CSE 232 Midterm Exam, November 18, 2021

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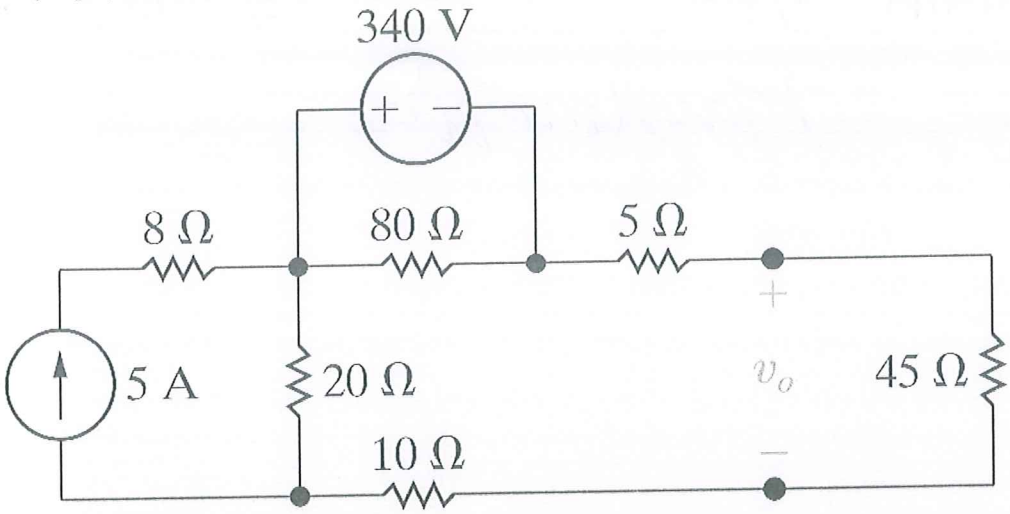
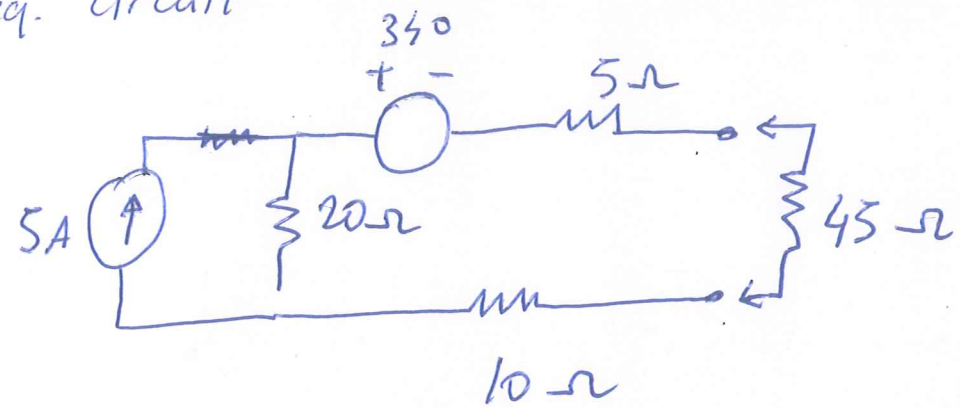
Soo easy

CSE 232 Midterm Exam, November 18, 2021

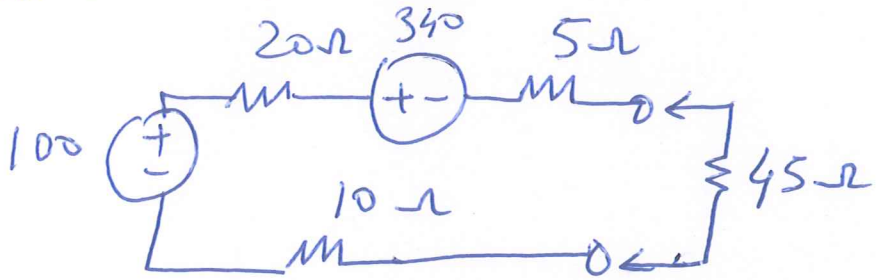
1. (20 pts) Find v_o using source transformations



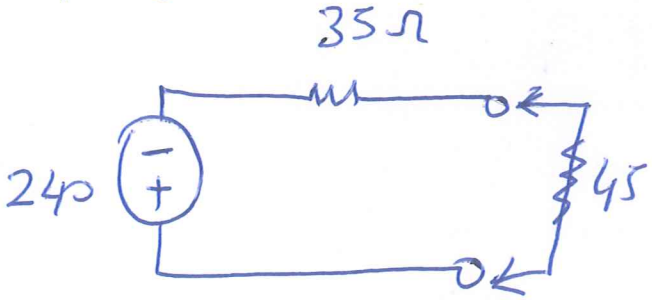
eq. circuit



Source transformation



Simplify



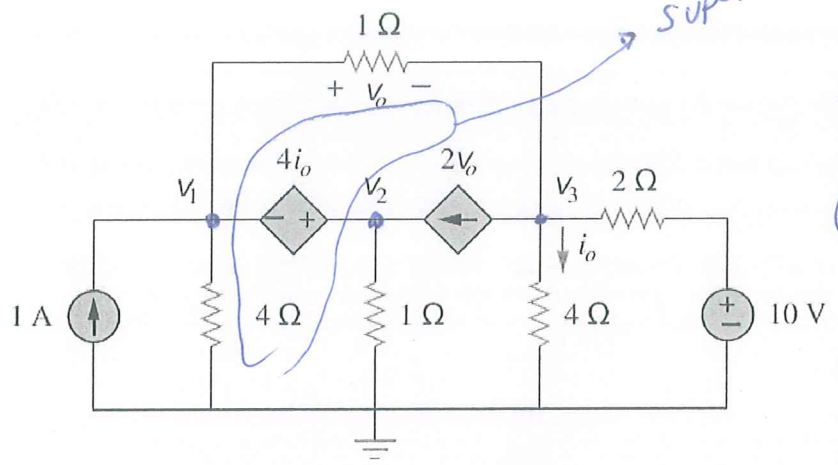
Voltage division

$$V_o = \frac{-240}{35+45} \cdot 45$$

$$\boxed{V_o = -135\,V}$$

CSE 232 Midterm Exam, November 18, 2021

2. (20 pts) Determine the node voltages, for the circuit given below



super node

note:

$i_o = \frac{v_3}{4}$

$v_o = v_1 - v_3$

$v_2 - v_1 = 4i_o$

v_3

v_o

$$(I-II) \quad -1 + \frac{v_1}{4} + \frac{v_1 - v_3}{1} - 2v_o + \frac{v_2}{1} = 0$$

insert $v_3 = v_2 - v_1$

$$\boxed{-7v_1 + 8v_2 = 4}$$

$-v_o$

$$(III) \quad 2v_o + \frac{v_3}{4} + \frac{v_3 - 10}{2} + \frac{v_3 - v_1}{1} = 0$$

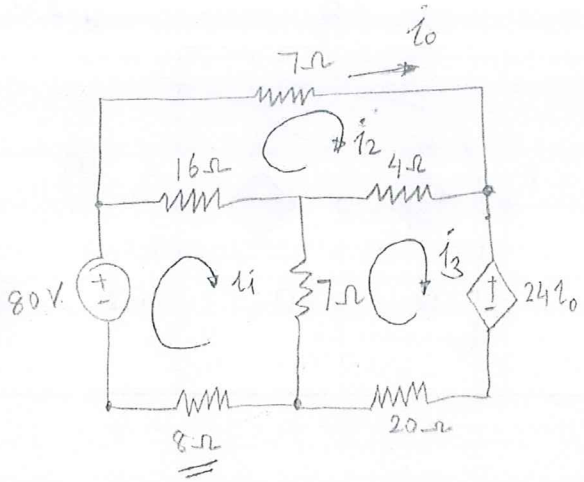
$$\rightarrow \boxed{5v_1 - v_2 = 20}$$

Solve for v_1, v_2 & v_3

$$\boxed{\begin{aligned} v_1 &= 4 \\ v_2 &= 4 \\ v_3 &= 0 \end{aligned}}$$

CSE 232 Midterm Exam, November 18, 2021

3. (20 pts) Apply mesh analysis to find the mesh current equations and find the total power dissipated on the 8 Ohm resistor for the circuit given below



$$(I) \quad -80 + 31i_1 - 16i_2 - 7i_3 = 0$$

$$(II) \quad -16i_1 + 27i_2 - 4i_3 = 0$$

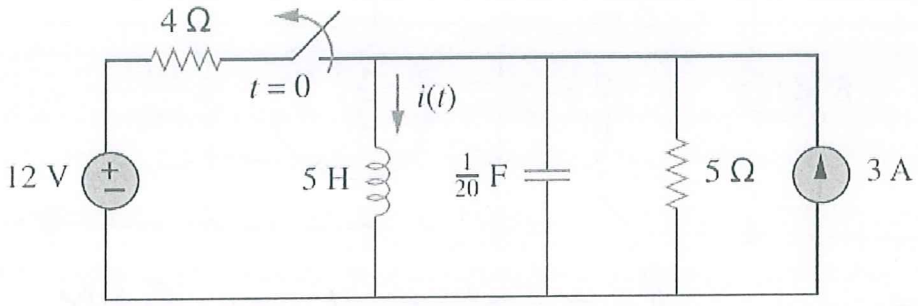
$$(III) \quad -7i_1 - 4i_2 + 31i_3 + 24i_2 = 0$$

$$\Rightarrow i_1 = 3.5A$$

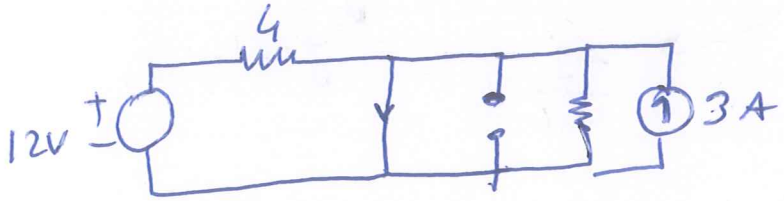
$$P_{8\Omega} = (3.5)^2 \cdot 8 = 98 \text{ W}$$

CSE 232 Midterm Exam, November 18, 2021

4. (20 pts) The switch in the circuit given below has been on for a very long time and at time, $t=0$ is turned off. Determine $i(t)$ for $t>0$



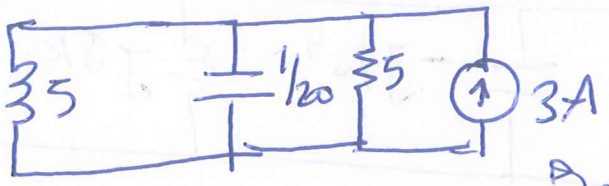
$t<0$ $L \to$ S.C., $C \to$ O.C.



$V_C(0^+) = 0$

$i_L(0^+) = 6\,A$

$t>0$



RLC (parallel)

$\alpha = \frac{1}{2RC}$

$\omega_0 = \frac{1}{\sqrt{LC}}$

$i_L(\infty) = 3A$

$V_L(\infty) = 0V$

$\alpha = 2$, $\omega_0 = 2$ } critically damp

$i_L = D_1 \cdot e^{-2t} + D_2 t e^{-2t} + 3$

use $i_L(0) = 6 \to D_1 = 3$

use $L\frac{di}{dt} = V(0) \to -2D_1 e^{-2t} + D_2 e^{-2t} - 2D_2 t e^{-2t} = 0$

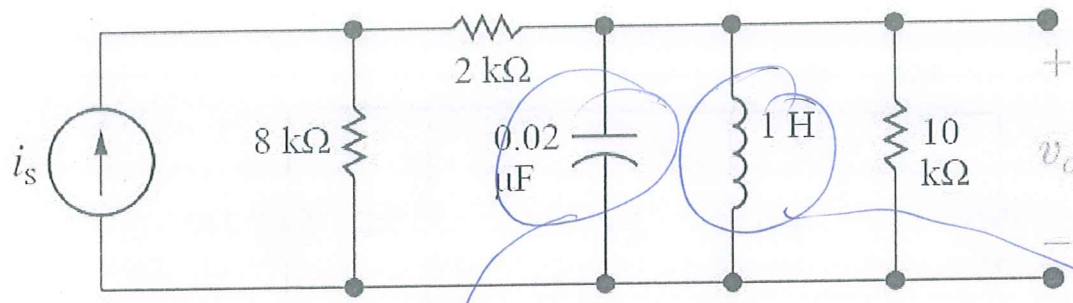
$-2D_1 + D_2 = 0 \Rightarrow D_2 = 6$

$\Rightarrow i_L(t) = 3e^{-2t} + 6te^{-2t} + 3$

CSE 232 Midterm Exam, November 18, 2021

5. (20 pts) Find $v_0(t)$ (time domain representation) for $i_s=12.5\cos(5000t)$ (mA). Use phasor!

from the slides



$\omega = 5000$

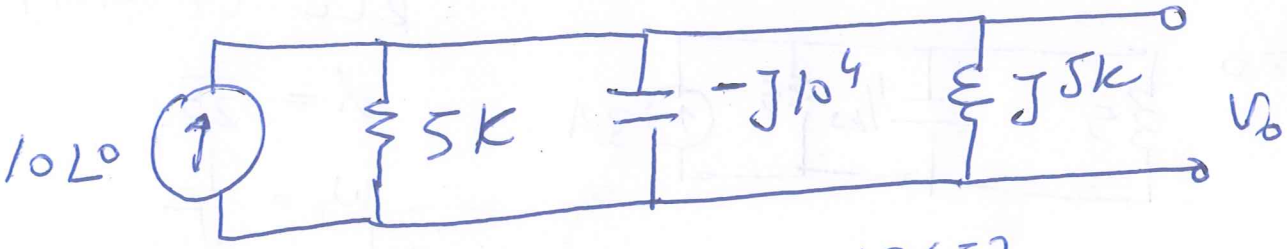
i_s → real part as cosine

$i_s = 12.5 \angle 0^\circ$

use phasor

$\frac{-j}{\omega C}$ → $j\omega L$

use source transformation to obtain



$$Z_{eq} = \frac{1}{0.224 \times 10^{-3} \angle -26.57} \rightarrow Y_{eq}$$

$$V_o = \bar{I} \cdot Z_{eq}$$

(phasor)

$$\rightarrow V_o = 44.64 \angle 26.57$$

In time domain

$$V_o = 44.64 \cdot \cos(5000t + 26.57) \text{ Volts}$$