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Student ID : 202052307

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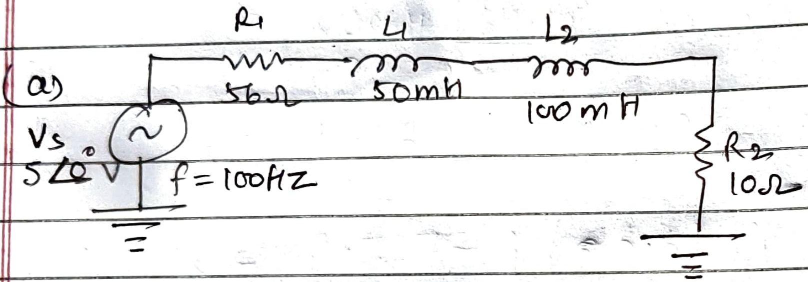
EE100 : Assignment 1

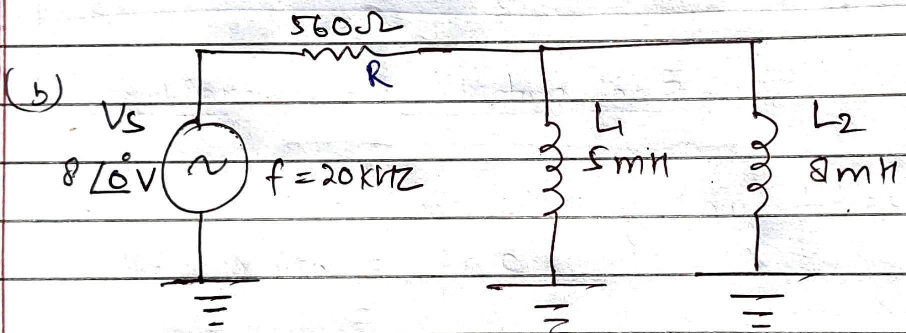
1 Problem from Section 16-3

11. Express the total current in the following circuits in rectangular and polar form

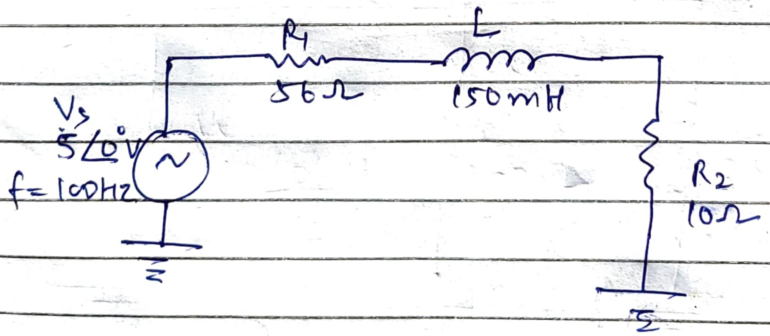
(a)



(b)



(a) The circuit can be redrawn as



$L = L_1 + L_2 = 150\,mH$

$\omega L = 2\pi f L = 2\pi \times 100 \times 150\,mH$

$= 94.2\,\Omega$

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$$\therefore Z = (56+10) + j(94.2)\ \Omega$$

$$Z = 115.02 \angle 54.98^\circ\ \Omega$$

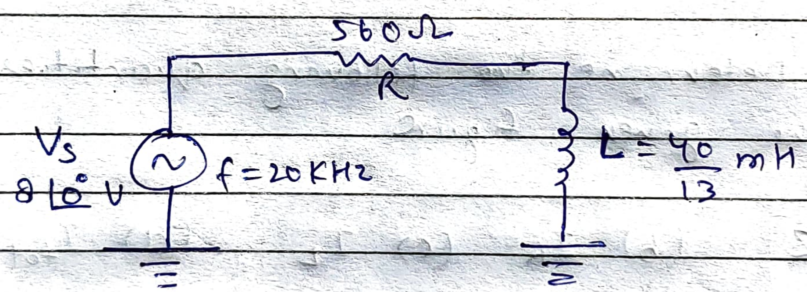
$$\therefore \text{total current } \bar{I} = \frac{\bar{V_s}}{Z}$$

$$\bar{I} = \frac{5 \angle 0^\circ}{115.02 \angle 54.98^\circ}\ A$$

$$\boxed{\begin{aligned} \bar{I} &= 43.47 \angle -54.98\ mA \\ \therefore I &= 24.946 - j(35.6)\ mA \end{aligned}}$$

Answer

(b) The circuit can be redrawn as



where, $L = L_1 \| L_2$

$$L = \frac{L_1 \times L_2}{L_1 + L_2} = \frac{(5mH)\times(8mH)}{13mH}$$

$$L = \frac{40}{13}\ mH$$

$$\therefore X_L = 2\pi f L \quad X_L = 2\times\pi\times(20K)\left(\frac{40}{13}m\right)$$

$$X_L = 386.46\ \Omega$$

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$\therefore Z = 560 + j\,386.46\ \Omega$

$Z = 680.4 \angle 34.19^\circ\ \Omega$

$\therefore$ total current $\overline{I_s} = \dfrac{\overline{V_s}}{Z}$

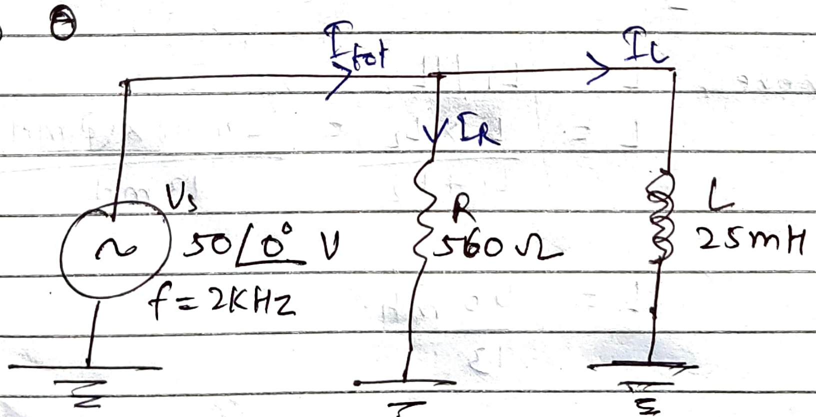
$= \dfrac{8 \angle 0^\circ}{680.4 \angle 34.19^\circ} = 11.76 \angle -34.19^\circ\ mA$

$$\boxed{\begin{array}{l} \overline{I_s} = 11.76 \angle -34.19^\circ\ mA \\ \therefore I_s = 9.727 - j\,(6.61)\ mA \end{array}}$$ Answer

1 Problem from section 16-5

25. Determine the following quantities in the given figure

(a) Z (b) I_R (c) I_L (d) I_{tot}
(e) θ



(a) $X_L = \omega L = 2\pi (2K)(25m)$
$= 314\ \Omega$

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$\therefore Z_R = 560\,\Omega \Rightarrow \bar{Z}_R = 560\angle 0^\circ$

$Z_{X_L} = j(314\,\Omega) \Rightarrow \bar{Z}_{XL} = 314\angle 90^\circ$

and $Z = Z_R \parallel Z_{XL}$

$= \dfrac{Z_R \cdot Z_{XL}}{Z_R + Z_{XL}}$

$$\bar{Z} = \frac{560\angle 0^\circ \times 314\angle 90^\circ}{560 + j314}\,\Omega$$

$$\bar{Z} = \frac{175840\angle 90^\circ}{642.02\angle 29.279}\,\Omega$$

$$\boxed{\begin{aligned}\bar{Z} &= 273.88\angle 60.721\,\Omega \\ \therefore Z &= 133.945 + j(238.89)\,\Omega\end{aligned}}$$
Answer

(b) $\bar{I}_R = \dfrac{\bar{V}_s}{\bar{Z}_R}$

$= \dfrac{50\angle 0^\circ}{560\angle 0^\circ}$

$$\boxed{\begin{aligned}\bar{I}_R &= 89.286\angle 0^\circ \text{ mA} \\ \therefore I_R &= 89.286\text{ mA} + j(0)\end{aligned}}$$
Answer

(c) $\bar{I}_L = \dfrac{\bar{V}_s}{\bar{Z}_{XL}} = \dfrac{50\angle 0^\circ}{314\angle 90^\circ}$

$$\boxed{\begin{aligned}\bar{I}_L &= 159.236\angle -90^\circ \text{ mA} \\ I_L &= 0 - j(159.236\text{ mA})\end{aligned}}$$
Answer

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(d) $I_{tot} = I_R + I_L$

$$\boxed{\begin{aligned} I_{tot} &= 89.286\ mA - j(159.236\ mA) \\ I_{tot} &= 182.56 \angle -60.72^\circ\ mA \end{aligned}}$$
Answer

(e) $\theta = \phi_v - \phi_{I_{tot}}$

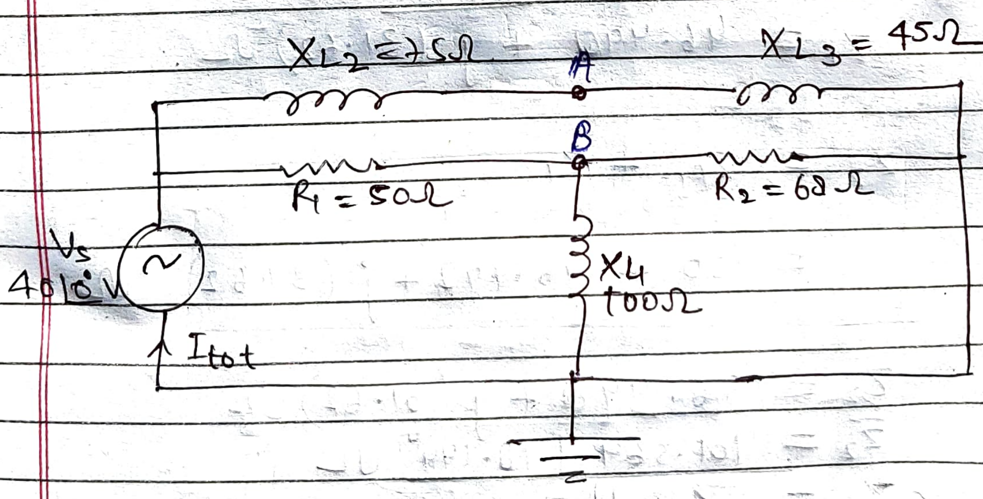
$= 0 - (-60.72^\circ)$

$$\boxed{\theta = 60.72^\circ}$$
Answer

1 Problem from Section 16-6:

33. For the circuit determine the following

(a) I_{tot} (b) V_{L_1} (c) V_{AB}



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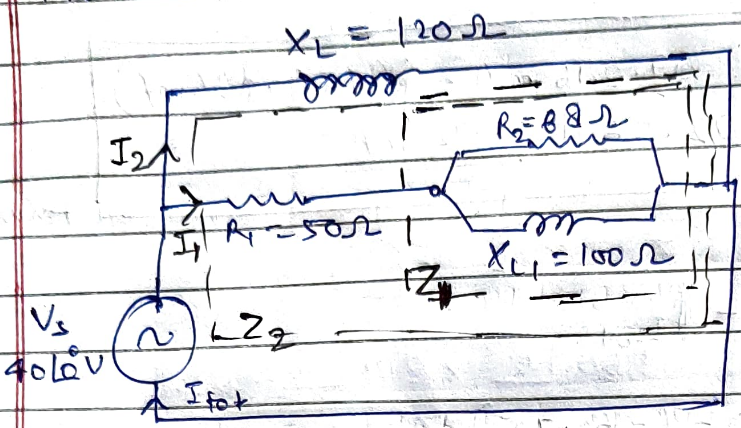
The circuit can be redrawn as



$$Z_1 = Z_{R_2} \parallel Z_{X_{L_1}}$$

$$= \frac{68\angle 0° \times 100\angle 90°}{68 + j(100)}$$

$$\bar{Z_1} = \frac{6800\angle 90°}{120.93\angle 55.785}\ \Omega$$

$$\bar{Z_1} = 56.23\angle 34.215°\ \Omega$$

$$Z_1 = 46.498 + j(31.62)\ \Omega$$

$$Z_2 = Z_{R_1} + Z_1$$

$$= 50 + 46.498 + j(31.62)\ \Omega$$

$$Z_2 = 96.498 + j(31.62)\ \Omega$$

$$\bar{Z_2} = 101.569\angle 18.144°\ \Omega$$

$$Z = Z_{X_L} \parallel Z_2$$

$$= \frac{Z_{X_L} \cdot Z_2}{Z_{X_L} + Z_2}$$

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$$\bar{Z} = \frac{120\angle 90^\circ \times 101.564\angle 18.144^\circ}{j(120) + \cancel{101.564}\ 96.498 + j(31.62)}$$

$$\bar{Z} = \frac{12187.68\angle 108.144^\circ}{179.72\angle 57.52^\circ}$$

$$\bar{Z} = 67.815\angle 50.624^\circ\ \Omega$$

(a)

$$\therefore \bar{I}_{tot} = \frac{\bar{V_s}}{\bar{Z}}$$

$$\bar{I}_{tot} = \frac{40\angle 0^\circ}{67.815\angle 50.624^\circ}$$

$$\boxed{\begin{aligned} \bar{I}_{tot} &= 589.84\angle -50.624^\circ\ mA \\ I_{tot} &= 374.2 - j(455.95)\ mA \end{aligned}}$$

Answer

(b)

$$\bar{I}_1 = \frac{I_{tot} \cdot Z_{XL}}{Z_{XL} + Z_2}$$

$$\bar{I}_1 = \frac{589.84\angle -50.624 \times 120\angle 90^\circ}{j(120) + 96.498 + j(31.62)}\ (mA \cdot \Omega)$$

$$= \frac{589.84 \times 120\ \angle 39.376^\circ}{179.72\ \angle 57.72^\circ}\ mA$$

$$\bar{I}_1 = 393.84\angle -18.344^\circ\ mA$$

$$I_1 = 373.82 - j(123.95)\ mA$$

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~~$\overline{V}_{L1} = \overline{V}_s + V_{R1}$~~

$$V_{L1} = V_s - V_{R_1}$$

$$\overline{V}_{R_1} = \overline{I}_1 \times \overline{Z}_{R_1}$$

$$= 393.84 \angle -18.344^\circ \times 50 \angle 0^\circ \text{ mV}$$

$$\overrightarrow{V}_{R_1} = 19.69 \angle -18.344^\circ \text{ V}$$

$$V_{R_1} = 18.69 - j(6.197) \text{ V}$$

$$\therefore V_{L1} = 40 - (18.69 - j6.197)$$

$$\boxed{V_{L_1} = 21.31 + j\,6.197 \text{ V}}$$

Answer

(c) $V_A = V_s - V_{XL_2} = V_s - I_2 Z_{XL_2}$

Now, $I_2 = I_{tot} - I_1$

$$I_2 = 374.2 - j(455.95) - (373.82 - j(123.95))$$

$$I_2 = 0.38 - j332 \text{ mA}$$

$$\overline{I}_2 = 332 \angle -89.93 \text{ mA}$$

$$\therefore V_{XL_2} = 332 \angle -89.93 \times 75 \angle 90^\circ \text{ mV}$$

$$V_{XL_2} = 24.9 \angle 0.07 \text{ V}$$

$$V_{XL_2} \approx 24.9 \text{ V}$$

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$\therefore V_A = 40 - 24.9V$

$= 15.1V$

and $V_B = V_{L1} = 21.31 + j(6.197)V$

$\therefore V_{AB} = V_A - V_B$

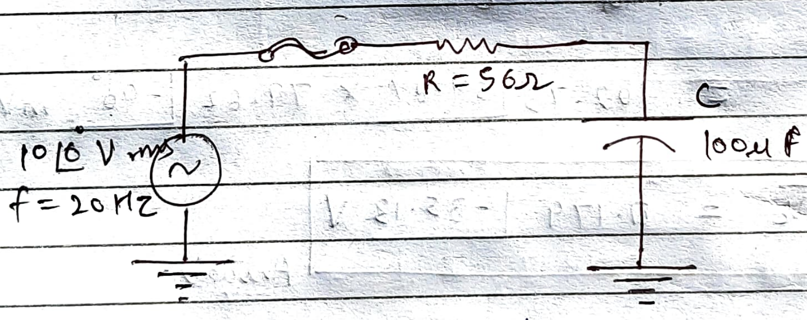
$$\boxed{V_{AB} = -6.21 - j(6.197)\ V}$$

Answer

1 Problem from Section 15-4:

33. For the circuit, determine the following in polar form

(a) Z (b) I_{tot} (c) V_R (d) V_C



$X_C = \frac{1}{2\pi f C} = \frac{1}{2\times(3.14)\times 20\times(100\mu)}$

$X_C = 79.62\ \Omega$

$\therefore Z = 56 + j(-79.62)\ \Omega$

(a) $\boxed{Z = 97.34\angle -54.87^\circ\ \Omega}$

Answer

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(b) $\overline{I_{tot}} = \dfrac{\overline{V_s}}{\overline{Z}}$

$= \dfrac{10 \angle 0^\circ}{97.34 \angle -54.87^\circ}$

$$\boxed{\overline{I_{tot}} = 102.73 \angle 54.87 \text{ mA}}$$ Answer

(c) $\overline{V_R} = \overline{I_{tot}} \times \overline{Z_R}$

$= 102.73 \angle 54.87^\circ \times 56 \angle 0^\circ$ mV

$$\boxed{\overline{V_R} = 5.754 \angle 54.87 \text{ V}}$$ Answer

(d) $\overline{V_c} = \overline{I_{tot}} \times \overline{Z_c}$

$= 102.73 \angle 54.87 \times 79.62 \angle -90^\circ$ mV

$$\boxed{\overline{V_c} = 8.179 \angle -35.13 \text{ V}}$$ Answer

1 Problem from Section 15-6 :-

46. For the parallel circuit, find the magnitude of each branch current and total current. What is the phase angle between the applied voltage and total current?

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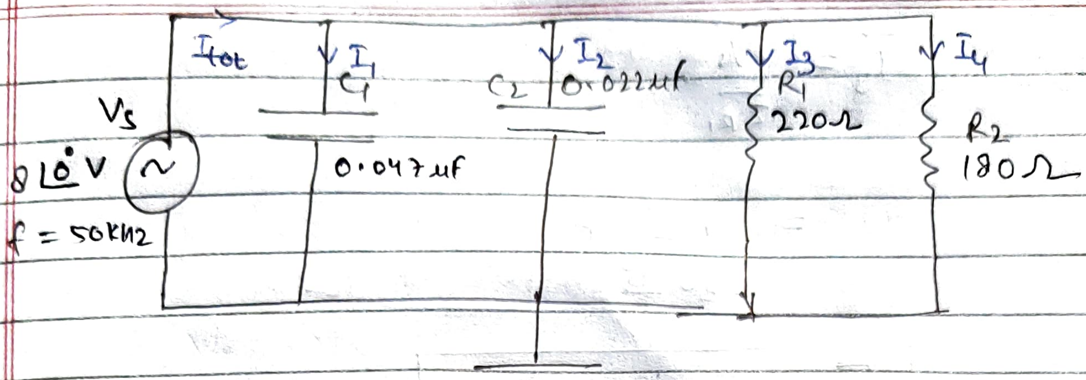

$$\bar{I_1} = \frac{\bar{V_s}}{\bar{Z_{C_1}}}$$

$$X_{C_1} = \frac{1}{\omega C} = \frac{1}{2 \times 3.14 \times (50K) \times (0.047\mu)}$$

$$X_{C_1} = 67.76\ \Omega$$

$$\therefore \bar{Z_{C_1}} = 67.76 \angle{-90^\circ}\ \Omega$$

$$\therefore \bar{I_1} = \frac{8 \angle 0^\circ}{67.76 \angle -90^\circ}$$

$$\boxed{\begin{aligned} \bar{I_1} &= 118.06 \angle 90^\circ \text{ mA} \\ I_1 &= j(118.06) \text{ mA} \end{aligned}}$$

$$X_{C_2} = \frac{1}{2\pi f C_2} = 144.75\ \Omega$$

$$Z_{C_2} = 144.75 \angle -90^\circ\ \Omega$$

$$\therefore \bar{I_2} = \frac{\bar{V_s}}{\bar{Z_{C_2}}} = \frac{8 \angle 0^\circ}{144.75 \angle -90^\circ}$$

$$\boxed{\begin{aligned} \bar{I_2} &= 55.26 \angle 90^\circ \text{ mA} \\ I_2 &= j(55.26) \text{ mA} \end{aligned}}$$

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$$\bar{I_3} = \frac{\bar{V_s}}{\bar{Z_{R_1}}}$$

$$= \frac{8 \angle 0^\circ \text{ A}}{220 \angle 0^\circ}$$

$$\boxed{\begin{aligned} \bar{I_3} &= 36.36 \angle 0^\circ \text{ mA} \\ I_3 &= 36.36 \text{ mA} \end{aligned}}$$

$$\bar{I_4} = \frac{\bar{V_s}}{\bar{Z_{R_2}}}$$

$$= \frac{8 \angle 0^\circ \text{ A}}{180 \angle 0^\circ}$$

$$\boxed{\begin{aligned} \bar{I_4} &= 44.44 \angle 0^\circ \text{ mA} \\ I_4 &= 44.44 \text{ mA} \end{aligned}}$$

Using KCL, we know

$$I_{tot} = I_1 + I_2 + I_3 + I_4$$

$$\therefore I_{tot} = (36.36 + 44.44) + j(118.06 + 55.26) \text{ mA}$$

$$\boxed{\begin{aligned} I_{tot} &= 80.8 + j(173.32) \text{ mA} \\ I_{tot} &= 191.25 \angle 65^\circ \text{ mA} \end{aligned}}$$

phase angle between applied voltage and total current is

$$\boxed{\phi = 0 - 65^\circ = -65^\circ}$$

Answer

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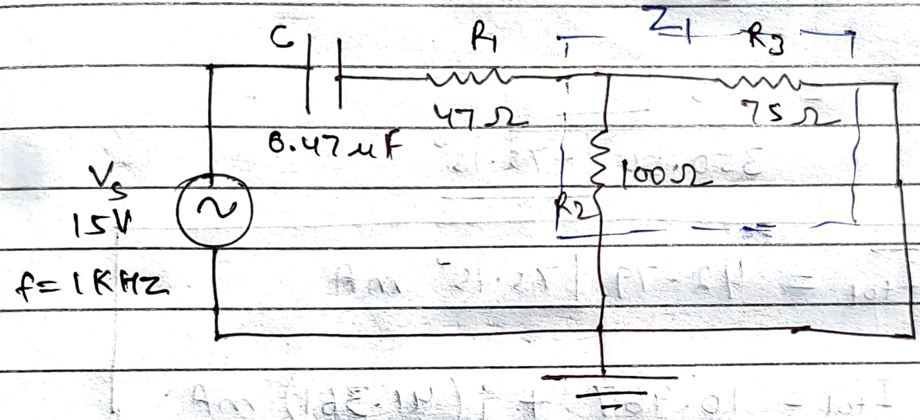
1 Problem from Section 15-7 :-

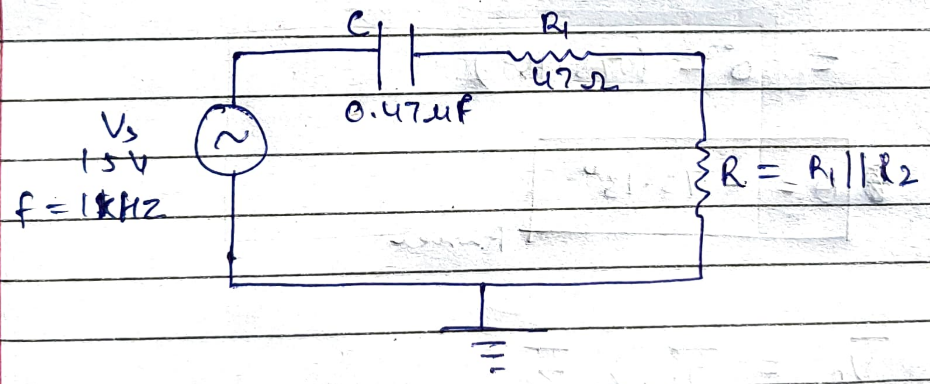
54. For the circuit in the figure, determine

(a) I_{tot} (b) θ (c) V_{R_1} (d) V_{R_2}

(e) V_{R_3} (f) V_C



the circuit can be redrawn as



$$R = \frac{\cancel{75}^{3} \times 100}{\cancel{175}_{7}} = 42.857\,\Omega$$

$$X_C = \frac{1}{\omega C} = \frac{1}{2\times(3.14)\times(1K)\times(0.47\mu)}$$

$$X_C = 338.8\,\Omega$$

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$\therefore\ Z = (47 + 42.857) - j(338.8)\ \Omega$

$Z = (89.857) - j(338.8)\ \Omega$

$\bar{Z} = 350.50 \angle -75.15^\circ\ \Omega$

(a) $\bar{I}_{tot} = \dfrac{\bar{V}_s}{\bar{Z}}$

$= \dfrac{15 \angle 0^\circ}{350.50 \angle -75.15^\circ}$

$$\boxed{\begin{aligned} \bar{I}_{tot} &= 42.79 \angle 75.15^\circ\ mA \\ I_{tot} &= 10.967 + j(41.361)\ mA \end{aligned}}$$

Answer

(b) $\theta = \phi_v - \phi I_{tot}$

$= 0^\circ - (75.15^\circ)$

$\boxed{\theta = -75.15^\circ}$ Answer

(c) $\bar{V}_{R_1} = \bar{I}_{tot} \times \bar{Z}_{R_1}$

$= 42.79 \angle 75.15^\circ \times 47 \angle 0^\circ\ mV$

$$\boxed{\begin{aligned} \bar{V}_{R_1} &= 2.011 \angle 75.15^\circ\ V \\ V_{R_1} &= 0.515 + j(1.944)\ V \end{aligned}}$$

Answer

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(d) $\overline{V_{R_2}} = \overline{I_{tot}} \times \overline{V_R}$

$= 42.79 \angle 75.15^\circ \times 42.857 \angle 0^\circ \ \Omega$

$$\boxed{\begin{aligned} \overline{V_{R_2}} &= 1.834 \angle 75.15^\circ \ V \\ V_{R_2} &= 0.47 + j(1.773) \ V \end{aligned}}$$ Answer

(e) Since R_2 and R_3 are in parallel

$$\boxed{\begin{aligned} \therefore \ V_{R_3} &= V_{R_2} \\ V_{R_3} &= 0.47 + j(1.773) \ V \end{aligned}}$$ Answer

(f) $\overline{V_c} = \overline{I_{tot}} \times \overline{Z_{Xc}}$

$= 42.79 \angle 75.15^\circ \times 338.8 \angle -90^\circ \ mV$

$$\boxed{\begin{aligned} \overline{V_c} &= 14.497 \angle -14.85^\circ \ V \\ V_c &= 14.013 - j(3.715) \ V \end{aligned}}$$ Answer

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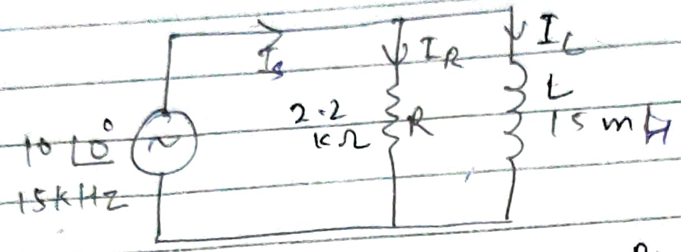
5 Questions from Home work

Ques



Find $\bar{I}$, $\bar{I_R}$, $\bar{I_L}$, P, Q, S. Plot time domain and phasor ~~for~~. Prove KCL.

$$Z_R = 2.2 K\Omega$$

$$X_L = 2\pi(15k)(15m)$$
$$= 1.413 K\Omega$$

$$\therefore Z_L = j(1.413) k\Omega$$

$$\therefore Z = Z_R \parallel Z_{X_L}$$

$$Z = \frac{2.2k\angle 0^\circ \times 1.413k\angle 90^\circ}{2.2k + j(1.413k)}$$

$$\bar{Z} = \frac{3.12\angle 90^\circ}{2.615\angle 32.71^\circ} k\Omega$$

$$\boxed{\begin{aligned}\bar{Z} &= 1.193\angle 57.29^\circ\ k\Omega \\ Z &= 0.72 + j(1.003)\ k\Omega\end{aligned}}$$

$$I_s = \frac{\bar{V_s}}{\bar{Z}} = \frac{10\angle 0^\circ}{1.193\angle 57.29^\circ\ k\Omega}$$

$$\boxed{\bar{I_s} = 8.382\angle -57.29^\circ\ mA}$$

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$$\bar{I}_R = \frac{\bar{V}_S}{\bar{Z}_R} = \frac{10\angle 0^\circ}{2.2k\angle 0^\circ}$$

$$\boxed{\bar{I}_R = 4.545\angle 0^\circ \text{ mA}}$$

$$\bar{I}_L = \frac{\bar{V}_S}{\bar{Z}_L} = \frac{10\angle 0^\circ}{1.413k\angle 90^\circ}$$

$$\boxed{\bar{I}_L = 7.08\angle -90^\circ \text{ mA}}$$

$$\therefore \phi = \phi_{V_S} - \phi_{I_S}$$

$$\phi = 0 - (-57.29^\circ)$$

$$\phi = 57.29^\circ$$

$$\therefore P = V_S I_S \cos\phi$$

$$= 10 \times 8.382 \cos(57.29^\circ) \text{ mW}$$

$$\boxed{P = 45.295 \text{ mW}}$$

$$Q = V_S I_S \sin\phi$$

$$Q = 10 \times 8.382 \sin(57.29^\circ)$$

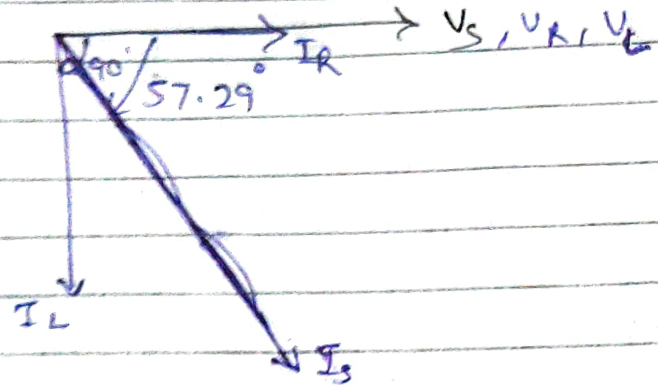
$$\boxed{Q = 70.53 \times 10^{-3} \text{ VAR}}$$

$$S = \sqrt{P^2 + Q^2}$$

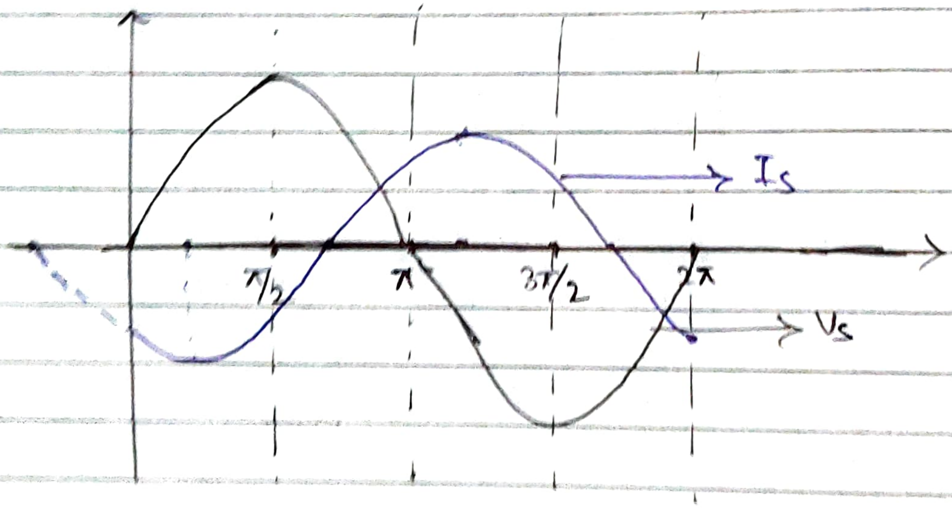
$$= \sqrt{(45.295)^2 + (70.53)^2}$$

$$\boxed{S = 83.82 \times 10^{-3} \text{ VA}}$$

Phasor Diagram



Time Domain



$V_s = 10 + j(0)$ V

$V_s = 10 \sin(\omega t)$ V

$I_s = 8.382 \sin(\omega t - 57.29°)$ mA

$I_s = 4.529 - j(7.052)$ mA

$I_R = 4.545 + j0$ mA

$I_L = 0 - j(7.08)$ mA

Clearly $I_s = I_R + I_L$, hence KCL is proved

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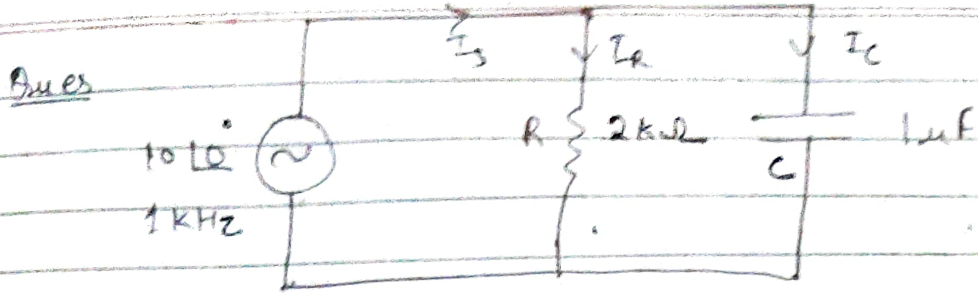

Find $\bar{I}_R$, $\bar{I}_c$, $\bar{I}_s$, P, Q, S.
Plot the phasor diagram and time domain diagram

$$X_c = \frac{1}{2\pi f C} = \frac{1}{2 \times 3.14 \times 1k \times 1u} = 0.159\,k\Omega$$

$$Z_c = -j\,(0.159k)\ \Omega$$

$$Z_R = 2k\ \Omega$$

$$\therefore\ \bar{I}_R = \frac{\bar{V}_s}{\bar{Z}_R} = \frac{10\angle 0^\circ}{2k\angle 0^\circ}$$

$$\bar{I}_R = 5\,mA\angle 0^\circ$$

$$\boxed{I_R = 5\ mA + j\,(0)}$$

$$\bar{I}_c = \frac{\bar{V}_s}{\bar{Z}_c} = \frac{10\angle 0^\circ}{0.159K\angle -90^\circ}$$

$$\boxed{\begin{array}{l}\bar{I}_c = 62.89\angle 90^\circ\ mA \\ I_c = 0 + j\,(62.89)\ mA\end{array}}$$

Using KCL,

$$I_s = I_R + I_c$$

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$$\boxed{\begin{aligned} I_s &= 5 + j(62.89)\ mA \\ I_s &= 63.088\angle 85.454^\circ\ mA \end{aligned}}$$

$$\phi = \phi_{Vs} - \phi_{Is}$$
$$= 0 - 85.454^\circ$$
$$\phi = -85.454^\circ$$

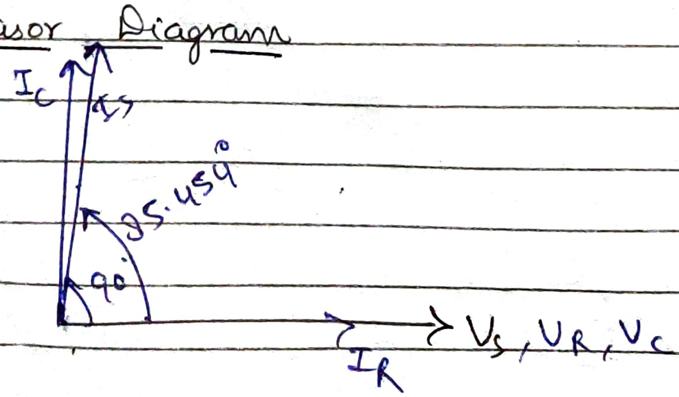
$$\boxed{\begin{aligned} \therefore P &= I_s V_s \cos\phi \\ &= 50\ mW \end{aligned}}$$

$$\boxed{\begin{aligned} Q &= I_s V_s \sin\phi \\ Q &= -628.89 \times 10^{-3}\ VAR \end{aligned}}$$

$$S = \sqrt{P^2 + Q^2}$$
$$= \sqrt{(50)^2 + (-628.89)^2}$$

$$\boxed{S = 630.874 \times 10^{-3}\ VA}$$

Phasor Diagram



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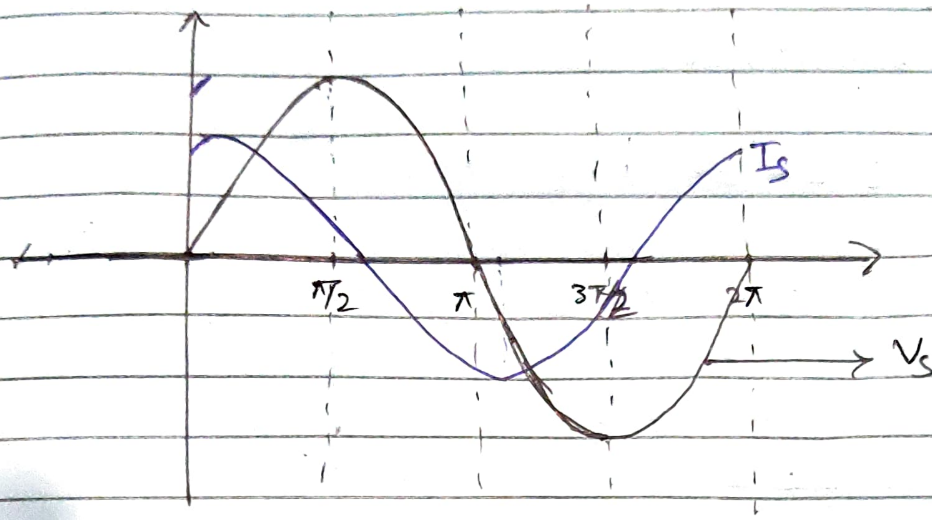
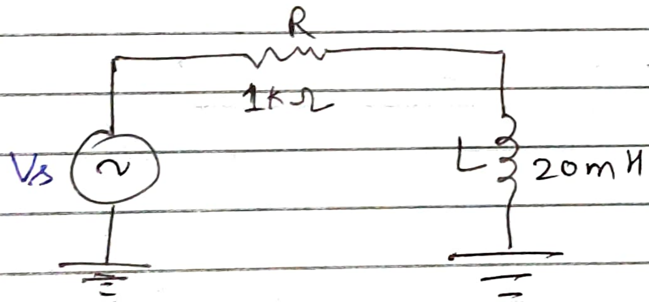
Time Domain



Ques 3 For the series RL circuit, determine magnitude of total impedance and phase angle at each of the following frequencies

(a) 10 kHz (b) 20 kHz (c) 30 kHz



(a) $f = 10\,kHz$

$X_L = 2\pi f L = 2\pi(10k)(20m) = 1.26\,k\Omega$

$\therefore\ Z = 1k + j(1.26k)\ \Omega$

$$\boxed{\begin{aligned} Z &= 1.61k \angle 51.5^\circ\ \Omega \\ \phi &= 51.5^\circ \end{aligned}}$$

Name: Archit Agrawal
Student ID: 202052307

(b) $f = 20\,KHz$

$X_L = 2\pi f X_L = 2\pi(20K)(20m) \approx 2.51K\,\Omega$

$\therefore Z = 1K + j(2.51K)\,\Omega$

$$\boxed{\begin{aligned}\bar{Z} &\approx 2.70K \angle 68.3^\circ\,\Omega \\ \therefore \phi &= 68.3^\circ\end{aligned}}$$

(c) $f = 30\,KHz$

$X_L = 2\pi f X_L = 2\pi(30k)(20m) = 3.77K\Omega$

$Z = 1K + j(3.77K)\,\Omega$

$$\boxed{\begin{aligned}\bar{Z} &\approx 3.90 \angle 75.1^\circ\,K\Omega \\ \phi &= 75.1^\circ\end{aligned}}$$

Ques 4. Given two voltages

$v_1(t) = 10 \sin(\omega t + 30^\circ)$
$v_2(t) = 15 \sin(\omega t + 60^\circ)$

Find $v_1(t) + v_2(t)$ and $v_1(t) \cdot v_2(t)$

$\bar{V}_1 = 10 \angle 30^\circ\ V$
$\bar{V}_2 = 15 \angle 60^\circ\ V$

$V_1 = 8.66 + j(5)\ V$
$V_2 = 7.5 + j(12.99)\ V$

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$$V_1 + V_2 = (8.66 + 7.5) + j(5 + 12.99)$$

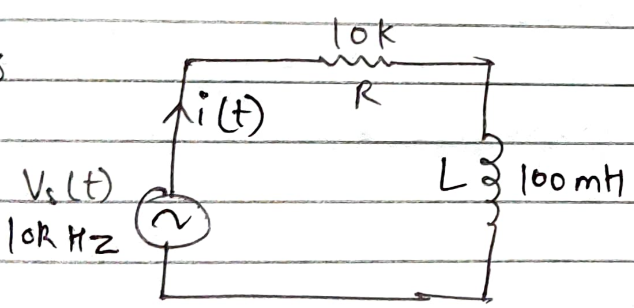
$$\boxed{\begin{aligned} V_1 + V_2 &= 16.16 + j(17.99)\ V \\ \overline{V_1 + V_2} &= 24.18 \angle 48.06^\circ\ V \end{aligned}}$$

$$v_1(t) + v_2(t) = 24.18 \sin(\omega t + 48.06^\circ)\ V$$

$$\overline{V_1 \cdot V_2} = \overline{V_1} \cdot \overline{V_2}$$
$$= 10\angle 30^\circ \times 15 \angle 60^\circ$$
$$= 150 \angle 90^\circ\ V$$

$$\boxed{\begin{aligned} \overline{V_1 \cdot V_2} &= 150 \angle 90^\circ\ V \\ V_1 \cdot V_2 &= j(150)\ V \\ v_1(t) \cdot v_2(t) &= 150 \sin(\omega t + 90^\circ)\ V \end{aligned}}$$

Q.5



$I_s = 0.2 \angle 0^\circ$ mA. Find $\overline{V_s}$, $V_s(t)$, $\overline{V_R}$, $\overline{V_L}$, $V_R(t)$, $V_s(t)$. Plot phasor diagram.

$$X_L = 2\pi (10k)(100m)$$
$$= 6.28\ k\Omega$$

$$\therefore Z = 10k + j(6.28k)$$

$$Z = 11.8 \angle 32.1^\circ\ k\Omega$$

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$\overline{V_s} = \overline{I_s} \cdot \overline{Z}$

$\overline{V_s} = 0.2 \angle 0^\circ \text{ mA} \times 11.8 \angle 32.1^\circ \text{ k}\Omega$

$$\boxed{\begin{aligned} \overline{V_s} &= 2.36 \angle 32.1^\circ \text{ V} \\ V_s(t) &= 2.36 \sin(\omega t + 32.1^\circ) \text{ V} \end{aligned}}$$

$\overline{V_R} = \overline{I_s} \cdot \overline{Z_R}$
$= 0.2 \angle 0^\circ \text{ mA} \times 10 \angle 0^\circ \text{ k}\Omega$

$$\boxed{\begin{aligned} \overline{V_R} &= 2 \angle 0^\circ \text{ V} \\ V_R(t) &= 2 \sin(\omega t + 0^\circ) \text{ V} \end{aligned}}$$

$\overline{V_L} = \overline{I_s} \cdot \overline{Z_L}$
$= 0.2 \angle 0^\circ \text{ mA} \times 6.28\text{k} \angle 90^\circ \ \Omega$
$= 1.256 \angle 90^\circ \text{ V}$

$$\boxed{\begin{aligned} \overline{V_L} &= 1.256 \angle 90^\circ \text{ V} \\ V_L(t) &= 1.256 \sin(\omega t + 90^\circ) \end{aligned}}$$