1) $R_{ad} = 4 // 4 + 1 = 3\ \Omega$

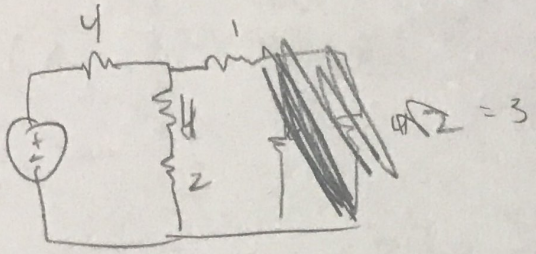
$R_{cd} = 3 // 6 = 2\ \Omega$

$R_{eq} = 6\ \Omega$

$V = IR$

$54 = i_s(6)$

$i_s = 9\ A$



$V_a = 54 - (9)(4) = 18$ $\boxed{V_a = 18}$ $\boxed{V_d = 0}$

$$\frac{V_b - V_a}{1} + \frac{V_b - V_d}{4} + \frac{V_b - V_d}{4} = 0$$

$$V_b - 18 + \frac{V_b}{4} + \frac{V_b}{4} = 0 \qquad V_b\left(1 + \tfrac{1}{4} + \tfrac{1}{4}\right) = 18$$

$\boxed{V_b = 12}$

$$\frac{V_c - V_a}{4} + \frac{V_c}{6} + \frac{V_c}{3} = 0$$

$\boxed{V_c = 6}$

$$V_c\left(\tfrac{1}{4} + \tfrac{1}{6} + \tfrac{1}{3}\right) = \tfrac{18}{4}$$

$$I_6 = \frac{V_a - V_c}{4} = \frac{18 - 6}{4} = 3A$$

$54 - 18 - 6 = 30\ V$

$30 = i_0(6)$

$\boxed{i_0 = 5\ A}$

2) $V_1/V_2/V_3) \quad -i_{s1} + \frac{V_1 - V_4}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3} - i_{s2} = 0$

$V_4/V_5) \quad \frac{V_4 - V_1}{R_1} + \frac{V_4}{R_4} + i_{s2} + \frac{V_5}{R_5} + \frac{V_5}{R_6} - i_{s3} = 0$

$V_2 - V_1 = V_{s1} \qquad V_2 - V_3 = V_{s2}$

$V_4 - V_5 = V_{s3}$

3) Supermesh in $i_1/i_2/i_3$, one in i_4/i_5

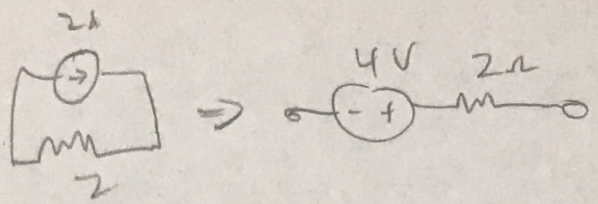
$i_1 R_1 + i_{s1} + R_5(i_3 - i_4) + R_6 i_3 + i_{s2} - i_{s1} + R_2 i_2 - i_{s2} = 0$

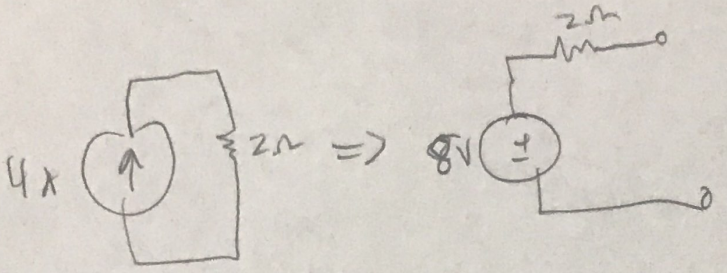
$R_5(i_4 - i_3) + R_3 i_4 + R_4 i_5 + R_7 i_4 = 0$

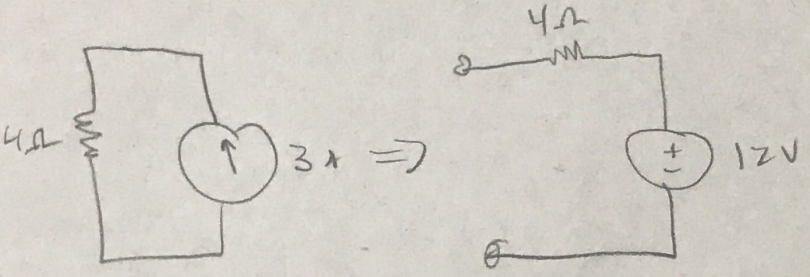
$i_5 - i_4 = 4 i_x \qquad i_x = i_2$

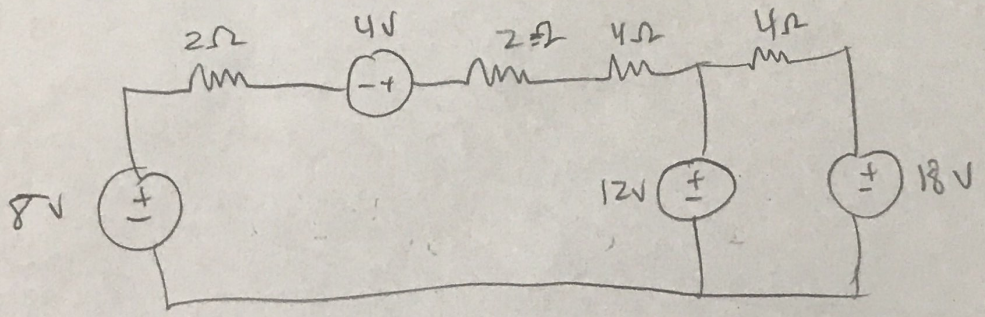
$= 4 i_2$

4) $V = IR$

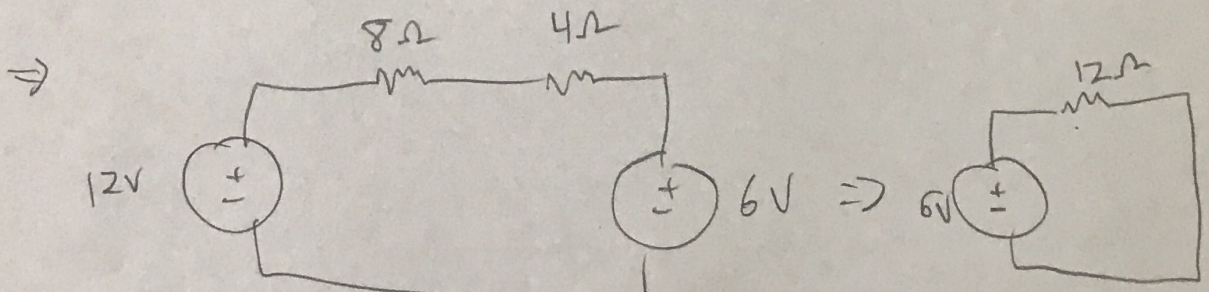






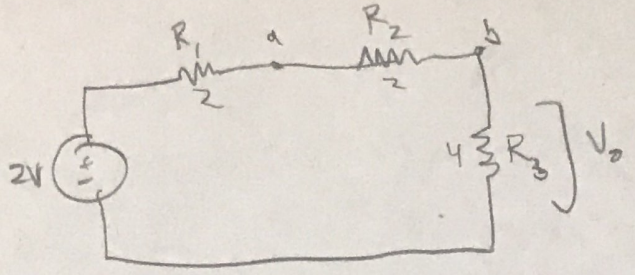


18 - 12



$6 = 12(I)$ $\boxed{I_o = 0.5\ A}$

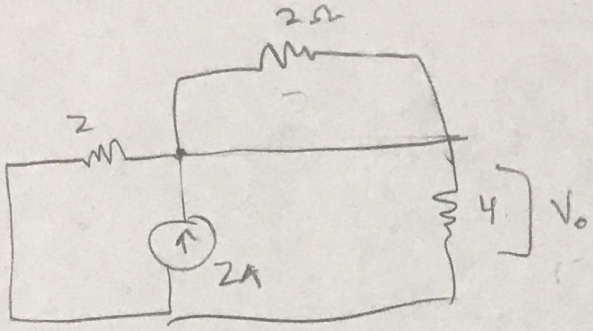
5) V_5)



$$V_o = \frac{R_3}{R_1+R_2+R_3}(2)$$

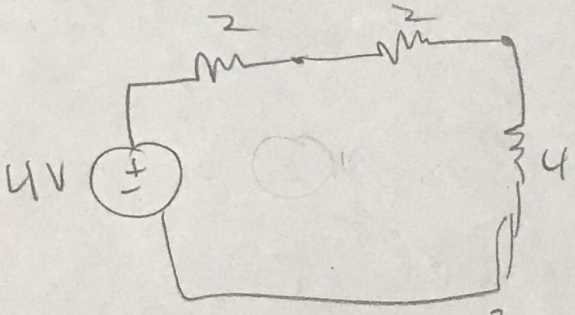
$$= \frac{4}{8}(2) = \boxed{1\ V}$$

i_5)



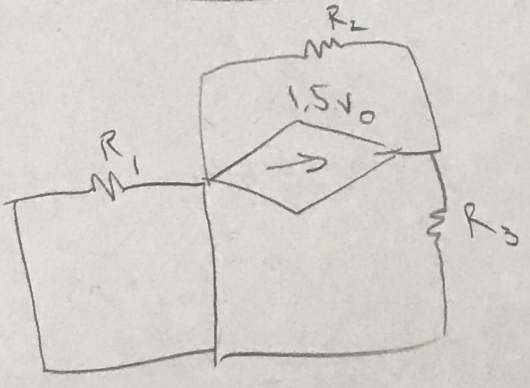
R_{eq} =

$V = IR$



$$V_o = \frac{4}{4+2+2}(4) = \boxed{2\ V}$$

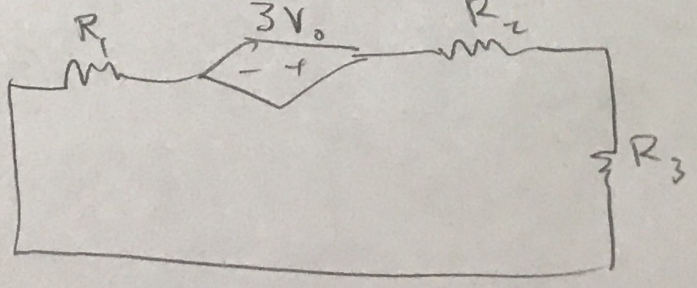
V_o)



$V = IR$

$1.5V_o \cdot 2 =$

$\Rightarrow$



$R_{eq} = 8\ \Omega$

$3V_o = I\,8$

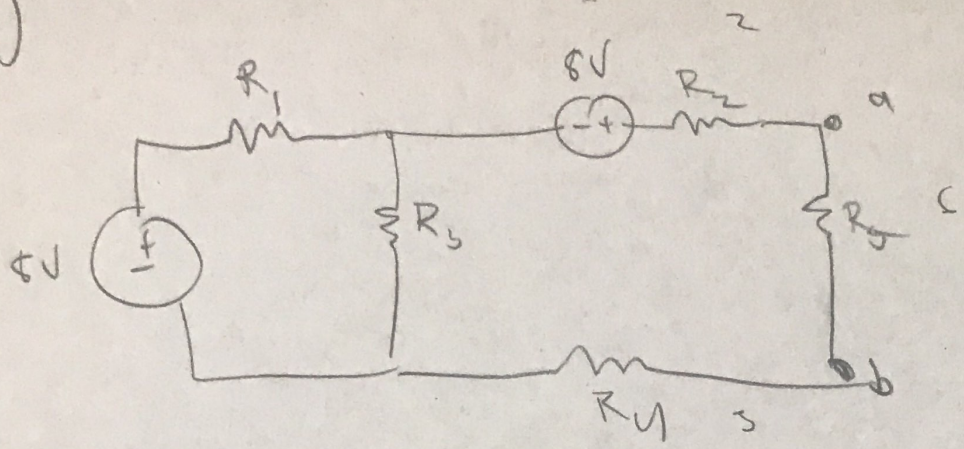
$I = \frac{3V_o}{8}$

$-3V_o + I_2(R_1+R_2+R_3) =$

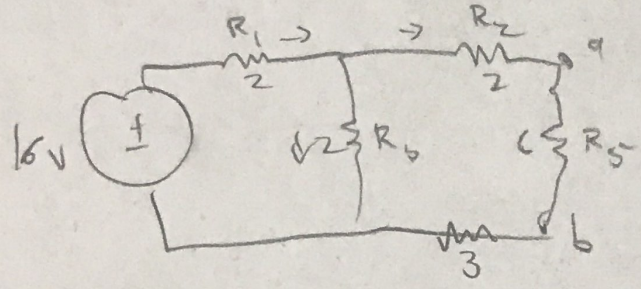
$\frac{3V_o}{8} \cdot 4 = \frac{3}{2}V_o$

$V_o = 1+2+\frac{3}{2} = \boxed{4.5\ V}$

6)



$V_{oc} = V_{ab} = i_5 R_5$



$I_5 = I_3 + I_5$

$I_5 = \frac{2}{3}$

$V_{oc} = \left(\frac{2}{3}\right)(6) = 4\,V$

$V = IR$

$R_{th} = R_{eq} = (R_1 // R_3 + R_4) + R_2 // R_5 = 5.5$

$(\frac{1}{11} + \frac{1}{2})^{-1} + 2$

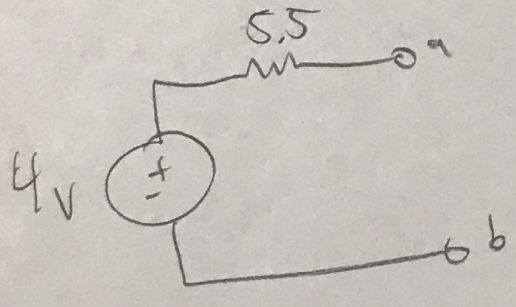
$R_{eq} = 3.692\,\Omega$

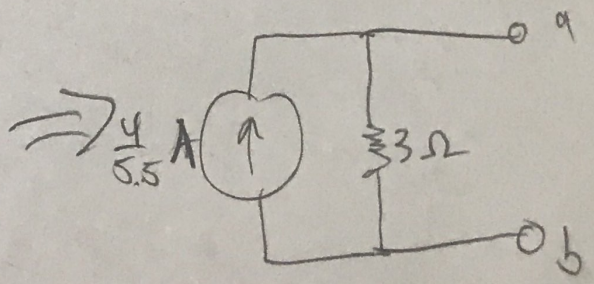
$16 = I(3.692)$

$I_5 = 4.333$

$-16 + (4.333)(2) + (i_3)(2)$

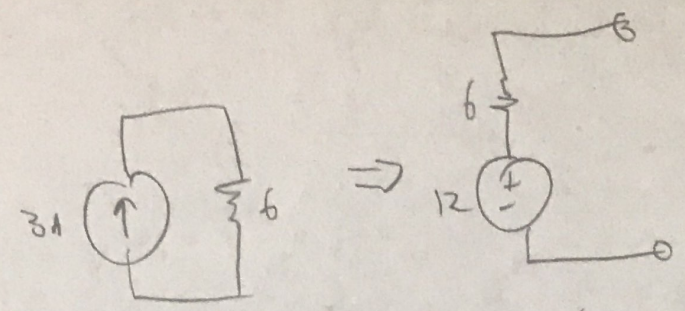
$i_3 = 3.666$

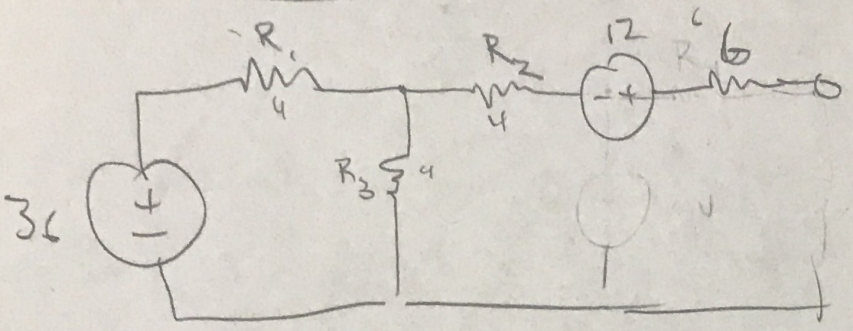




$I = \frac{V}{R}$

7)

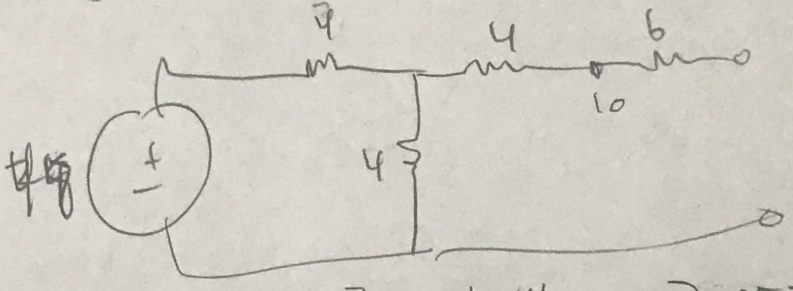




V_{oc}

$P_{max} = \frac{(V)^2}{4R_{th}}$

$V_s = 48$



R_{eq} 40//4 = 2.857+4 = 6.857

$$P_{max} = \frac{48^2}{4(6.857)} = \boxed{336\ W}$$

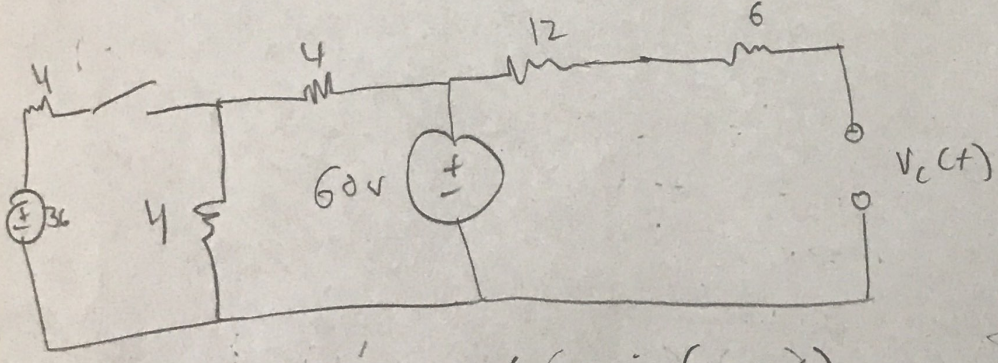
8)

$$\frac{V_n - V_a}{R_a} + \frac{V_n - V_b}{R_b} + \frac{V_n}{R_g} + \frac{V_n - V_o}{R_f} = 0 \qquad V_n = V_p = V_c \quad V_p = V_c$$

$$\frac{V_c - V_a}{R_a} + \frac{V_c - V_b}{R_b} + \frac{V_c}{R_g} + \frac{V_c - V_o}{R_f} = 0$$

$$V_o = R_f\left(\frac{V_c}{R_f} + \frac{V_c}{R_g} + \frac{V_c - V_b}{R_b} + \frac{V_c - V_a}{R_a}\right)$$

9) Capacitor is an open circuit $t<0$



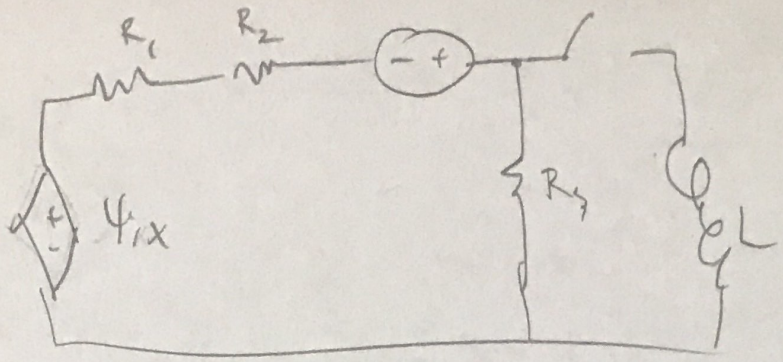
$$-60 + i_o(12+6) = 0$$

$$i_o = \frac{10}{3}\,A$$

$$V_c(0) - 60 + i_o(18) = 120V$$

$$V_o(t) = \frac{\frac{10}{3}}{6} = 0.555\,V$$

10)



$V = IR$

$4ix$

$R_{12} = 6\,\Omega$

$i(0^-) = \frac{V_b}{R_3} + \frac{V_b}{R_1} =$

11) $Z_C = \frac{1}{j(1)(\frac{1}{4})} = \frac{4}{j}$ $i_S = 3\cos(t)$ $I_S = 3\angle 0^\circ$

$W = 1$

$Z_{R2} = 2$

$Z_{R_1} = 4$

$Z_L = j(1)(3) = 3j$

$i_S = i_x + i_1$

$Z_{eq} = (Z_{R2} + Z_C) \parallel (Z_{R_1} + Z_L) = (2 + \frac{4}{j}) \parallel (4 + 3j)$

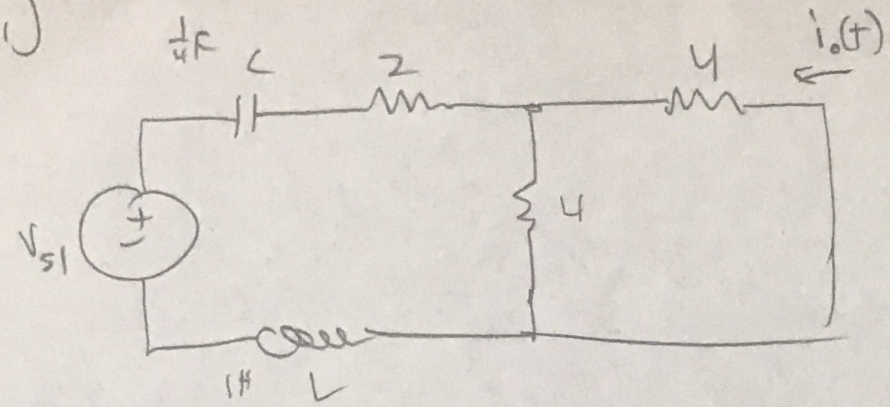
$V_{DC}(t) = 0.5\, i_x$

$\frac{2j+4}{j} \parallel (4+3j)$

$i_x = i_S - i_1$

$\left(\frac{j}{2j+4} + \frac{1}{4+3j}\right)^{-1}$

12) V_{S1})



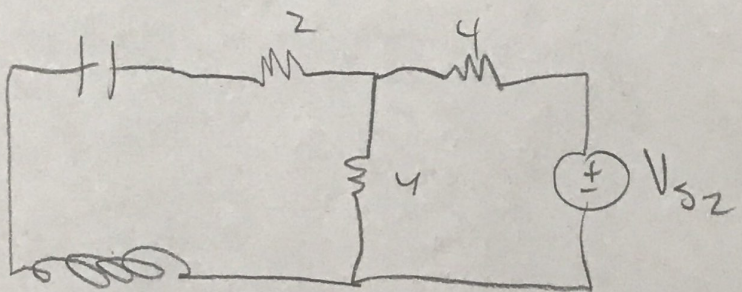
$V_{S1} = 8\cos(2t) = 8\angle 0°$ $\quad \omega = 2$

$Z_{C1} = \frac{1}{j(2)(\frac{1}{4})} = \frac{2}{j}$ $\quad Z_{L1} = j(2)(1) = 2j$

$-8\cos(2t) + \frac{2}{j} + 2 + 4 + 2j = 0$

$Z_{eq} = \left(\frac{2}{j} + 2\right) + (4 \,//\, (4 + 2j))$

V_{S2})



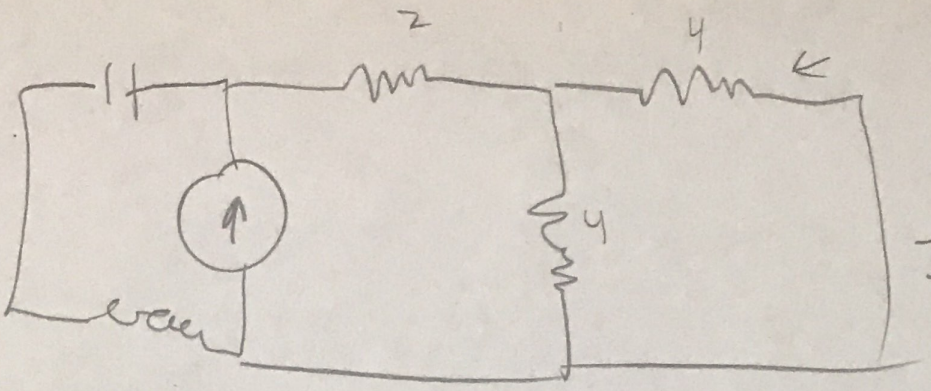
$V_{S2} = 8V$

$\omega = 0$

$Z_{C2} = \infty$ $\quad Z_{L2} = 0$ $\quad V = IR$

$Z_{eq} = 5.333$ $\quad \frac{8}{5.333} = \boxed{1.5A}$

i_s)



$\omega = 4$

$I_s = 4 + 3j$

$Z_C = \frac{1}{j(4)(\frac{1}{4})} = \frac{1}{j}$ $\quad Z_L = j(4)(1) = 4j$