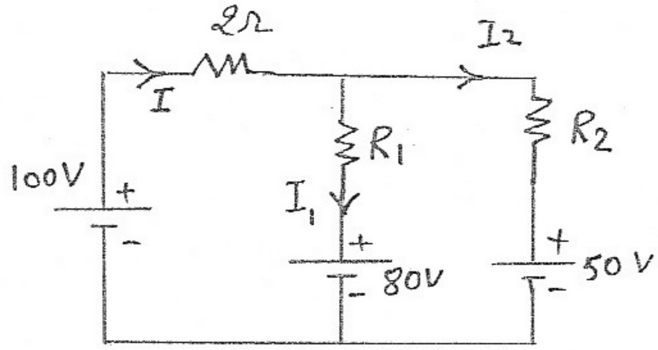
1. Determine the resistance between terminals A and B in the circuit below.

a. 6R/7
b. 3R/7
c. 4R/7
d. 5R/7
e. none of the above



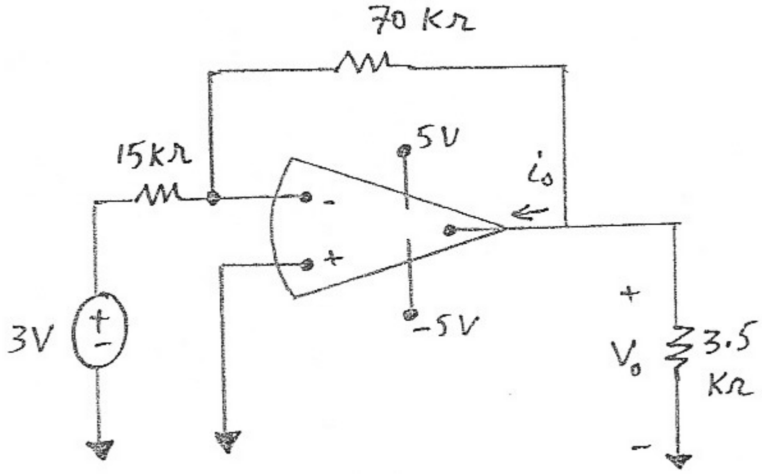
2. Determine the values of resistances R_1 and R_2 in the network below such that I_1 and I_2 are equal to 4A and 6A respectively.

a. R1= 0Ω, R2=11.6 Ω
b. R1=10 Ω, R2=5 Ω
c. R1=0 Ω, R2=5 Ω
d. R1=10 Ω, R2=11.6 Ω
e. none of the above

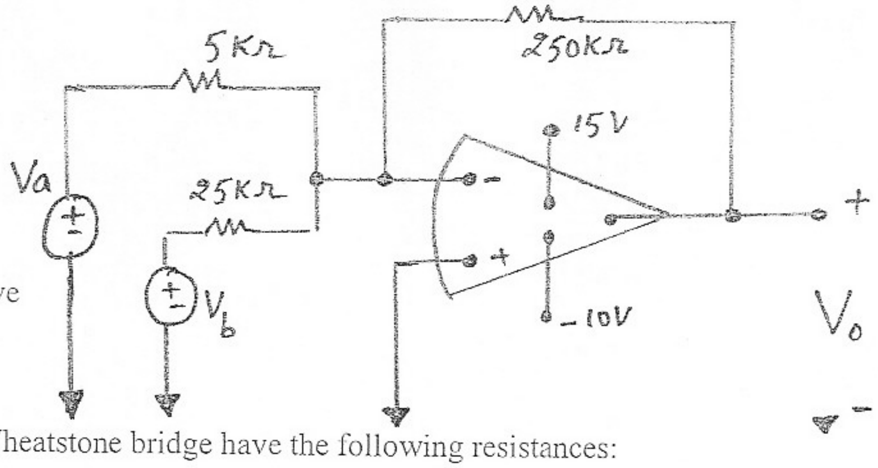


3. The op amp in the circuit below is ideal. Calculate V_o.

a. 10V
b. -18V
c. -14V
d. -12V
e. none of the above



4. Find V_o in the circuit shown if $V_a = 0.1V$ and $V_b = 0.25V$.

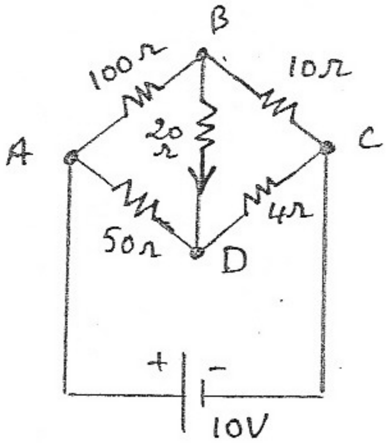


a. 0.15V
b. -7.5V
c. -2.5V
d. 0.25V
e. none of the above

5. The four arms of a Wheatstone bridge have the following resistances:

AB = 100 Ω, BC = 10 Ω, CD = 4 Ω, DA = 50Ω.

A 20 Ω resistance is connected across BD. Compute the Thevenin voltage between terminals B-D when a potential difference of 10V is maintained across AC.

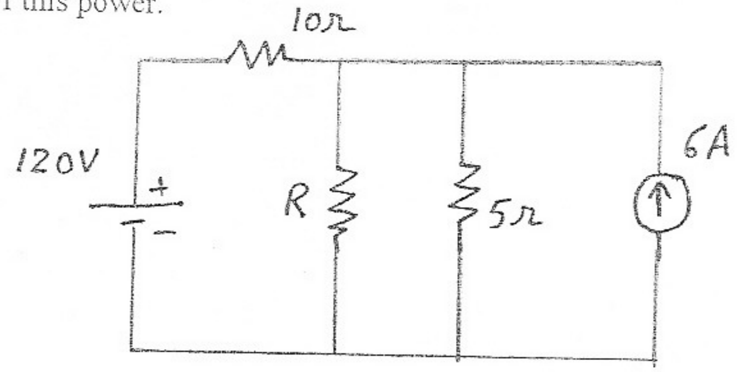


a. ~0.168 V
b. ~0.741 V
c. ~0.554 V
d. ~0.909 V
e. none of the above

6. In problem 5, find the current flowing through the 20 Ω resistance between terminals B-D

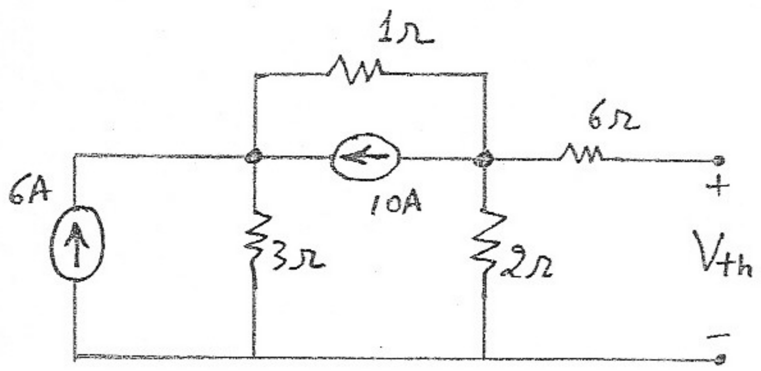
a. ~6 mA
b. ~4mA
c. ~3 mA
d. ~5mA
e. none of the above

7. Calculate the value of R which will absorb maximum power from the circuit shown below. Also compute the value of this power.



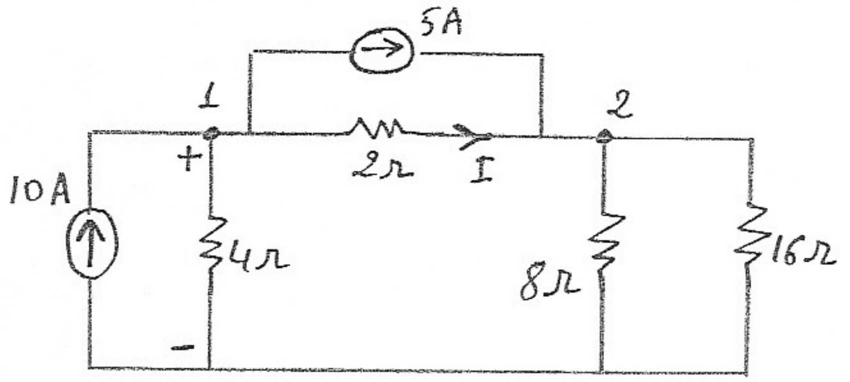
a. 5 Ω, 720W
b. 10/3 Ω, 270W
c. 10 Ω, 1800W
d. 10/3 Ω, 1080W
e. none of the above

8. Find the Thevenin voltage V_{TH} shown in the circuit below



a. 3.87V
b. 2.67 V
c. 1.45V
d. 5.62V
e. none of the above

9. A network excited only by current sources is shown below. Determine the voltage at Node 1.

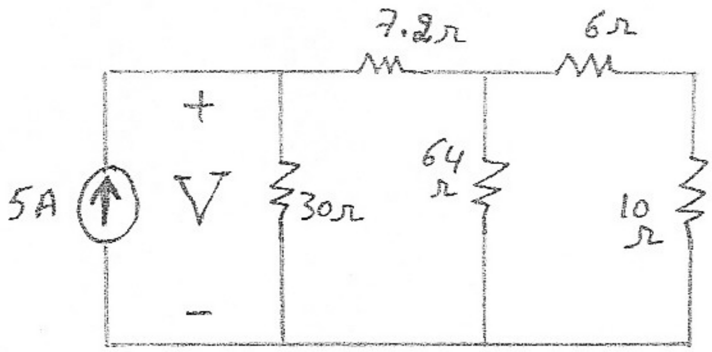


a. 18.65V
b. 26.43V
c. 31.33V
d. 22.35V
e. none of the above

10. In problem 9, find the current through the 2 Ω resistance.

a. -0.856A
b. -5A
c. -1.350A
d. -0.588A
e. none of the above

11. For the circuit below, find the voltage V.



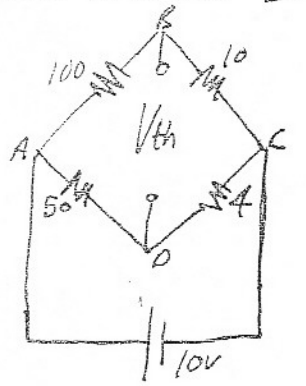
a. 40V
b. 60V
c. 50V
d. 70V
e. none of the above

12. In problem 11, find the power delivered to the circuit by the current source.

a. 400W
b. 300W
c. 200W
d. 500W
e. none of the above

American University of Beirut
Department of Electrical and Computer Engineering
EECE 210 – Electric Circuits – Spring 2004
Q 1 - solution

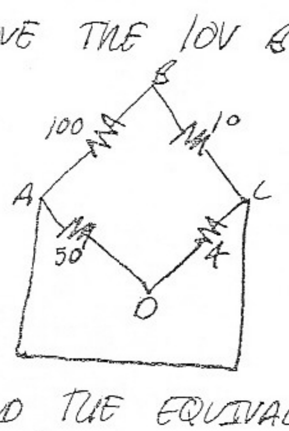
1. WHEN THE GALVANOMETER IS REMOVED, WE GET THE CIRCUIT BELOW:



* LET US NOW FIND THE OPEN-CIRCUIT VOLTAGE (V_{TH}). REMEMBERING THAT ABC (AS WELL AS ADC) IS A POTENTIAL DIVIDER ON WHICH A 10V DROP TAKES PLACE, WE GET:

Potential of B w.r.t C $= 10 \times 10/110 = 0.909V$.
Potential of D w.r.t C $= 10 \times 4/54 = 0.741V$.
$\Rightarrow$ Potential between B & D $= V_{th} = 0.909 - 0.741 = 0.168V$.

* NOW REMOVE THE 10V BATTERY BY SHORTING PTS. A & C.



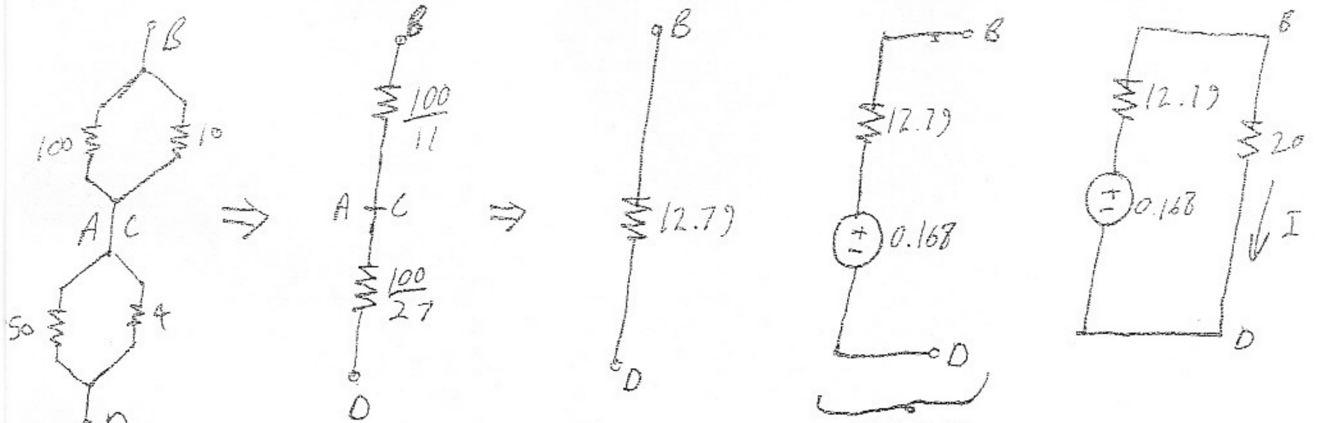
* NEXT FIND THE EQUIVALENT RESISTANCE OF THE CIRCUIT AS SEEN BY TERMINALS B & D. NOTE THE POTENTIALS A & C ARE NOW THE SAME, BA // BC & AD // CD.
$\Rightarrow R_{BD} = 12.79\ \Omega$.

* NOW, SO FAR AS POINTS B & D ARE CONCERNED, THE NETWORK HAS A VOLTAGE OF 0.168V AND RESISTANCE 12.79Ω.

* CONNECTING BACK THE GALVANOMETER TO THE THEVENIN SOURCE, WE CAN CALCULATE THE CURRENT I FLOWING THROUGH IT:

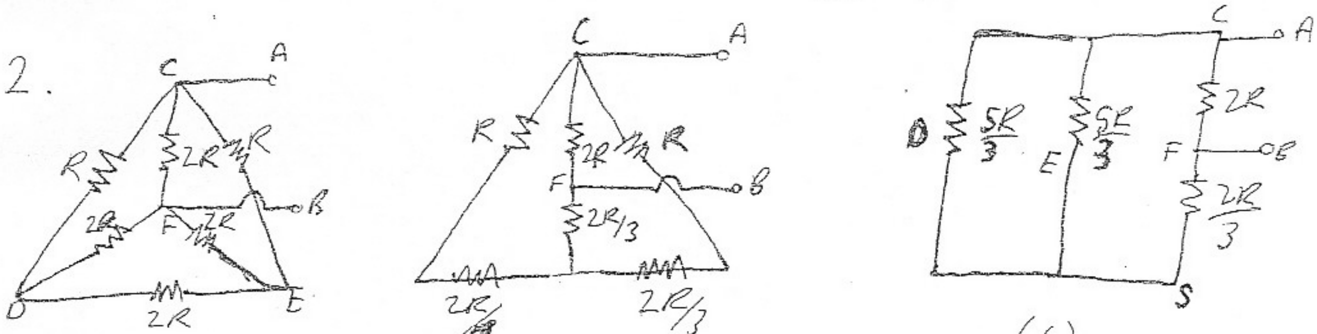
$$I = 0.168 / (12.79 + 20) = 0.005 = 5mA.$$

THE FOLLOWING CIRCUITS SHOULD SIMPLIFY MATTERS:



THEVENIN

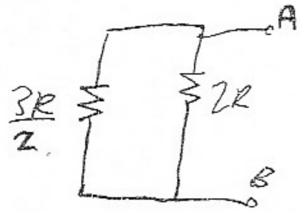
2.



(a) (b) (c)

THE Δ FDE MAY BE REPLACED BY ITS EQUIVALENT Y, AS SHOWN IN (b). IN (c) TWO SERIES RESISTANCES ALONG CES & COS HAVE BEEN REPLACED BY SINGLE RESISTANCE.

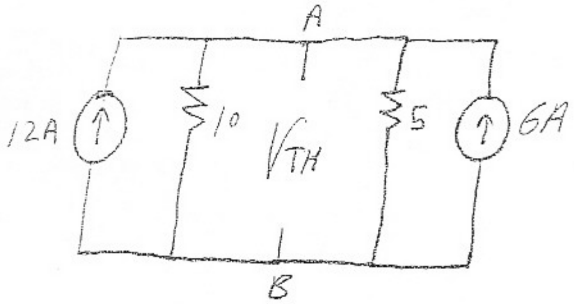
FURTHER SIMPLIFICATION GIVES THE CIRCUIT BELOW:



$$\Rightarrow R_{AB} = \frac{3R}{2} \parallel 2R = \frac{6R}{7}.$$

3. FOR FINDING POWER, AN EQUATION RELATING I TO R MUST BE FOUND.

* REMOVE R AND FIND V_{TH} ACCROSS AB. IT IS HELPFUL TO CONVERT THE 120V, 10Ω TO A CURRENT SOURCE IN // TO A RESISTOR, AS SHOWN BELOW:



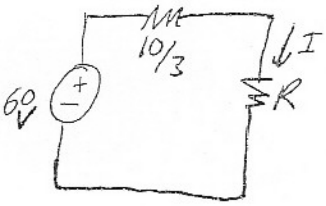
A KCL YIELDS:

$$\frac{V_{th}}{10} + \frac{V_{th}}{5} = 12 + 6 \Rightarrow V_{th} = 60V.$$

* TO FIND R_{TH}, THE SOURCES ARE REMOVED.

$$\Rightarrow R_{TH} = 10 // 5 = 10/3\ \Omega.$$

* THE EQUIVALENT CIRCUIT:

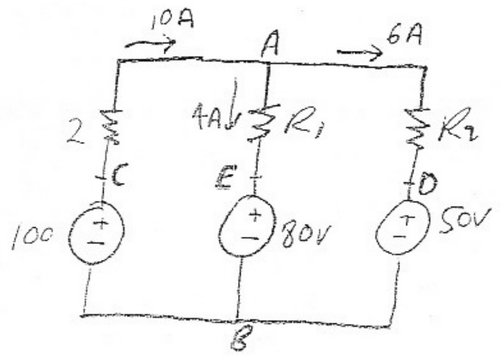


* R WILL ABSORB MAXIMUM POWER WHEN IT EQUALS $10/3\ \Omega$.

$$\Rightarrow I = 60/\tfrac{20}{3} = 9A.$$

* $P_{max} = I^2 R = 9^2 \times 10/3 = 270W.$

4. $I = I_1 + I_2 = 4 + 6 = 10A.$



THE THREE PATHS ARE // ACROSS AB.
V_{AB} VIA PATH BCA $= 100 - (2 \times 10) = 80V$.
SINCE 80V ALREADY EXISTS IN PATH AEB, THERE IS NO V DROP ACROSS R_1. $\Rightarrow R_1 = 0\Omega$.
IN BRANCH ADB, V DROP ACROSS R_2 IS $80 - 50 = 30V$.

$$\Rightarrow 6R_2 = 30 \Rightarrow R_2 = 5\Omega.$$

5. AT NODE 1; (NOTE THAT $V_2 = V_{TH}$)

$$6 + 10 = \frac{V_1}{3} + \frac{V_1 - V_{TH}}{1} \Rightarrow 48 = 4V_1 - 3V_{TH}.$$

AT NODE 2;

$$10 + \frac{V_{TH}}{2} = \frac{V_1 - V_{TH}}{1} \Rightarrow 20 = 2V_1 - 3V_{TH},$$

Solving, $V_{TH} = 2.67V$.

6. AT NODE 1;

$$10 = \frac{V_1}{4} + 5 + \frac{V_1 - V_2}{2} \Rightarrow \boxed{3V_1 - 2V_2 = 20} \quad (1)$$

AT NODE 2;

$$5 + \frac{V_1 - V_2}{2} = \frac{V_2}{8} + \frac{V_2}{16} \Rightarrow \boxed{-8V_1 + 11V_2 = 80} \quad (2)$$

SOLVING EQ. (1) & (2)

$V_1 = 22.353V$

$V_2 = 23.529V$

$$I_{2\Omega} = I = \frac{V_1 - V_2}{2} = \frac{22.353 - 23.529}{2} = -0.588A.$$

7). (a). $V = 60V$

(b). $P = 300W$,

(c). $P_{10\Omega} = 57.6W$.

9). (a) $-7.5V$, ~~(b) 0.15V, (c) 0.5V, (d) −2.5, 0.25 & 2V.~~