LEHIGH UNIVERSITY

DEPT. OF ELECTRICAL & COMPUTER ENGINEERING

ECE 083 – SPRING 2013

EXAM #2

WEDNESDAY 27 MARCH 2013

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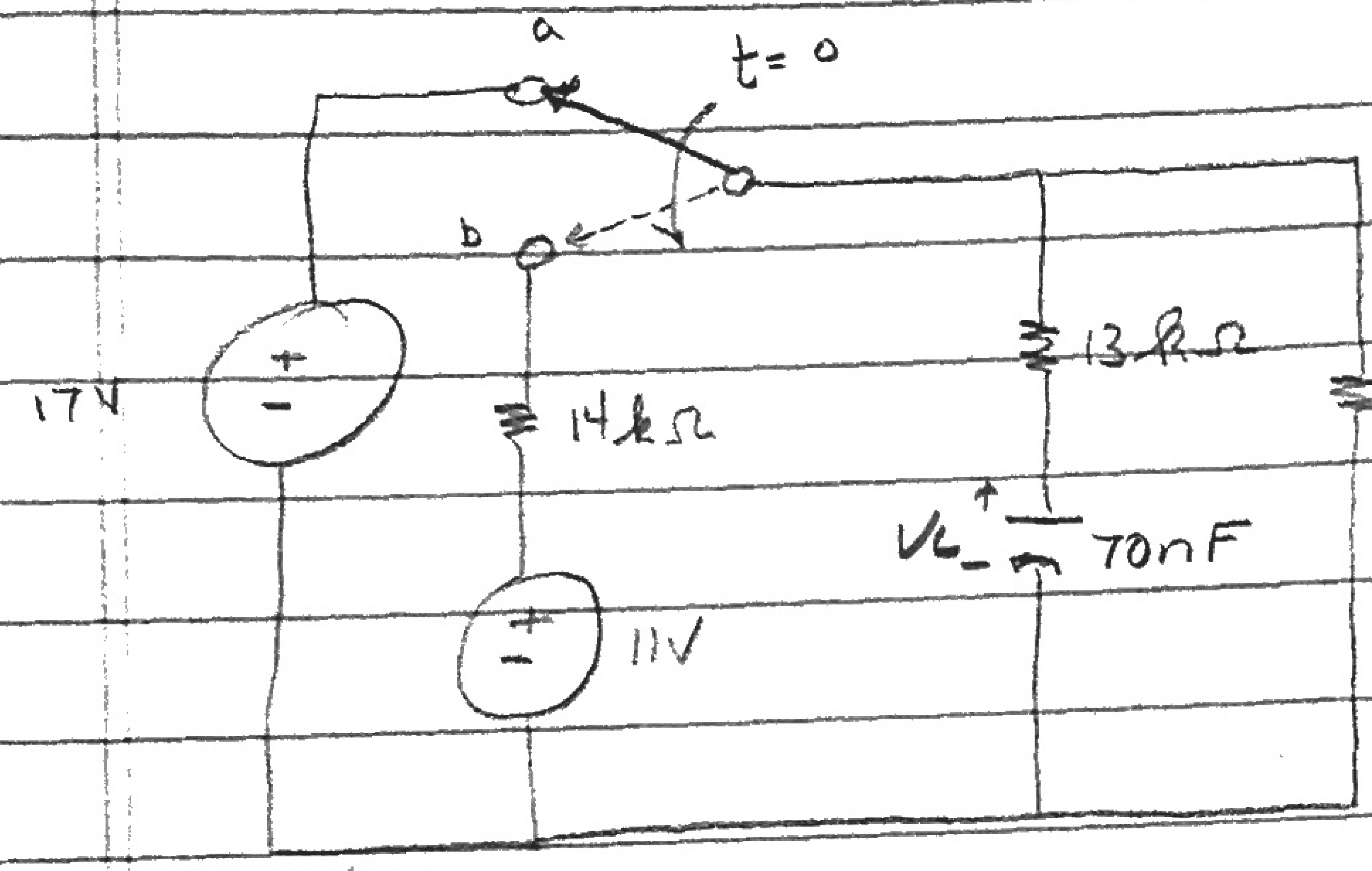
#1 For the Given Circuit Find $v_c(t)$ For $t > 0$.



Note: Circuit Has Been @ a For A Long Time Before it Switches.

$V_c(0) = V_s = 17\ V$

$\tau = RC$

$R_{eq} = (4550)(70 \times 10^{-9} F) = 3.185 \times 10^{-4}\ s$

$V_c(t) = I_sR + (V_1 - I_sR)e^{-t/RC}$

$11 + (17 - 11)e^{-t/3.185 \times 10^{-4}}$

$V_c(t) = 11 + 6e^{-3139.716}$

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#2 Given $v_1(t)$, $v_2(t)$ and $v_3(t)$ Find $v_f(t)$

If $v_f(t) = v_1(t) + v_2(t) + v_3(t)$

$v_1(t) = 40\cos(60t-30)$

$v_2(t) = 60\cos(60t+45)$

$v_3(t) = 90\sin(60t-75) \rightarrow 90\cos(60t-165°)$

$V_1(t) = 40\angle -30 \rightarrow 40(\cos(-30) + j\sin(-30)) = 34.64 - 20j$

$V_2(t) = 60\angle 45 \rightarrow 60(\cos(45) + j\sin(45)) = 42.42 + j42.42$

$V_3(t) = 90\angle -165 \rightarrow 90(\cos(-165) + j\sin(-165)) = -86.93 - j23.29$

adding these $\rightarrow$ $-9.87 - j.87$

$$\sqrt{(-9.87)^2 + (.87)^2} = 9.908$$

$$\tan^{-1}\left(\frac{-.87}{-9.87}\right) = 5.037$$

$$9.908\cos(60t + 5.037) = Vf(t)$$

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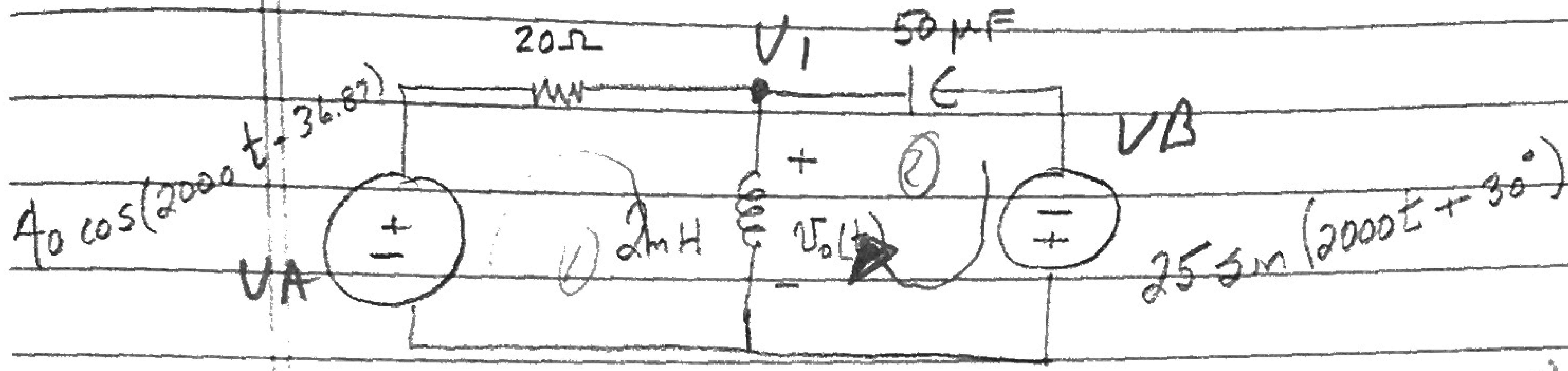
answer ~~on~~ On Back

#3 For the Given Circuit Find $V_o(t)$.



$40\cos(2000t - 36.87)$ $\qquad$ $25\sin(2000t + 30°)$

$= 40\angle -36.87$ $\qquad$ $= 25\angle -60°$

$= 31.99 - j24$ $\qquad$ $12.5 - j21.65$

total V in outer loop $= 44.5 - j45.65 = 63.75\angle -45.73$

Look Down

$Z_{eq} \rightarrow 20\Omega,\ j(2\times10^{-3})(2000),\ -j\left(\frac{1}{(2000)(50\times10^{-6})}\right)$

$= 20\ s\ j4 \parallel -j10 = 20 + j6.666$

~~$V_o(t) = 44.5\cos(2000t - 45.73)$~~

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~~solve for V_1~~

node

$$\frac{V_1 - V_A}{20} + \frac{V_1}{j4\Omega} + \frac{V_1 + V_A}{-j10} = 0$$

$$\frac{V_1 - (31.94 - j24)}{20\Omega} + \frac{V_1}{j4\Omega} + \frac{V_1 + (12.5 - j21.65)}{-j10} = 0$$

$$V_1\left(\frac{-31.94 - j24}{20\Omega}\right) + \frac{1}{j4\Omega} + \cancel{\frac{12.5 - j21.65}{-j10}}$$

$$V_1 - 1.597 - j24 + \frac{V_1}{j4} + \cancel{V_1} + 1.25j\angle 30$$

Back

~~1.08~~ $+ j.625)$

$$V_1 - .517 - j23.375 + \frac{V_1}{j4} = 0 \qquad V_1 = j4(-.517 - j23.375) =$$

$4 \angle 90 \; (23.38 \angle 88.7324)$

$93.522 \angle 178.7324 = V_0$

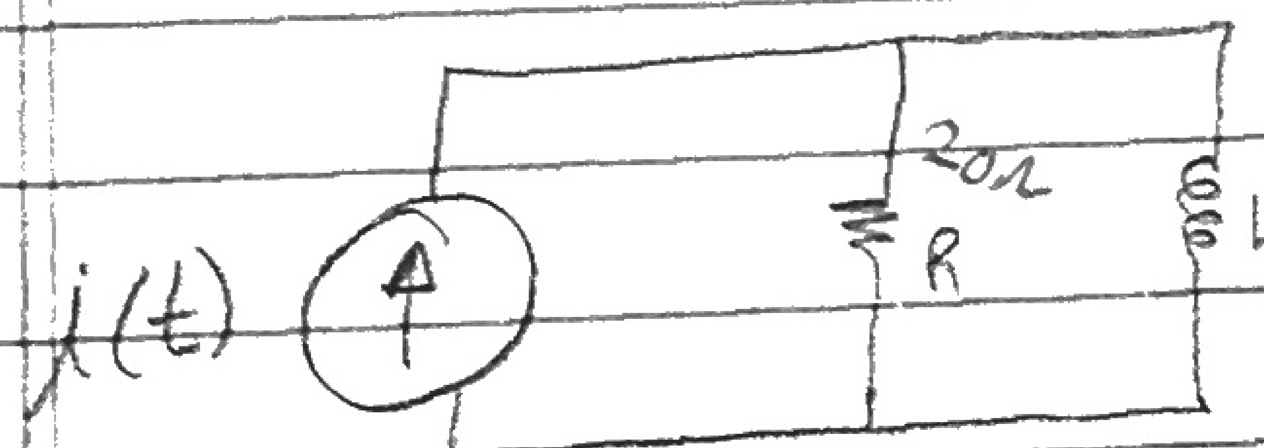
$$V_0 = 93.522 \cos(2000t + 178.7724)$$

#4 For the Circuit Shown $i(t) = 1.25 \overset{\cos}{(5t - 15°)}$ A (RMS)

a) What is the Value of the Complex Power Associated with the Source if $R = 20\Omega$ & $L = 3H$?

b) What are the Values of R & L if the Power Associated with the Source is: $S = 16.57\angle 45°$?

$S = Q + P$



so, Find Q + P on part A

a) impedance $j(5)(3) = 15j$

$z_{eq} = \frac{1}{20\Omega} + \frac{1}{j15\Omega} = \frac{1}{\text{ans}} = 20 + j15\Omega$

$V = Iz \rightarrow (1.25\angle 15)(20 + j15) \rightarrow (1.25\angle 15)(25 + \angle 36.86)$

$V = 31.25 + \angle 51.86$

$P = V_{rms} I_{rms} \cos(\theta_v - \theta_i) \rightarrow (31.25)(1.25)\cos(51.86 - 15)$

$= 31.25$ Watts

$Q = V_{rms} I_{rms} \sin(\theta_v - \theta_i) = 23.432$ VAR

$\boxed{S = 31.25 + j23.432 \ \cancel{X}V.A}$

b) $16.57\angle 45° = P + Q$ $\quad 1.25(R + jL)$

We know R will be Real Power and Q will be Reactive Power

SO, $16.57\angle 45 \rightarrow 11.716 + j11.716$

Real $\rightarrow$ $11.716 = V_{Rms} I_{Rms} \cos(\theta)$ $\rightarrow$ $V_{Rms} = 13.255$ V $\quad \theta = 45$ for this to be true

Reactive $\rightarrow$ $11.716 = V_{Rms} I_{Rms} \sin(\theta)$ $\rightarrow$

Back

$$\frac{RL}{R+L} = Z$$

$S = P + Q$

$P = (I)^2(Z)\cos(\theta_v - \theta_i) = 1.25^2(Z)\cos(45) = 11.716$

$Q = (I)^2(Z)\sin(\theta_v - \theta_i) = (1.25)^2(Z)\sin(45) = 11.716$ s

$$10.604 = Z = \frac{RL}{R+L}$$

$10.604R + 10.604L = RL$

$Z = \omega L$

$L = \frac{Z}{\omega}$

$R = 10.604\ \Omega$

$L = 2.1208$ H