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UNIVERSITY OF MICHIGAN-DEARBORN

ECE 210 Circuits
Fall 2014 Quiz 2 November 3, 2014
Instructor: Prof. M. Shridhar

Please sign and observe Honor Code

I did not receive or give unauthorized help in this quiz.

STUDENT ID:

M. Shridhar

NAME: Signature

Answer all questions. Write your answer in the space provided below the question. Use the **FACING** side to continue your answers. All rough work should be turned in. Partial credit is given if all steps are clearly described.

NOTE: THIS QUIZ TESTS YOU ON YOUR ABILITY TO ANALYZE AC AND DC LINEAR CIRCUITS, USING NETWORK REDUCTION, AND NODAL ANALYSIS.

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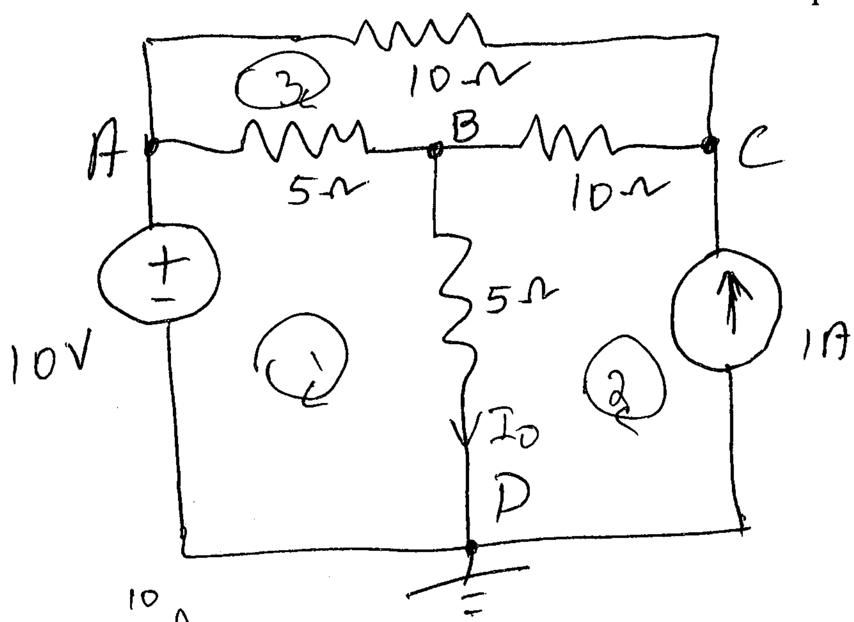
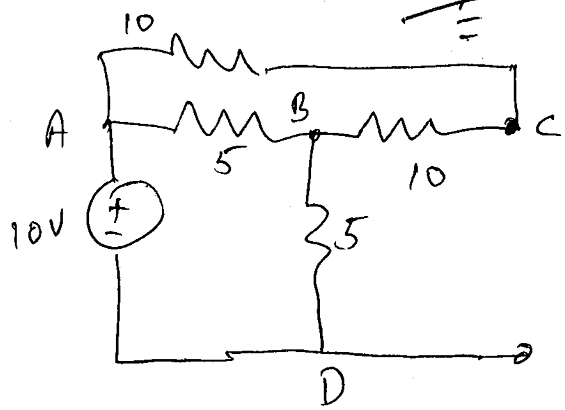
1. Using superposition find the current I_o. Show all the steps.



1)



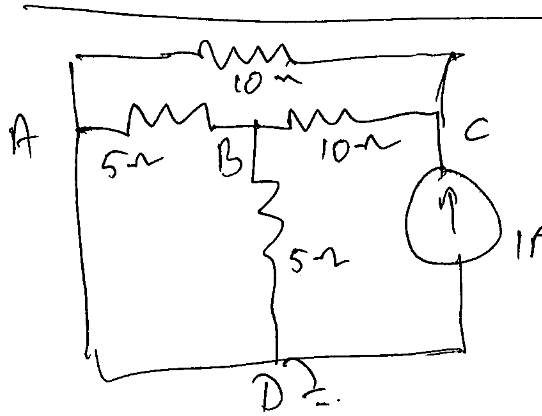
$$B: \quad \left(\frac{1}{5}+\frac{1}{5}+\frac{1}{10}\right)V_B - \frac{1}{10}V_C = 2 \Rightarrow 5V_B - V_C = 20$$

$$C: \quad -\frac{1}{10}V_B + \left(\frac{1}{10}+\frac{1}{10}\right)V_C = 1 \Rightarrow -V_B + 2V_C = 10$$

$$10V_B - 2V_C = 40$$

$$9V_B = 50 \Rightarrow V_B = \frac{50}{9}$$

$$I_{o1} = \frac{10}{9}A$$



$V_A = 0$

$$B: \left(\frac{1}{5}+\frac{1}{5}+\frac{1}{10}\right)V_B - \frac{1}{10}V_C = 0 \rightarrow 5V_B - V_C = 0$$

$$C: -\frac{1}{10}V_B + \left(\frac{1}{10}+\frac{1}{10}\right)V_C = 1 \rightarrow -V_B + 2V_C = 10$$

$$10V_B - 2V_C = 0$$

$$9V_B = 10$$

$$V_B = \frac{10}{9}$$

$$I_{o2} = \frac{2}{9}$$

$$I_o = \frac{10}{9} + \frac{2}{9} = \frac{12}{9} = 4/3\,A$$

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2. Write node and loop equations that will allow you to find V_B and V_C. Show all steps clearly and legibly. Find V_B and V_C using one of the two methods. Use the circuit of Q1.

B: $\left(\frac{1}{5}+\frac{1}{5}+\frac{1}{10}\right)V_B - \frac{1}{10}V_C = \frac{10}{5} \rightarrow \underline{5V_B - V_C = 20}$

C: $-\frac{1}{10}V_B + \left(\frac{1}{10}+\frac{1}{10}\right)V_C = \frac{10}{10}+1$

$-V_B + 2V_C = 20$

$10V_B - 2V_C = 40$

$9V_B = 60 \Rightarrow V_B = \frac{60}{9} = \frac{20}{3}$

$V_C = 5V_B - 20$

$\frac{100}{3} - \frac{60}{3} = \frac{40}{3}$ V

$V_B = \frac{20}{3}$ V

$V_C = \frac{40}{3}$ V

Loop $I_2 = -1A$

Loop1: $10I_1 - 5I_2 - 5I_3 = 10 \Rightarrow 10I_1 - 5I_3 = 5$

Loop3: $-5I_1 - 10I_2 + 25I_3 = 0 \Rightarrow -5I_1 + 25I_3 = -10$

$-10I_1 + 50I_3 = -20$

$45I_3 = -15 \Rightarrow I_3 = -\frac{1}{3}$

$10I_1 = 5 + 5I_3 = 5 - \frac{5}{3} = \frac{10}{3}$

$I_1 = 1/3 A$

$V_B: 5(I_1 - I_2) = 5\left(\frac{1}{3}+1\right) = 5\cdot\frac{4}{3} = \underline{\frac{20}{3} V}$

$V_C = 5(I_1 - I_2) + 10(I_3 - I_2) = 5I_1 - 15I_2 + 10I_3$

$5/3 + 15 - \frac{10}{3} = \underline{\frac{40}{3} V}$

$I_0 = \frac{V_B}{5} = \frac{20}{15} = \underline{\frac{4}{3} A}$

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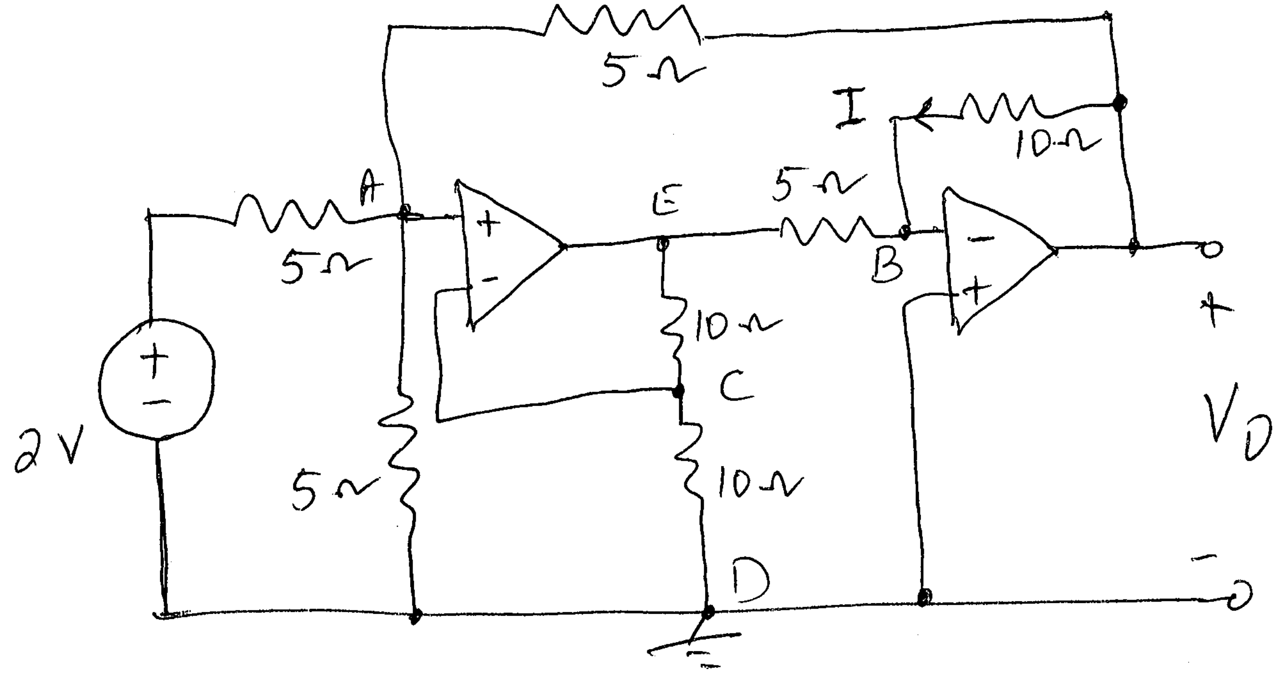
3. Find the current I in the circuit shown below. Show all steps clearly.



$V_A = V_C = \frac{V_E}{2}$ $V_B = 0$

A: $\frac{V_A - 2}{5} + \frac{V_A}{5} + \frac{V_A - V_O}{5} = 0$

$\left(\frac{1}{5} + \frac{1}{5} + \frac{1}{5}\right)V_A - \frac{1}{5}V_O = \frac{2}{5}$

$3V_A - V_O = 2$

B: $\frac{V_B - V_E}{5} + \frac{V_B - V_O}{10} = 0$

$-\frac{V_E}{5} - \frac{V_O}{10} = 0$ $\frac{V_O}{10} = -\frac{V_E}{5}$, $V_O = -2V_E$

$V_O = -2V_E$, $V_A = \frac{V_E}{2} = -\frac{1}{4}V_O$

$V_E = -\frac{1}{2}V_O$

$-\frac{3}{4}V_O - V_O = 2$

$-\frac{7}{4}V_O = 2$, $V_O = -\frac{8}{7}V = -\frac{8}{7}V$

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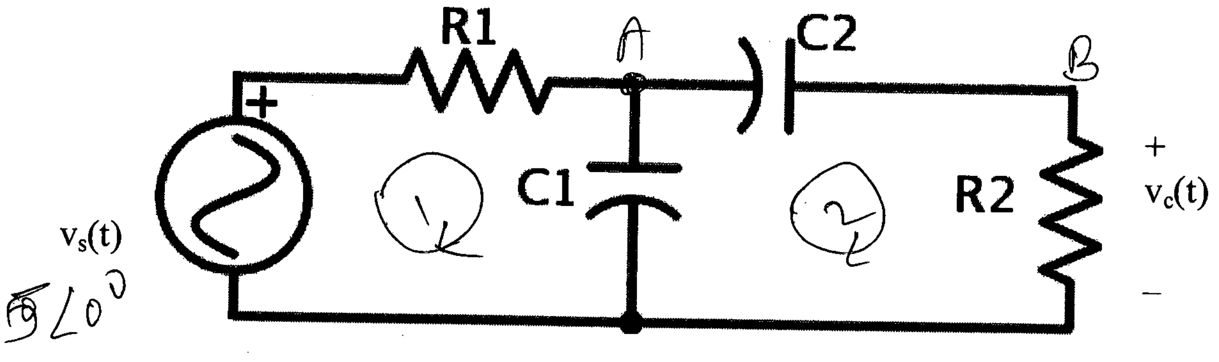
4. Find $v_c(t)$ for the circuit shown below. How many ways can you solve this problem. List them. Choose one method, write the equations and find $v_c(t)$. Show all the steps.



R1 = 2Ω, R2 = 4 Ω, C1 = 0.5F, C2 = 0.25F

$V_s(t) = 5\cos(t)$, $\omega = 1$ r/s

$C_1 = 0.5F \rightarrow \frac{1}{j\omega C} = \frac{-j}{0.5} = -j2$

$C_2 = 0.25F \rightarrow \frac{1}{j\omega C} = \frac{-j}{0.25} = -j4$

1) Loop
2) Node
3) Network reduction

Loop 1: $(2 - j2)I_1 + j2I_2 = 5\angle 0^\circ$

Loop 2: $(4 - j6)I_2 + j2I_1 = 0$

Node A: $\left(\frac{1}{-j2} + \frac{1}{2} + \frac{1}{-j4}\right)V_A - \frac{1}{-j4}V_B = \frac{5\angle 0}{2}$

B: $-\frac{1}{-j4}V_A + \left(\frac{1}{4} + \frac{1}{-j4}\right)V_B = 0$

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