SOLUTION

ELEC 3605
1/3

TEST #1, October 3, 2013
4:40-5:50 PM

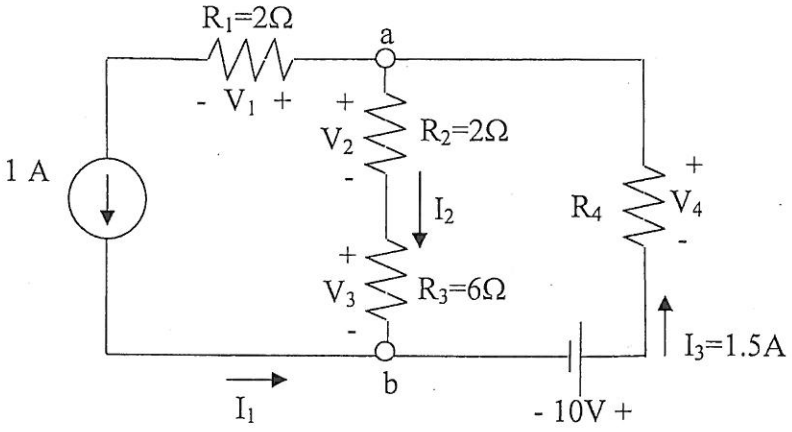
Name_____
Student #_____

Instructions: Answer all 3 questions. Each question is equally weighted.
Answer on the exam questionnaire. Use the back of pages for rough work.

Q1	Q2	Q3	Total

AUTHORIZED MEMORANDA: CALCULATOR, OPEN NOTES, TEXT (Foundations of Electric Circuits). NO COMMUNICATING DEVICES!

Question 1:



a) Apply KCL to find I_2.
b) Apply Ohm's law to find V_{ab}.
c) Calculate the power supplied by the 1A source.
d) Find the value of R_4.

a) At node b) $I_1 + I_2 - I_3 = 0$ ①

$1A + I_2 - 1.5A = 0$ ① $I_2 = 0.5A$

b) $V_{ab} = V_2 + V_3 = I_2(R_2 + R_3)$ ①

$= 0.5A \times (2\Omega + 6\Omega)$ ① $V_{ab} = 4V$

c) KVL: $V_{source} + V_1 - V_{ab} = 0$ ①

$V_{source} = 4V - 1A \times 2\Omega = 2V$ ①

$Power = V \times I = 2V \times 1A$ ① $P_{source} = 2W$

d) KVL: $10V + V_4 - V_{ab} = 0$ ①

$V_4 = 4V - 10V = -6V$ ①

then $R_4 = V_4 / I_3 = 6V / 1.5A$ ① $R_4 = 4\Omega$

10

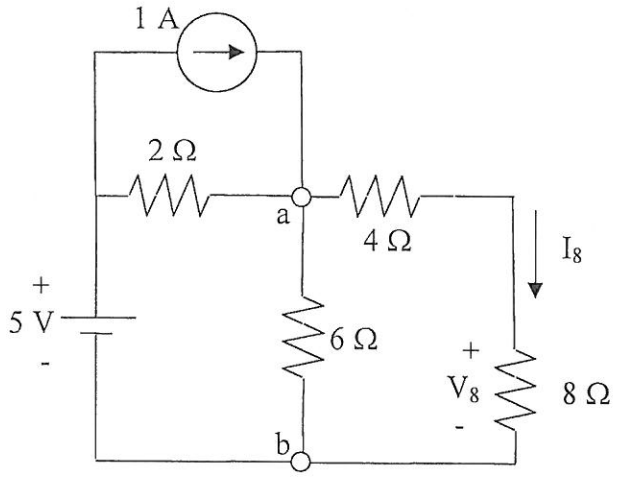
SOLUTION

ELEC 3605
2/3

TEST #1, October 3, 2013
4:40-5:50 PM

Name_____
Student #_____

Question 2:



a) For the 1A source only (voltage source = 0V), use current division to find I_8.
b) For the 5V source only (current source = 0A), use voltage division to find V_8.
c) With **both** sources in the circuit, find the total current through the 8 Ω resistor.
d) With **both** sources in the circuit, find the power delivered to the 8 Ω resistor.

a) $I_8 = 1A \times \frac{R_{eq}}{(4+8)\Omega}$ ① $= 1A \times \frac{2\Omega // 6\Omega // 12\Omega}{12\Omega}$ ① $= 0.111A$ ①

b) $V_8 = V_{ab} \times \frac{8\Omega}{(8+4)\Omega}$ ① $= 5V \times \left(\frac{6\Omega // 12\Omega}{2 + 6\Omega // 12\Omega}\right)\left(\frac{8\Omega}{12\Omega}\right)$ ①

$V_8 = 5V \times \frac{4}{6} \times \frac{8}{12} = \frac{20}{9} V = 2.222V$ ①

c) For the 5V source $I_8 = V_8/R = \frac{2.222V}{8\Omega} = 0.278A$ ①

$I_{8\,total} = 0.111A + 0.278A = 0.389A$ ①

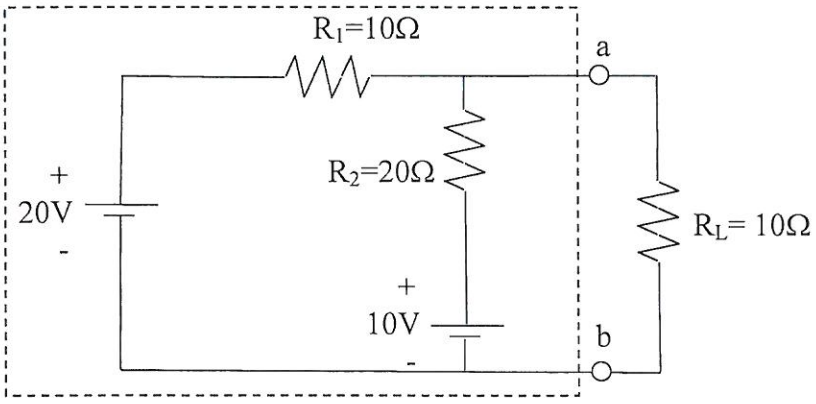
d) $P = I^2R = (0.389A)^2 \times 8\Omega$ ① $= 1.21W$ ①

10

SOLUTION

ELEC 3605 TEST #1, October 3, 2013 Name_____
3/3 4:40-5:50 PM Student #_____

Question 3: R_L is a load resistor.

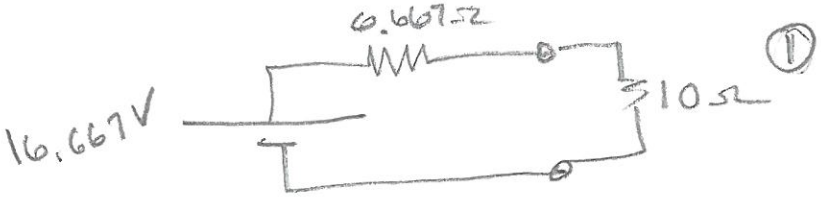


a) Evaluate V_{th} and R_{th}, and draw the Thevenin equivalent for the circuit driving the load resistor R_L.
b) Convert the circuit to a Norton equivalent circuit.
c) Find the power delivered to the load resistor R_L.
d) What value of R_L would result in maximum power dissipated in the load? Calculate the power for this new value of R_L.

a) $V_{oc} = 20V \times \frac{20}{20+10}$ (1) $+ 10V\left(1 - \frac{20}{20+10}\right)$ (1)

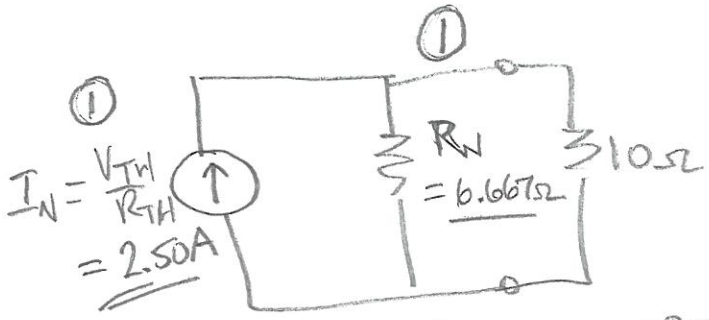
$V_{th} = 16.667V$

$R_{th} = Req\big|_{source=0} = 10\Omega // 20\Omega = 6.667\Omega$ (1)



(1)

b)



c) $P = V^2/R = \left(16.667V \times \frac{10\Omega}{16.667\Omega}\right)^2 / 10\Omega$ (1)

$P_L = 10W$ (1)

d) maximum power
(1) $R_L = R_{th} = 6.667\Omega$

Then
(1) $P_L = \left(16.667V \times \frac{1}{2}\right)^2 / 6.667$

$P_L = 10.417W$

10