KEY

ECE 210 Final Exam **Fall 2000**

Name:

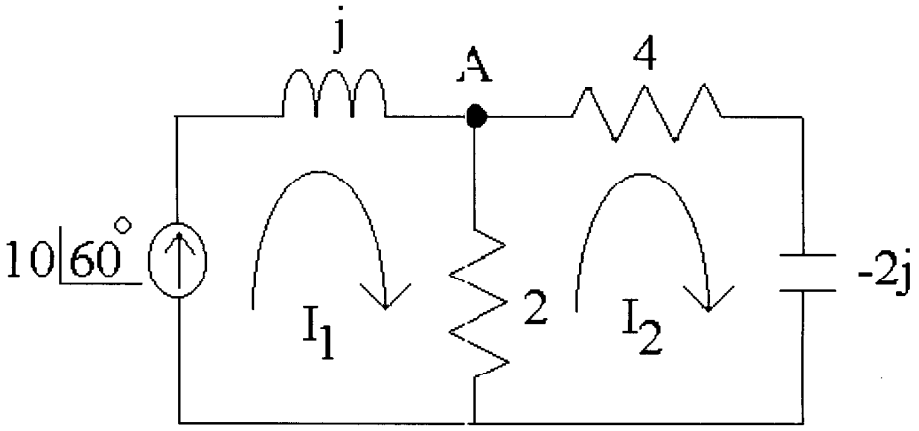
Honor Code:

Instructions:

- Complete the 4 problems in the allotted time.
- Use the space on the accompanying pages to work the problems. Do not use a bluebook. Attach additional worksheets if necessary.
- If you wish to have partial credit awarded for any of your incorrect answers **you must write clearly and legibly.** Explain your work in words, if necessary.
- Don't Panic.

Good Luck.

1. [21 points] For the circuit below,
   a. [4+4 points] Solve for A using nodal equation(s).
   b. [4+4 points] Solve for A using loop equation(s).
   c. [5] Find the Power Absorbed/Delivered to each of the elements.



a. $-10\angle 60 + \frac{A}{2} + \frac{A}{4-2j} = 0$

$\Rightarrow \underline{A} = 14.1421\angle 51.87^\circ$ V

b. $\underline{I_1} = 10\angle 60^\circ$

$-2(\underline{I_1} - \underline{I_2}) + 4\underline{I_2} - 2j\underline{I_2} = 0$

$\underline{I_2} = 3.1623\angle 78.43^\circ$ A

$\underline{A} = (4-2j)\underline{I_2} = 14.142\angle 51.87^\circ$ V

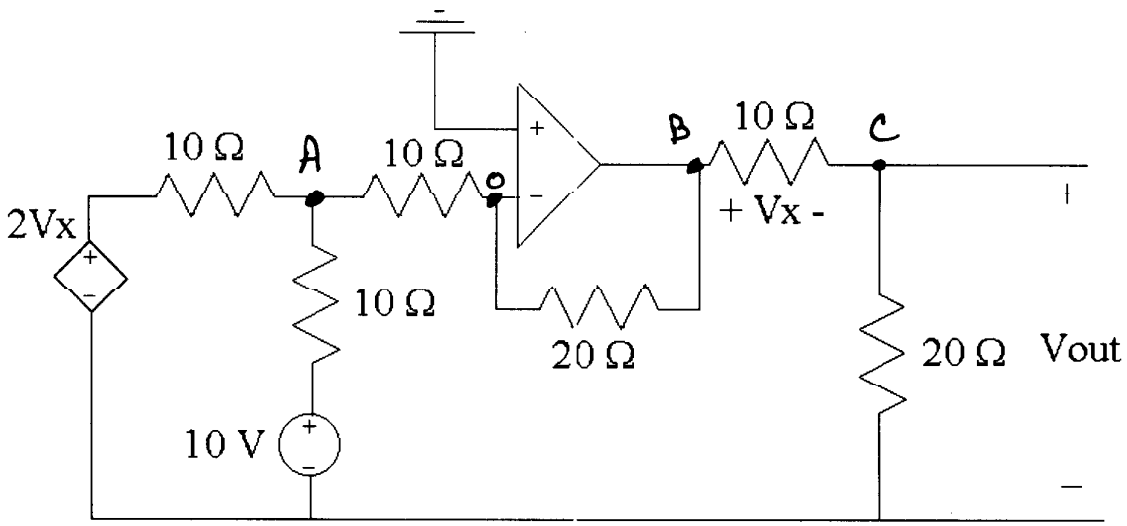
c. $\overline{P}_j = 0$ W, $\overline{P}_{-2j} = 0$ W } Always!

$P_{2\Omega} = \frac{1}{2} V_m^2/R = \left(\frac{1}{2}\right)(14.142^2)/2 = 50$ W

$P_{4\Omega} = \frac{1}{2} I_m^2 R = \left(\frac{1}{2}\right)(3.1623)^2 4 = 20$ W

$P_{10\angle 60^\circ} = -70$ W since $\Sigma P = 0$

2. [12+8] Find the Voltage Vout.



$$\frac{A-2V_x}{10}+\frac{A-10}{10}+\frac{A-0}{10}=0 \Rightarrow 3A-2V_x=10$$

$$\frac{0-A}{10}+\frac{0-B}{20}=0 \Rightarrow 2A+B=0$$

$$\frac{C-B}{10}+\frac{C}{20}=0 \Rightarrow 3C-2B=0$$

$$V_x=B-C \Rightarrow B-C-V_x=0$$

4 eqns. 4 unknowns

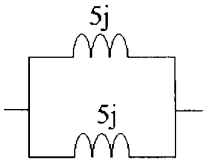
$$C=\frac{-40}{13}\,V$$

3. [25] Choose the best answer.

i. [2] A circuit with sinusoidal input always produces a sinusoidal output.
(a.) True
b. False

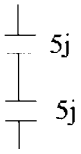
ii. [2] The equivalent single impedance of the following elements is

(a.) 2.5j
b. 10j
c. –10j
d. –2.5j



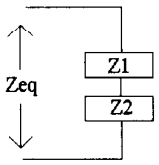
iii. [2] The equivalent single impedance of the following elements is

a. 2.5j
(b.) 10j
c. –10j
d. –2.5j



iv. [2] The equivalent impedance (Zeq) of the two elements Z1 and Z2 is (20+j10) Ohms. They must be:

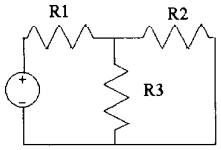
(a.) A resistor & an inductor
b. Two resistors
c. A resistor & a capacitor
d. A capacitor & an inductor



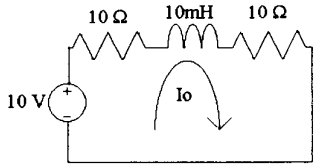
v. [2] 'Transient response' is
a. The response of a circuit after a 'long' time (as t->∞)
(b.) The short-lasting response of a circuit immediately after the power is connected
c. Is only meaningful with DC inputs
d. Both b & c

vi. [2] R_1 and R_2 are in series.

a. True
(b.) False

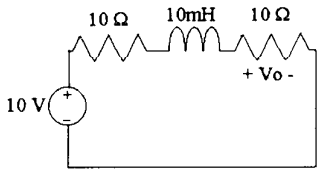


vii. [2] The steady-state current Io is
a. 1 A
b. 5j A
c. $10\angle 0°$ A
(d.) 5 A



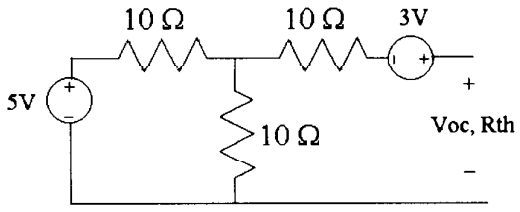
viii. [2] A circuit with DC input produces and output of the form $V_{out} = (K1 - K2e^{-t/\tau})$
(a.) True
b. False

ix. [2] The steady-state voltage Vo is
a. $e^{-.5t}$ V
b. $10\angle 0°$ V
(c.) 5 V
d. 5j V



x. [2] An AC circuit excited by a source with ω=100 Hz may produce an output with ω=200 Hz
a. True
(b.) False

xi. [2] The Thevenin equivalent impedance in the following circuit is



a. 10 Ω
b. 5 Ω
(c.) 15 Ω
d. 50/5 Ω

xii. [3] The Thevenin equivalent voltage in the preceding circuit is
a. 2.5 Volts
(b.) 5.5 Volts
c. 5 Volts
d. –0.5 Volts

4. [20 points]
   a. [8 points] Find Vo in Fig 4-a.
   b. [8 points] Find Io in Fig 4-b.
   c. [4 points] Find Rth in Fig 4-c.

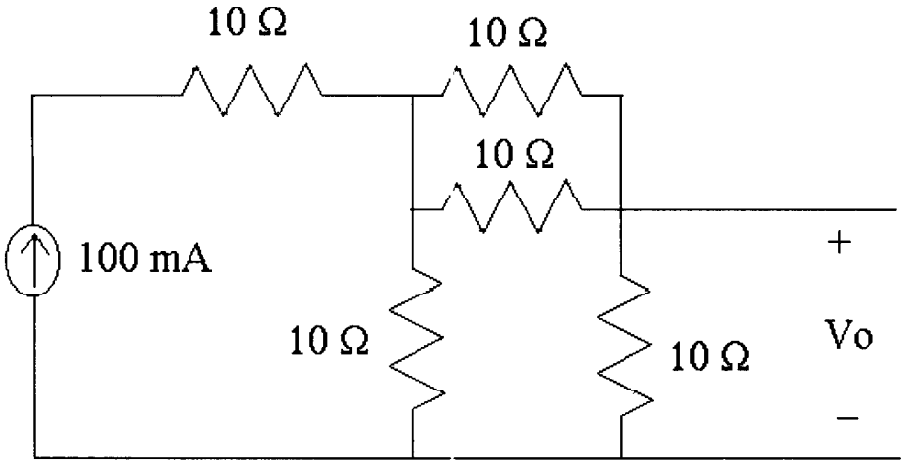


Figure 4-a.

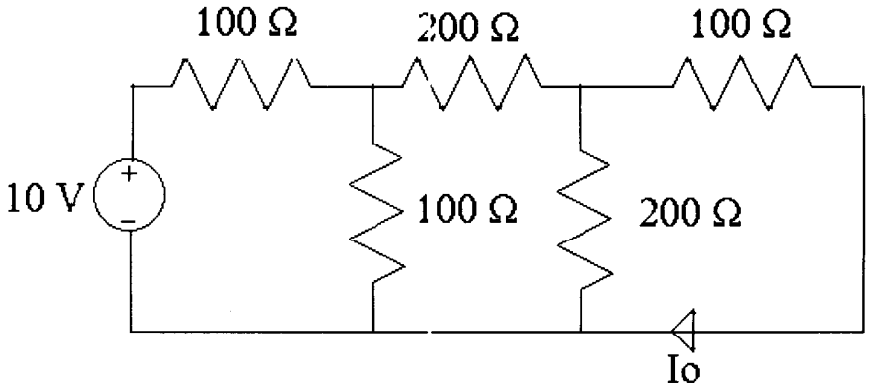


Figure 4-b.

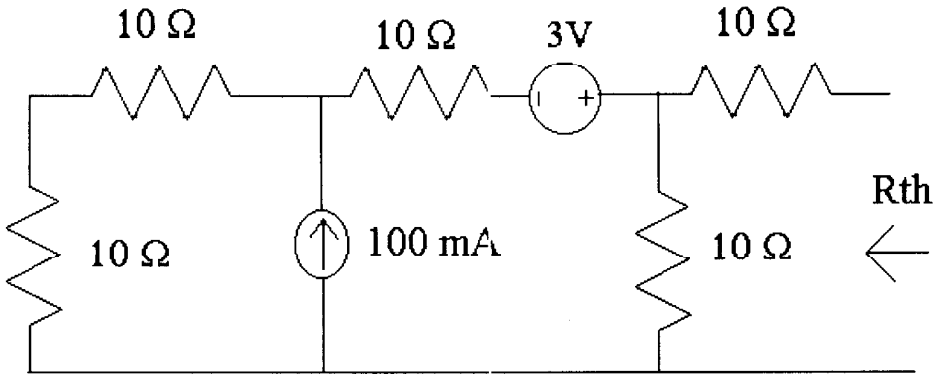
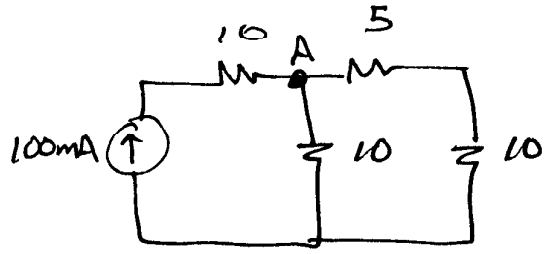


Figure 4-c.

a.

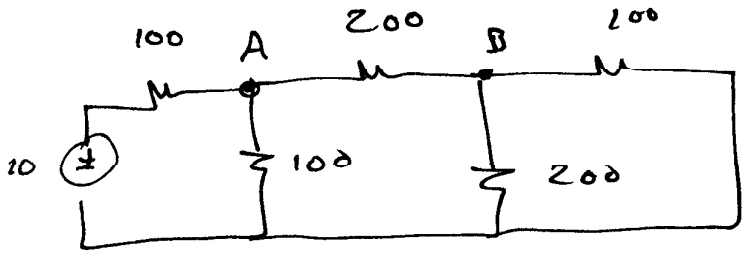


$$-100\,mA + \frac{A}{10} + \frac{A}{15} = 0$$

$$A = \frac{3}{5}\,V$$

$$V_o = \frac{10}{15}A = \underline{0.4\,V}$$

b.



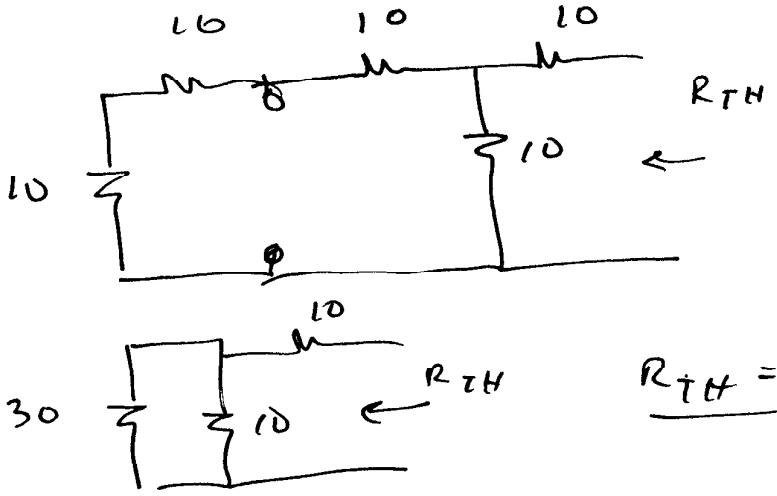
$$\frac{A-10}{100} + \frac{A}{100} + \frac{A-B}{200} = 0 \Rightarrow 5A - B = 20$$

$$\frac{B-A}{200} + \frac{B}{200} + \frac{B}{100} = 0 \Rightarrow -A + 4B = 0$$

$$B = 1.0526\,V$$

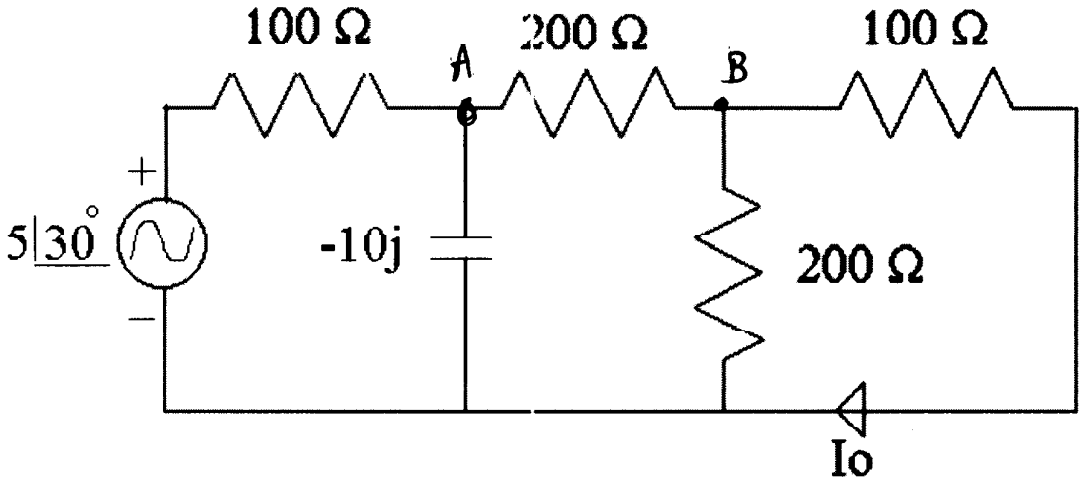
$$I_o = B/100 = \underline{10.52\,mA}$$

C.



$$\underline{R_{TH} = 17.5\,\Omega}$$

5. [13] Find Io in the following circuit



$$\frac{A-5\angle 30}{100}+\frac{A}{-10j}+\frac{A-B}{200}=0$$

$$\frac{B-A}{200}+\frac{B}{200}+\frac{B}{100}=0$$

$$\begin{bmatrix} .015+.1j & -.005 \\ -.005 & .02 \end{bmatrix}\begin{bmatrix} A \\ B \end{bmatrix}=\begin{bmatrix} \frac{5\angle 30}{100} \\ 0 \end{bmatrix}$$

$$B=.123835\angle -52.1709^\circ \quad V$$

$$I_o=B/100 = 1.238\angle -52.1709^\circ \quad mA$$