8.41

$t < 0 \quad V_0 = 100V \quad I_0 = 5A$

$$\alpha = \frac{1}{2RC} = \frac{1}{2(50)(25 \times 10^{-6})} = 400 \text{ rad/s}$$

$$\omega_0 = \sqrt{\frac{1}{LC}} = \sqrt{\frac{1}{(160 \times 10^{-3})(25 \times 10^{-6})}} = 500$$

$\alpha^2 < \omega_0^2 \Rightarrow$ underdamped

$$\omega_d = \sqrt{500^2 - 400^2} = \boxed{300}$$

8.22

$$\omega_0 = \sqrt{\frac{1}{LC}} = \sqrt{\frac{1}{(25\times10^{-3})(62.5\times10^{-6})}} = 800 \text{ rad/s}$$

$$\alpha = \frac{1}{2RC} = \frac{1}{25\,(62.5\times10^{-6})} = 640 \text{ rad/s}$$

$$\omega_d = \sqrt{800^2 - 640^2} = 480$$

$$I_F = 2A$$

$$i_L = 2 + B_1' e^{-640t}\cos 480t + B_2' e^{-640t}\sin 480t$$

$$i_L(0) = 2 + B_1' = 0 \Rightarrow \omega_d B_2' + (-\alpha B_1') = \frac{di_L}{dt}(0) = V_0/L$$

$$B_1' = -1 \qquad B_2' = 2.83$$

$$640 + 480 B_2' = 50/25\times10^{-3}$$

$$i_L(t) = 2 - e^{-640t}\cos 480t + 2.83\, e^{-640t}\sin 480t \text{ A} \qquad t \geq 0$$

8.35) $t<0$

$v_0 = v_0(0^-) = v_0(0^+) = \frac{3000}{4000}100 = 75\ V$

$i_0 = i_L(0^-) = i_L(0^+) = 100\ mA$

$t>0$

$\alpha = \frac{1}{2RC} = \frac{1}{80(25\times10^{-6})} = 500\ rad/s$

$\omega_0 = \sqrt{\frac{1}{(25\times10^{-2})(25\times10^{-6})}} = 600$

$s_{1,2} = -500 \pm \underbrace{\sqrt{500^2+400^2}}_{300} \doteq -200, -800$

Same eqv: twice

[a] $i_L = i_F + A_1 e^{-200t} + A_2 e^{-800t} \Rightarrow i_F = 100\ mA$

$i_L(0) = 0.1 + A_1 + A_2 = 0.1$, $A_1 + A_2 = 0$

$\frac{di_L}{dt}(0) = -200A_1 - 800A_2 = \frac{v_0}{L} = \frac{75}{0.125} = 300$

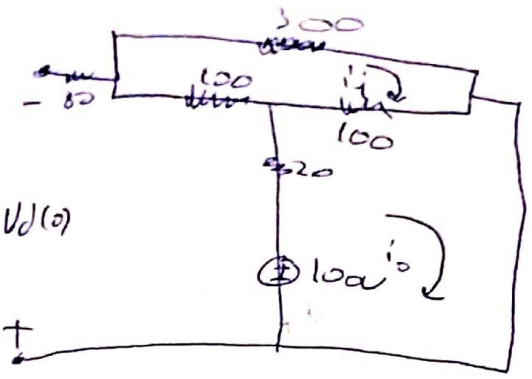
$A_1 = 0.5 \qquad A_2 = -0.5$

$i_L(t) = 0.1 + 0.5e^{-200t} - 0.5e^{-800t}\ A$

[b] $v_L(t) = v_L(t) = L\frac{di_L}{dt} = (0.25)(-100e^{-200t} + 400e^{-800t})$

$= -25e^{-200t} + 100e^{-800t}\ V \quad t \geq 0$

8.47 $t < 0$



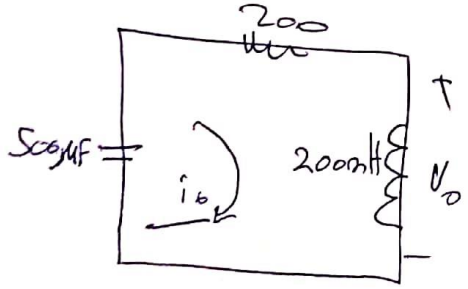
$500 i_1 - 100 i_0 = 0$ $\quad -100 i_1 + 120 i_0 = 100$

$i_1 = 0.2A$ $\quad i_0 = 1A$

$V_0 = -100 + 20 i_0 + 100 i_1$

$= 60V$

$t > 0$



$\alpha = \frac{R}{2L} = \frac{20}{2(0.2)} = 500$

$\omega_0 = \sqrt{\frac{1}{(0.4)(36.25 \times 10^{-6})}} = 400$

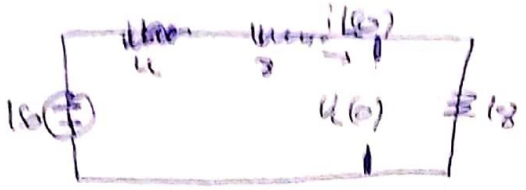
$s_{1,2} = -100 \pm \sqrt{500^2 - 400^2}$

$= -200, -800$ rad/s

$i_0 = A_1 e^{-200t} + A_2 e^{-800t}$

$i_0(0) = A_1 + A_2 = 1$

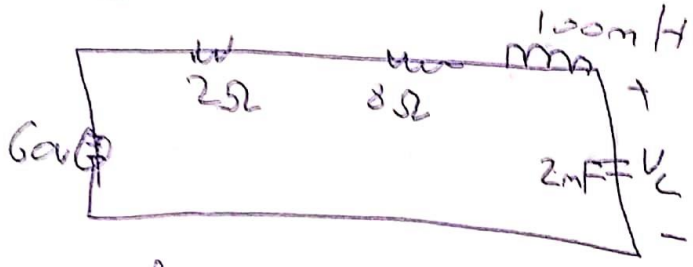
8.54 | $t<0$



$$i(0) = \frac{-150}{30} = -5A$$

$$v_c(0) = 18 i(0) = -90V$$

$t>0$



$$\alpha = \frac{R}{2L} = \frac{10}{0.2} = 50 \text{ rad/s}$$

$$\omega_0^2 = \frac{1}{0.1(2\times10^{-3})} = 5000$$

$$s_{1,2} = -50 \pm \sqrt{50^2 - 5000} = -50 \pm j50$$

$$v_c = 60 + B_1' e^{-50t}\cos 50t + B_2' e^{-50t}\sin 50t$$

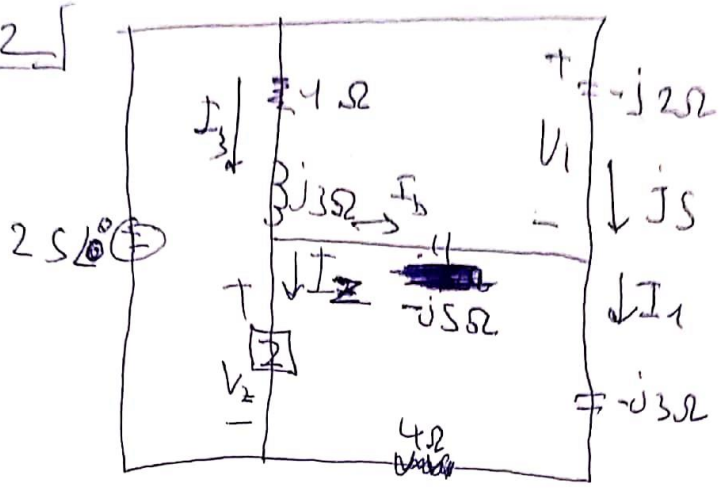
$$v_c(0) = -90 = 60 + B_1' \Rightarrow B_1' = -150$$

$$C\frac{dv_c}{dt}(0) = -5 \qquad \frac{dv_c}{dt}(0) = \frac{-5}{2\times10^{-3}} = -2500$$

$$-50B_1' + 50B_2' = -2500 \Rightarrow \boxed{B_2' = -200}$$

$$v_c = 60 - 150e^{-50t}\cos 50t - 200e^{-50t}\sin 50t \text{ V} \qquad t>0$$

9.32



$V_1 = j5(-j2) = 10V$

$-25+10+(4+j3)I_1 = 0 \Rightarrow I_1 = \frac{15}{4+j3} = 2.4 + j1.8\ A$

$I_b = I_1 - j5 = (2.4 + j1.8) - j5 = 2.4 - j3.2\ A$

$V_2 = -j5I_2 + (4-j3)I_1 = -j5(2.4 - j3.2) + (4-j3)(2.4+j1.8)$

$-1 - j12 V - 25 + (1+j3)I_3 + (-1-j12) = 0 \quad I_3 = 6.2 - j6.6\ A$

$I_2 = I_3 - I_2 = 3.8 - j3.4\ A$

$Z = \frac{V_2}{I_2} = 1.42 - j1.188\ \Omega$

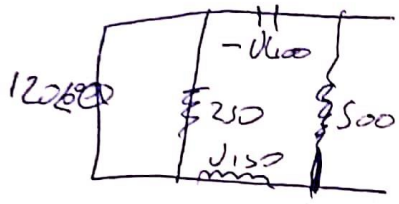
9.45

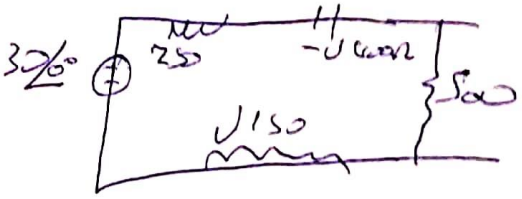
$(9.12\angle 0°)\,250 = 3\angle 0°\ V$

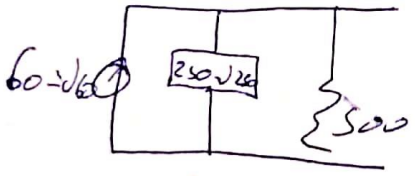
$250 - j600 + j150 = 250 - j250\ \Omega \qquad \frac{30\angle 0°}{250 - j250} = 60 - j60\ mA$

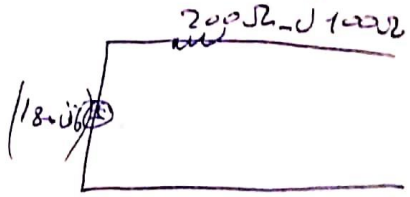
$(250 - j250) \parallel 500 = 200 - j100\ \Omega$

$(200 - j100)(0.06 - j0.06) = 18 - j6\ V$

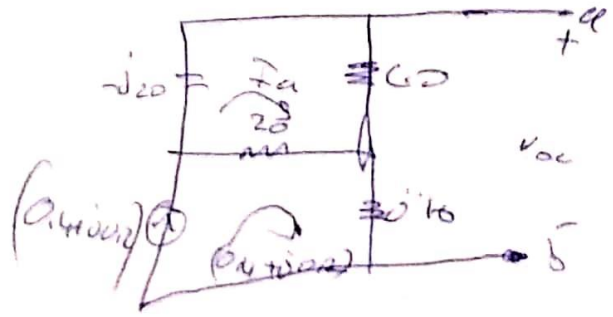








9.46 OPEN CIRCUIT !

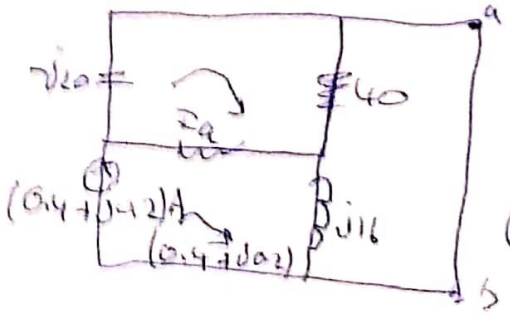


$$-j20I_a + 40I_a + 20(I_a - 0.4 - j0.2) = 0$$

$$I_a = \frac{20(0.4+j0.2)}{60 - j20} = 0.1 + j0.1\,A$$

$$V_{oc} = 40I_a + j16(0.4+j0.2) = 0.8 + j10.4\,V$$

Short circuit



$$-jI_a + 60(I_a - I_{sc}) + 20(I_a - 0.4 - j0.2) = 0$$

$$60(I_a - I_a) + j16(I_{sc} - 0.4 - j0.2) = 0$$

$$I_{sc} = 0.3 + j0.5\,A$$

$$Z_{th} = \frac{V_{th}}{I_{sc}} = \frac{0.8 + j10.4}{0.3 + j0.5} = 16 + j8\,\Omega$$

$16 + j8\,\Omega$

9.55

$U_1 \Rightarrow -5\angle 0° + \frac{U_1 - U_2}{-j8} + \frac{U_1 - 20\angle 90°}{-j4} = 0$

$U_2 \Rightarrow \frac{U_2 - U_1}{-j8} + \frac{U_2}{j4} + \frac{U_2 - 20\angle 90°}{12} = 0$

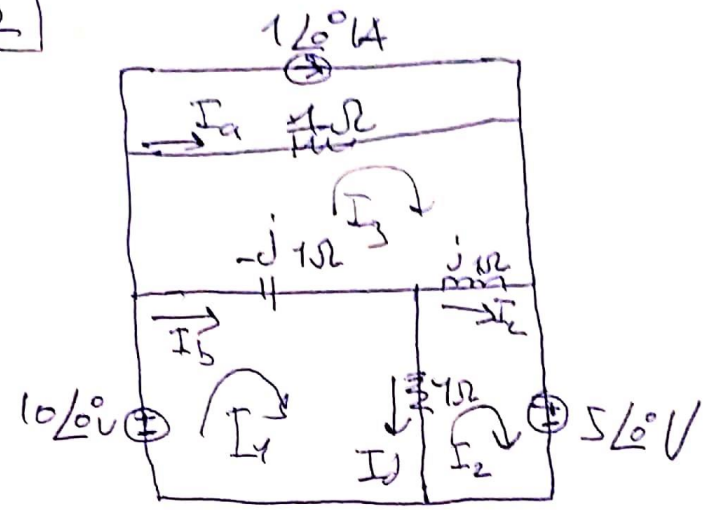
$U_1\left(\frac{1}{-j8} + \frac{1}{-j4}\right) + U_2\left(\frac{-1}{-j8}\right) = 5\angle 0° + \frac{20\angle 90°}{-j4}$

$U_1\left(\frac{1}{+j8}\right) + U_2\left(\frac{1}{-j8} + \frac{1}{j4} + \frac{1}{12}\right) = \frac{-20\angle 90°}{12}$

$U_1 = \frac{-8}{3} + j\frac{4}{3}$ $\qquad U_2 = -8 + j4$

$V_g = U_1 - 20\angle 90° = -\frac{8}{3} - j\frac{56}{3} V$

9.62



$10\angle 0° = (1-j1)I_1 - I_2 + jI_3$

$-5\angle 0° = -I_1 + (1+j1)I_2 - j1I_3$

$1 = j1I_1 - j1I_2 + I_3$

$I_1 = 11+j10\,A$, $I_2 = 11+j5\,A$, $I_3 = 6\,A$

$I_a = I_3 - 5A = 1A$

$I_b = I_1 - I_3 = 5 + j10\,A$

$I_c = I_2 - I_3 = 5 + j5A$

$I_d = I_1 - I_2 = j5A$