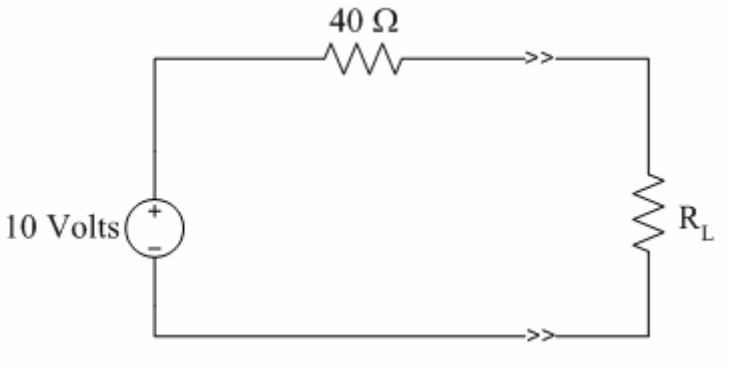
Name : _____ Section:_____ CWRU e-mail:_____

CASE WESTERN RESERVE UNIVERSITY
Case School of Engineering
Department of Electrical Engineering and Computer Science
ENGR 210. Introduction to Circuits and Instruments (4)

Quiz No. 6 2/27/04

PUT ANSWERS IN THE SPACE PROVIDED AND SHOW YOUR WORK IF APPROPRIATE
BE SURE TO STATE ALL ASSUMPTIONS

Problem 1 (10 points)



(a) The power dissipated by R_L will be a maximum for R_L=40 Ω; (3 points)

A source with a fixed Thevenin resistance R_T delivers maximum power to an adjustable load R_L when $R_L=R_T$. Detailed analysis is listed in p.114.

(b) The power dissipated by R_L for R_L=10 Ω is 0.4 Watts;

$$I=\frac{10V}{40\Omega+10\Omega}=0.2A \text{ (2 points)}, \quad P=I^2R=(0.2A)^2\cdot 10\Omega=0.4W \text{ (2 points)}$$

(c) If R_L increases from 10 Ω to 25 Ω, the power dissipated by it will increase;

If R_L=25 Ω, then $I=\frac{10V}{40\Omega+25\Omega}=0.15A$ (2 points), $P=I^2R=(0.15A)^2\cdot 25\Omega=0.59W$ (1 point)

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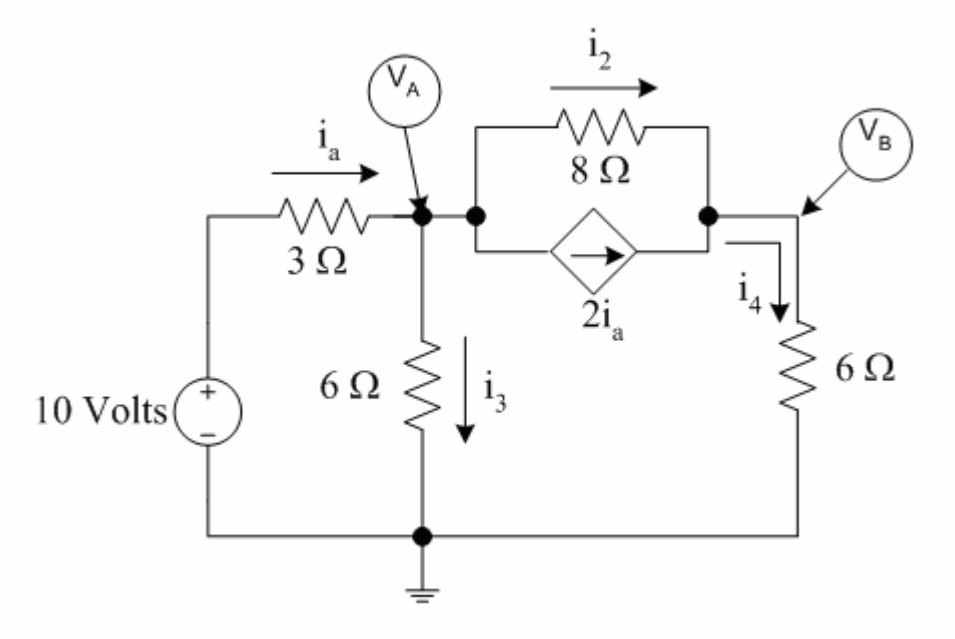
Problem 2 (10 points)
Consider this active circuit.



(a) Write node analysis equations (KCL) for nodes A and B.

$\Sigma I_{in} = \Sigma I_{out}$

At node A: $i_a = i_2 + i_3 + 2i_a$ (2 point)

$i_a = \frac{10V - V_A}{3\Omega}$, $i_2 = \frac{V_A - V_B}{8\Omega}$ and $i_3 = \frac{V_A}{6\Omega}$ (2 points)

So $\frac{10 - V_A}{3} = \frac{V_A - V_B}{8} + \frac{V_A}{6} + 2 \cdot \frac{10 - V_A}{3}$

$\Rightarrow (-\frac{1}{3} - \frac{1}{8} - \frac{1}{6} + \frac{2}{3})V_A + (\frac{1}{8})V_B = -\frac{10}{3} + \frac{20}{3}$

$\Rightarrow \frac{1}{24}V_A + \frac{1}{8}V_B = \frac{10}{3}$ or $V_A + 3V_B = 80$ (1 point)

At node B: $i_2 + 2i_a = i_4$ (1 point) and $i_4 = \frac{V_B}{6\Omega}$ (1 points)

$\frac{V_A - V_B}{8} + 2\frac{10 - V_A}{3} = \frac{V_B}{6}$

$\Rightarrow (\frac{1}{8} - \frac{2}{3})V_A + (-\frac{1}{8} - \frac{1}{6})V_B = -\frac{20}{3}$

$\Rightarrow -\frac{13}{24}V_A - \frac{7}{24}V_B = -\frac{20}{3}$ or $13V_A + 7V_B = 160$ (1 point)

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(b) Find the node voltages for the above circuit values.
So just solve for V_A and V_B from the above two equations:

$$\begin{cases} V_A + 3V_B = 80 \\ 13V_A + 7V_B = 160 \end{cases}$$

$$\Rightarrow \begin{cases} 13V_A + 39V_B = 1040 \\ 13V_A + 7V_B = 160 \end{cases}$$

$$\Rightarrow 32V_B = 880$$

$$\Rightarrow V_B = 27.5V$$ (1 point) and $$V_A = -2.5V$$ (1 point)