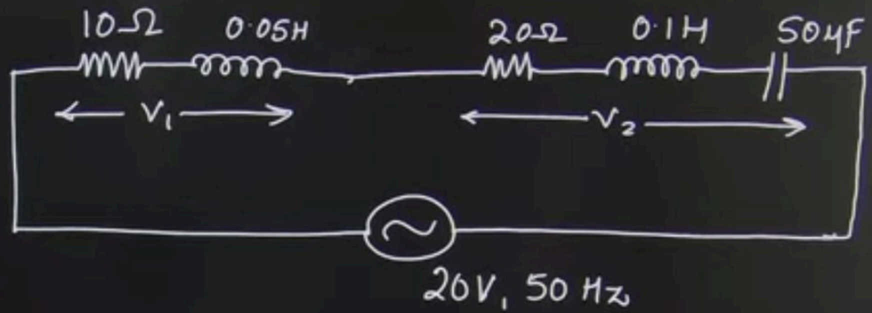
026 880

For a circuit shown in figure

(i) find current

(ii) Voltage drop V_1

(iii) Voltage drop V_2



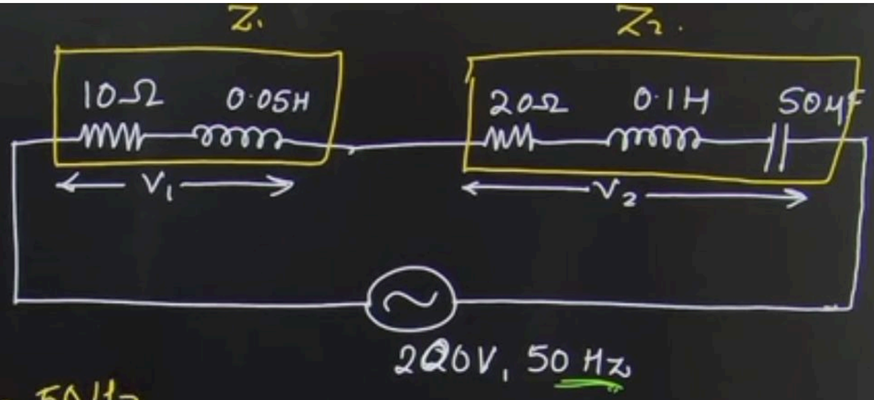
289 024

For a circuit shown in figure

(i) find current

(ii) Voltage drop V_1

(iii) Voltage drop V_2



Given data. $V = (200, \angle 0)$ $f = 50\,Hz$

$R_1 = 10\,\Omega$ $R_2 = 20\,\Omega$

$R = R_1 + R_2 = 10 + 20 = 30\,\Omega$.

$L_1 = 0.05\,H$ $L_2 = 0.1\,H$

$X_{L_1} = \omega L_1$

$= 2\pi f \cdot L_1$

$= 2 \times \pi \times 50 \times 0.05$

$X_{L_1} = 15.71\,\Omega$

$X_{L_2} = 2\pi f L_2$

$= 2 \times \pi \times 50 \times 0.1$

$X_{L_2} = 31.42\,\Omega$.

$C = 50\,\mu F$

$X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C}$

$= \frac{1}{2 \times \pi \times 50 \times 50 \times 10^{-6}}$

$X_C = 63.66\,\Omega$

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ACADEMY

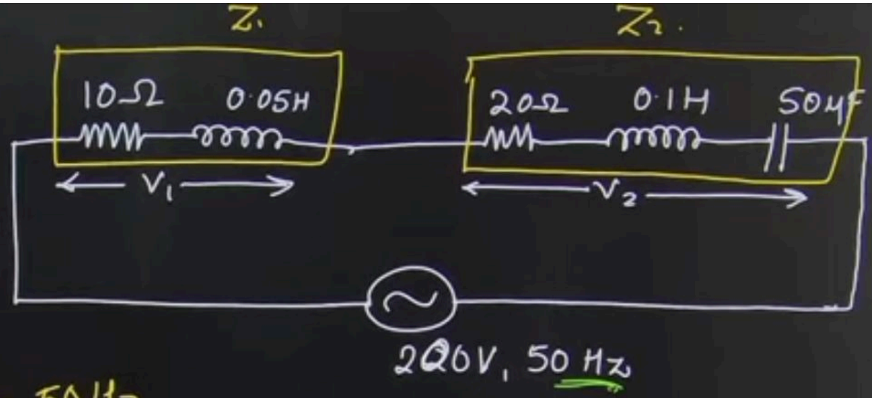
289 024

For a circuit shown in figure

(i) find current $= \frac{\text{Total V}}{\text{Total Z}}$.

(ii) Voltage drop V_1

(iii) Voltage drop V_2



Given data. V ...) $f = 50Hz$

R ... $_2 = 20\Omega$

$... 10 + 20 = 30\Omega$.

$L_1 = 0.0...$

X ... $\pi f L_2$

$... \times 50 \times 0.1$

$... 2\Omega$.

$C = 50\mu F$

$X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C}$

$= \frac{1}{2 \times \pi \times 50 \times 50 \times 10^{-6}}$

$X_C = 63.66\Omega$

$X_L = X_{L_1} + X_{L_2}$

$= 15.71 + 31.42$

$= 47.13$

$X_C = 63.66\Omega$

$X_C > X_L$

This is capacitive.

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289 024

Given data. $V = (200, \angle 0)$ $f = 50\,Hz$

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$C = 50\,\mu F$

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$= 15.71 + 31.42$

$= 47.13$

$X_C = 63.66\,\Omega$

$X_C > X_L$

This is capacitive.

$Z = (R - j(X_C - X_L))$

$\bar{Z} = (30 - j16.53)\,\Omega$

$\bar{Z} = (34.25, \angle -28.85)\,\Omega$.

$I = \dfrac{\bar{V}}{\bar{Z}} = \dfrac{(200, \angle 0)}{(34.25, \angle -28.85)}$

$= \left(\dfrac{200}{34.25} \angle [0 - (-28.85)]\right)$

$= (5.84 \angle 28.85)$

29/32

551 168

$200V,\ 50\,Hz$

(iii) Voltage drop V_2

Given data. $V = (200, \angle 0)$ $f = 50\,Hz$

$R_1 = 10\,\Omega$ $R_2 = 20\,\Omega$

$R = R_1 + R_2 = 10 + 20 = 30\,\Omega$.

$L_1 = 0.05\,H$ $L_2 = 0.1\,H$

$X_{L_1} = \omega L_1$
$= 2\pi f L_1$
$= 2\times\pi\times 50\times 0.05$
$X_{L_1} = 15.71\,\Omega$

$X_{L_2} = 2\pi f L_2$
$= 2\times\pi\times 50\times 0.1$
$X_{L_2} = 31.42\,\Omega$.

$C = 50\,\mu F$

$X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C}$
$= \frac{1}{2\times\pi\times 50\times 50\times 10^{-6}}$
$X_C = 63.66\,\Omega$

$X_L = X_{L_1} + X_{L_2}$
$= 15.71 + 31.42$
$= 47.13$
$X_C = 63.66\,\Omega$

$X_C > X_L$
This is capacitive.

$Z = (R - j(X_C - X_L)]$
$\bar{Z} = (30 - j16.53)\,\Omega$
$\bar{Z} = (34.25, \angle -28.85)\,\Omega$.

$I = \frac{\bar{V}}{\bar{Z}} = \frac{(200, \angle 0)}{(34.25, \angle -28.85)}$
$= \left(\frac{200}{34.25} \angle [0 - (-28.85)]\right)$
$I = (5.84 \angle 28.85)$

(ii) $V_1 = I Z_1$

$= (5.84 \angle 28.85)(18.62, \angle 57.52)$

$= (5.84\times 18.62, \angle 28.85 + 57.52)$

$V_1 = (108.74, \angle 86.37)$

$Z_1 = R_1 + jX_{L_1}$
$\bar{Z} = 10 + j15.71$
$\bar{Z} = (18.62, \angle 57.52)$.

551 168

$X_L = 15.71\,\Omega$

$Z = (R - j(X_C - X_L)]$

$\bar{Z} = (30 - j16.53)\,\Omega$

$\bar{Z} = (34.25, \angle -28.85)\,\Omega.$

$X_C = 63.66\,\Omega$

$I = \dfrac{\bar{V}}{\bar{Z}} = \dfrac{(200, \angle 0)}{(34.25, \angle -28.85)}$

$= \left(\dfrac{200}{34.25} \angle [0 - (-28.85])\right)$

$I = (5.84 \angle 28.85)$

(ii) $V_1 = I Z_1$

$= (5.84 \angle 28.85)(18.62, \angle 57.52)$

$= (5.84 \times 18.62, \angle 28.85 + 57.52)$

$\boxed{V_1 = (108.74, \angle 86.37)\ V}$

$V_2 = I Z_2$

$= (5.84 \angle 28.85)(37.94, \angle -58.19)$

$= (5.84 \times 37.94 \angle 28.85 - 58.19)$

$\boxed{V_2 = (221.57, \angle -29.34)\ V}$

$Z_1 = R_1 + jX_{L_1}$

$\bar{Z} = 10 + j15.71$

$\bar{Z} = (18.62, \angle 57.52).$

$\bar{Z}_2 = R_2 - j(X_C - X_L)$

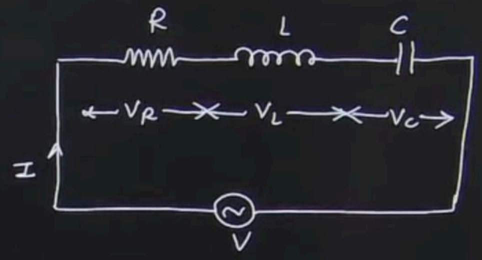
$\bar{Z}_2 = 20 - j(63.66 - 31.42)$

$= 20 - j(32.24)$

$\bar{Z} = (37.94, \angle -58.19).$

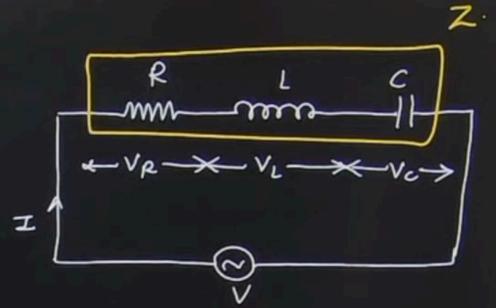
$\boxed{I = (5.84 \angle 28.85)}$

An R-L-C series circuit has a current that lags behind the applied voltage by 45°. The voltage across inductance has a maximum value equal to twice the maximum voltage across the capacitor. Voltage across the inductance is $300\sin(1000t)$ and $R = 20\,\Omega$. find values of Inductance and capacitance.



551 168

An R-L-C series circuit has a current that lags behind the applied voltage by 45°. The voltage across inductance has a maximum value equal to twice the maximum voltage across the capacitor. Voltage across the inductance is $300 \sin(1000t)$ and $R = 20\Omega$. find values of Inductance and capacitance.



Given. Inductive circuit.

$V_L = 2 V_c$ $\quad \boxed{X_L = 2 \cdot X_C}$ $\quad \phi = 45°$

$\sqrt{2} V_L = 2 \cdot \sqrt{2} V_c$ $\quad V_L = 300 \sin(1000t)$

$V_L = 2 \cdot V_c$ $\quad R = 20\Omega$.

$I X_L = 2 \cdot I X_c$ $\quad \omega = 1000$

power factor $= \cos\phi = \dfrac{R}{Z}$

$\cos 45 = \dfrac{20}{Z}$

$Z = 28.28\,\Omega$.

$Z = \sqrt{R^2 + (X_L - X_C)^2}$

$= \sqrt{20^2 + (2X_c - X_c)^2}$

$28.28 = \sqrt{400 + X_c^2}$

$X_c = 19.99\,\Omega$

$\boxed{X_c = 20\,\Omega}$

maximum voltage across the capacitor.

Voltage across the inductance is $300\sin(1000t)$ and $R = 20\,\Omega$. find values of Inductance and capacitance.

Given. Inductive circuit.

$V_L = 2V_c$ $\quad \boxed{X_L = 2 \cdot X_c}$ $\quad \phi = 45^\circ$

$\sqrt{2}V_L = 2 \cdot \sqrt{2}V_c$ $\quad V_L = 300\sin(1000t)$

$V_L = 2 \cdot V_c$ $\quad R = 20\,\Omega$.

$I X_L = 2 \cdot I X_c$ $\quad \omega = 1000$

$X_L = 2 \cdot 20$

$\boxed{X_L = 40\,\Omega}$ $\quad \boxed{X_c = 20\,\Omega}$ $\quad \boxed{Z = 28 \cdot 28}$

power factor $= \cos\phi = \dfrac{R}{Z}$

$\cos 45 = \dfrac{20}{Z}$

$Z = 28 \cdot 28\,\Omega$.

$Z = \sqrt{R^2 + (X_L - X_c)^2}$

$= \sqrt{20^2 + (2X_c - X_c)^2}$

$28 \cdot 28 = \sqrt{400 + X_c^2}$

$X_c = 19.99$

$\boxed{X_c = 20\,\Omega}$

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551 168

$V_L = 2V_c$ $\quad \boxed{X_L = 2\cdot X_c}$ $\quad \phi = 45^\circ$ $\quad Z = 28.28\,\Omega$

$\sqrt{2}V_L = 2\cdot\sqrt{2}V_c$

$V_L = 2\cdot V_c$

$I X_L = 2\cdot I X_c$

$X_L = 2\cdot 20$

$\boxed{X_L = 40\,\Omega}$

$V_L = 300\sin(1000t)$

$R = 20\,\Omega$

$\omega = 1000$

$\boxed{X_c = 20\,\Omega}$

$Z = \sqrt{R^2 + (X_L - X_c)^2}$

$= \sqrt{20^2 + (2X_c - X_c)^2}$

$28.28 = \sqrt{400 + X_c^2}$

$X_c = 19.\ldots$

$X_c = 20$

$\boxed{Z = 28.28}$

$\omega L = X_L$

$L = \dfrac{X_L}{\omega} = 40/1000 = 0.04\,H$

$\dfrac{1}{\omega C} = X_c$

$C = \dfrac{1}{\omega X_c} = \dfrac{1}{1000\times 20} = 5\times 10^{-5}$

$= \cancel{0.5\,\mu F}$

$= 50\times 10^{-6}$

$= 50\,\mu F$

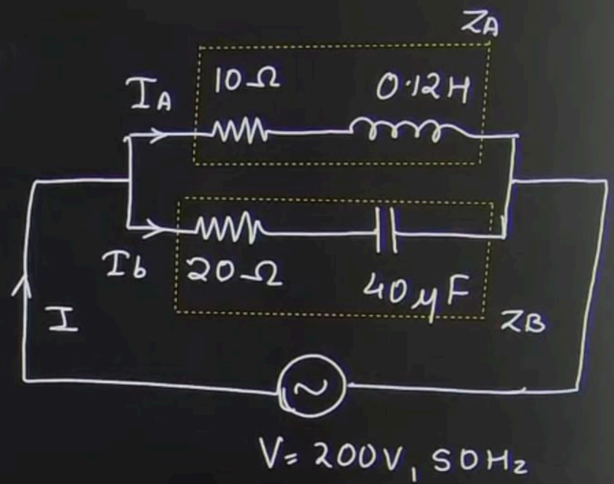
551 168

Two circuits A & B are connected in parallel across a 200V, 50Hz mains. Circuit A consists of resistance of $10\,\Omega$ and an inductance of 0.12H. connected in series with capacitor of $40\,\mu F$. Calculate

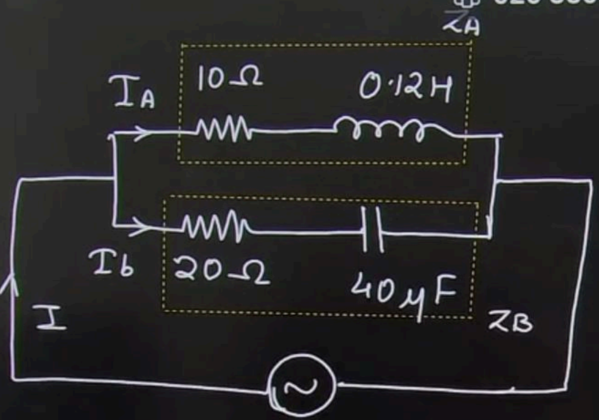
(i) Current in each branch

(ii) Power factor

(iii) Draw phasor diagram.



026 880



V= 200V, 50Hz

$V = (200 \angle 0)$

$f = 50Hz$

Consider circuit A.

$\bar{Z}_A = R_A + jX_{LA}$.

$\bar{Z}_A = 10 + j37.7\,\Omega$

$\bar{Z}_A = (39, \angle 75.14)$

$X_L = \omega \times L$

$= 2\times\pi\times f\times L$

$= 2\times\pi\times 50\times 0.12$

$X_L = 37.699\ \Omega$

$= 37.7\,\Omega$.

Consider circuit B.

$C = 40\mu F$

$X_C = \frac{1}{\omega C} = \frac{1}{2\times\pi\times 50\times 40\times 10^{-6}}$

$= 79.57$

$X_C = 79.6\,\Omega$

$Z_B = R_B - jX_C$

$\bar{Z}_B = 20 - j\,79.6\ \Omega$.

$\bar{Z}_B = (82.07, \angle -75.896)$

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Product - Rectangular/Complex form

Add/sub - Polar Form

289 024

$V = (200 \angle 0)$

$f = 50\,Hz$

Consider circuit A.

$\bar{Z}_A = R_A + jX_{LA}$.

$\bar{Z}_A = 10 + j37.7\,\Omega$

$\bar{Z}_A = (39, \angle 75.14)$

$X_L = \omega \times L$

$= 2 \times \pi \times f \times L$

$= 2 \times \pi \times 50 \times 0.12$

$X_L = 37.699\,\Omega$

$= 37.7\,\Omega$.

$Z_B = (82.07, \angle -75.896)$

$$\frac{1}{\bar{Z}} = \frac{1}{Z_A} + \frac{1}{Z_B}.$$

$$\bar{Z} = \frac{\bar{Z}_B \cdot \bar{Z}_A}{\bar{Z}_A + \bar{Z}_B} = \frac{(82.07, \angle -75.896)(39, \angle 75.14)}{(10 + j37.7) + (20 - j79.6)}$$

$$= \frac{(82.07 \times 39, \angle -75.896 + 75.14)}{30 - j41.9}$$

$$= \frac{(3200.73 \angle 0.75)}{(51.53 \angle -54.39)}$$

$$= \left(\frac{3200.73}{51.53} \angle 0.75 - (-54.39)\right)$$

$$\bar{Z} = (62.01 \angle 53.63)\,\Omega$$

$$\bar{Z} = (36.77 + j49.93)\,\Omega$$

289 024

$$\bar{Z}_A = R_A + jX_{LA}.$$

$$\bar{Z}_A = 10 + j37.7\,\Omega$$

$$\bar{Z}_A = (39, \angle 75.14)$$

$$= 2\times\pi\times 50\times 0.12$$

$$X_L = 37.699\,\Omega$$

$$= 37.7\,\Omega.$$

$$\phi = 53.63$$

$$I_A = \frac{V}{Z_A} = \left(\frac{200, \angle 0}{39, \angle 75.14}\right)$$

$$= (5.128, \angle -75.14)$$

$$I_B = \frac{V}{Z_B} = \left(\frac{200\angle 0}{82.07, \angle -75.896}\right)$$

$$= (2.44, \angle 75.896)$$

$$\bar{Z} = \frac{\bar{Z}_B\cdot\bar{Z}_A}{\bar{Z}_A+\bar{Z}_B} = \frac{(82.07, \angle -75.896)(39, \angle 75.14)}{(10+j37.7)+(20-j79.6)}$$

$$= \frac{(82.07\times 39, \angle -75.896 + 75.14)}{30 - j41.9}$$

$$= \frac{(3200.73 \angle 0.75)}{(51.53 \angle -54.39)}$$

$$= \left(\frac{3200.73}{51.53}\angle \underbrace{0.75 - (-54.39)}_{\phi}\right)$$

$$\bar{Z} = (62.01 \angle 53.63)\,\Omega$$

$$\bar{Z} = (36.77 + j49.93)\,\Omega$$

$\bar{Z}_A = R_A + jX_{LA}$

$\bar{Z}_A = 10 + j37.7\,\Omega$

$\bar{Z}_A = (39, \angle 75.14)$

289 024

$X_L = 2\times\pi\times 50\times 0.12$

$= 37.699\,\Omega$

$= 37.7\,\Omega$

$\phi = 53.63$

$pf = \cos\phi = \cos 53.63$

$= 0.594$

$= 0.6$ [lagging]

$I_A = \dfrac{V}{Z_A} = \left(\dfrac{200, \angle 0}{39, \angle 75.14}\right)$

$= (5.128, \angle -75.14)$

$I_B = \dfrac{V}{Z_B} = \left(\dfrac{200\angle 0}{82.07, \angle -75.896}\right)$

$= (2.44, \angle 75.896)$

$\bar{Z} = \dfrac{\bar{Z}_B \cdot \bar{Z}_A}{\bar{Z}_A + \bar{Z}_B} = \dfrac{(82.07, \angle -75.896)(39, \angle 75.14)}{(10+j37.7)+(20-j79.6)}$

$= \dfrac{(82.07\times 39, \angle -75.896 + 75.14)}{30 - j41.9}$

$= \dfrac{(3200.73 \angle 0.75)}{(51.53 \angle -54.39)}$

$= \left(\dfrac{3200.73}{51.53} \angle 0.75 - (-54.39)\right)$

$\bar{Z} = (62.01 \angle \underbrace{53.63}_{\phi})\,\Omega$

$\bar{Z} = (36.77 + j49.93)\,\Omega$

$$I_A = \frac{V}{Z_A} = \left(\frac{200, \angle 0}{39, \angle 75.14}\right) = (5.128, \angle -75.14)$$

$= 0.6$ [lagging]

$(51.53 \angle -54.39)$

$$= \left(\frac{3200.73}{51.53} \angle 0.75 - (-54.39)\right)$$

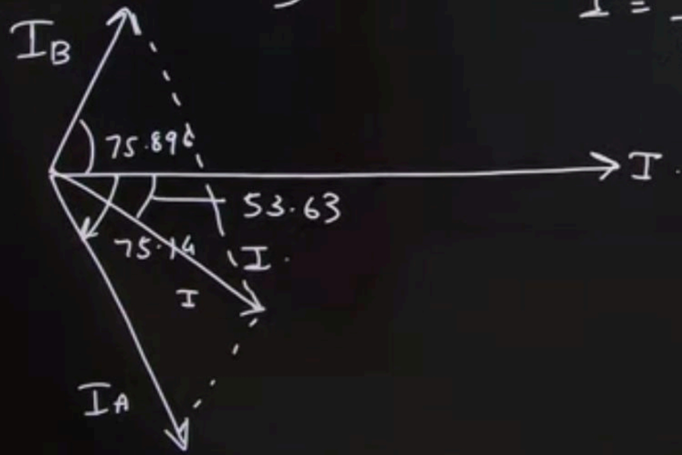
ϕ

$$\bar{Z} = (62.01 \angle \underline{53.63})\,\Omega$$

$$\bar{Z} = (36.77 + j\,49.93)\,\Omega$$

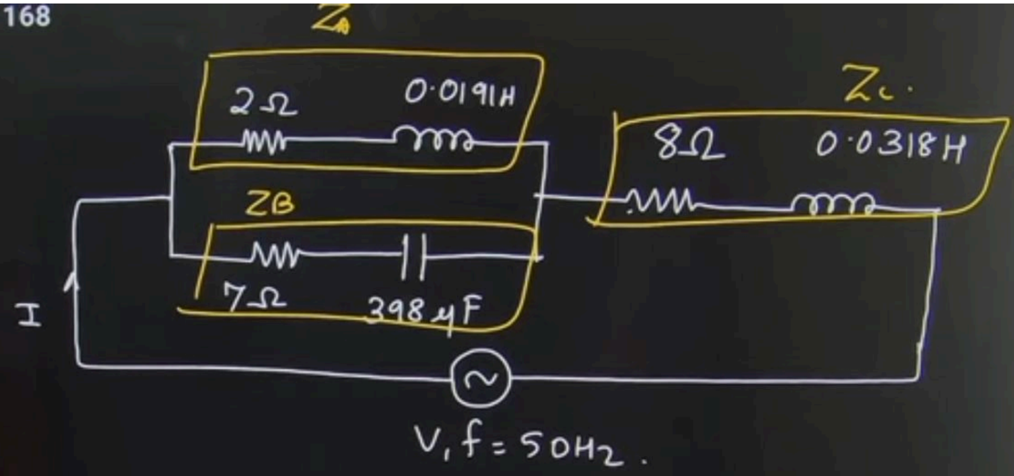
$$I_B = \frac{V}{Z_B} = \left(\frac{200\angle 0}{82.07, \angle -75.896}\right) = (2.44, \angle 75.896)$$

$$I = \frac{V}{\bar{Z}} = \frac{200\angle 0}{(62.01 \angle 53.63)} = \underline{3.22} \angle -53.63$$



551 168

Determine the equivalent impedance Z of circuit shown in figure

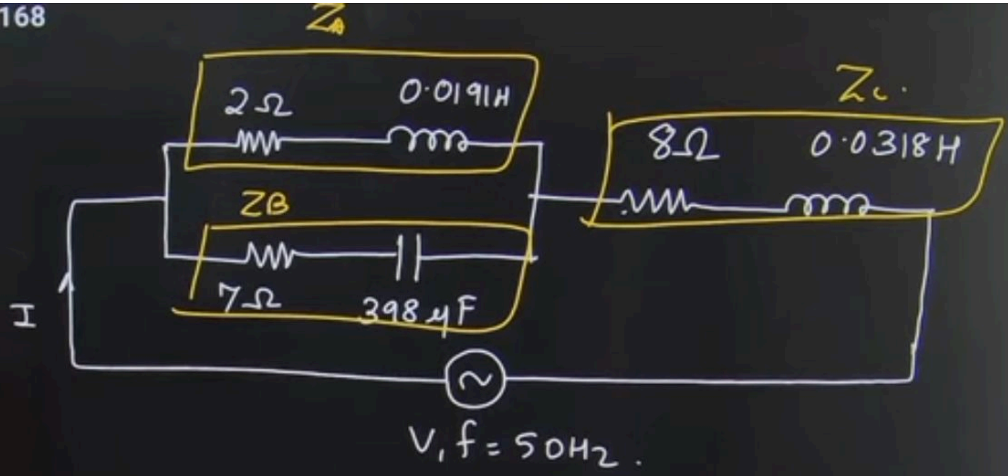


$$Z = R + j(X_L - X_C)$$

$$Z = R + j\left(\omega L - \frac{1}{\omega C}\right)$$

$$Z = R + j\left(2\pi f L - \frac{1}{2\pi f C}\right)$$

Determine the equivalent impedance Z of circuit shown in figure



$Z = R + j(X_L - X_C)$

$Z = R + j\left(\omega L - \frac{1}{\omega C}\right)$

$Z = R + j\left(2\pi f L - \frac{1}{2\pi f C}\right)$

$$Z_A = R + j\left(2\pi f L - \cancel{\frac{1}{2\pi f C}}^{\,0}\right)$$

$$= 2 + j(2\pi f\, 0.0191)$$

$$\bar{Z}_A = 2 + j(6)\Omega$$

$$= (6.32 \angle 71.56)$$

$$Z_B = 7 + j\left(0 - \frac{1}{2 \times \pi \times 50 \times 398 \times 10^{-6}}\right)$$

$$\bar{Z}_B = 7 - j(8)\Omega = (10.63 \angle -48.81)$$

$$Z_C = 8 + j(2 \times \pi \times 50 \times 0.0318)$$

$$\bar{Z}_C = 8 + j10 = (12.806, \angle 51.34).$$

026 880

Total Impedance $Z = Z_A \parallel Z_B + Z_C$

$$Z = \frac{Z_B \cdot Z_A}{Z_A + Z_B} + Z_C$$

$$= \frac{(10.63, \angle -48.81)(6.32, \angle 71.56)}{(2 + j6) + (7 - j8)} + 8 + j10$$

$$= \frac{(10.63 \times 6.32)(\angle -48.81 + 71.56)}{(9 - 2j)} + 8 + j10$$

$$= \frac{67.18 \angle 22.76}{9.22 \angle 12.53} + 8 + j10$$

$$= \left(\frac{67.18}{9.22} \angle 22.76 + 12.53\right) + 8 + j10$$

$$= (7.28 \angle 35.29)(+8 + j10) = 5.94 + j4.205 + 8 + j10$$

$$\boxed{Z = 13.94 + j14.205}$$

$$\bar{Z} = (19.9, \angle 45.53)$$

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