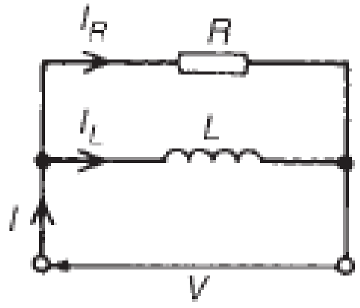
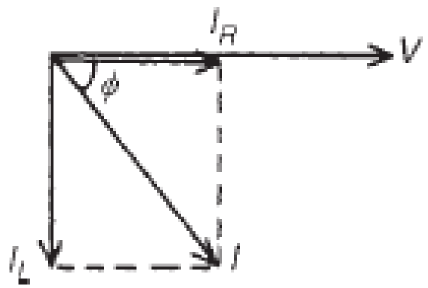
Parallel Circuits

CIRCUIT DIAGRAM



PHASOR DIAGRAM



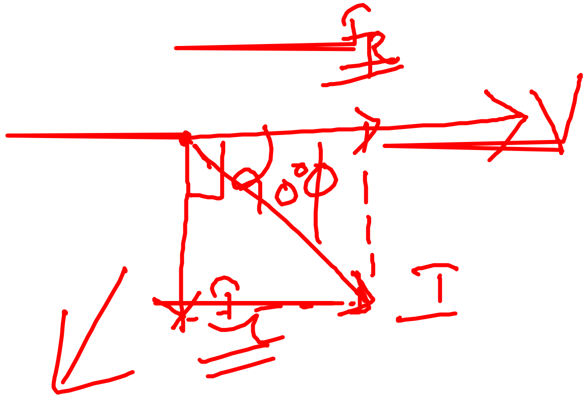
$$I = \sqrt{(I_R^2 + I_L^2)}, \text{ (by Pythagoras' theorem)}$$

where $I_R = \dfrac{V}{R}$ and $I_L = \dfrac{V}{X_L}$

$$\tan\phi = \frac{I_L}{I_R}, \sin\phi = \frac{I_L}{I} \text{ and}$$

$$\cos\phi = \frac{I_R}{I} \text{ (by trigonometric ratios)}$$

Circuit impedance, $Z = \dfrac{V}{I}$



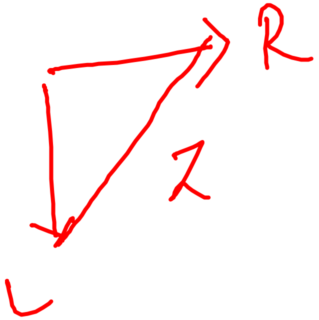
$\vec{I} = \vec{I}_R + \vec{I}_L$

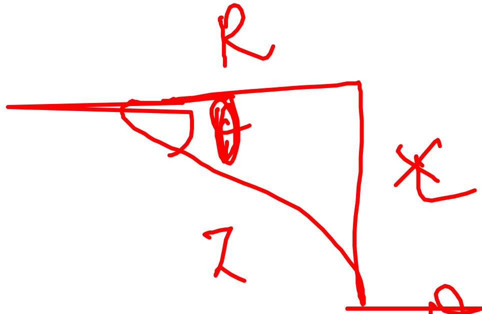
$= I_R \angle 0^\circ + I_L \angle 90^\circ$

$\phi =$

$\theta = \tan^{-1}\left(\frac{I_L}{I_R}\right)$

Impedance Δ





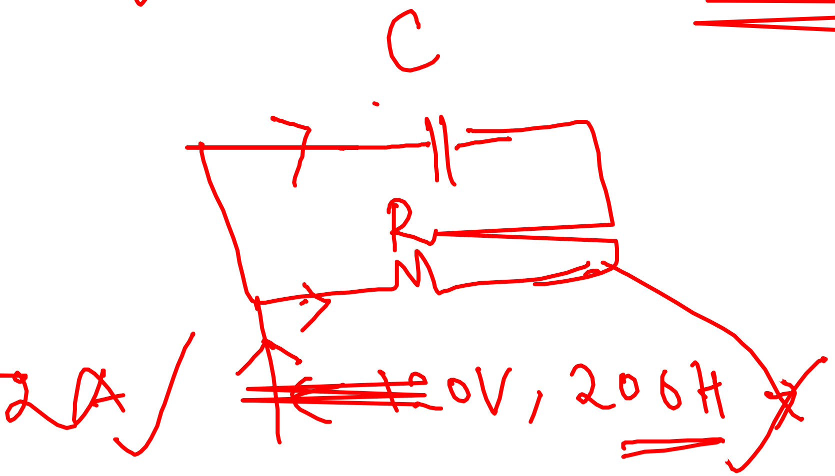
$Z = \sqrt{R^2 + X^2}$

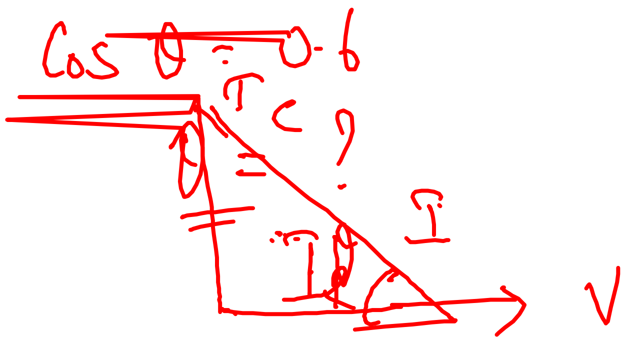
$\theta = \tan^{-1}\left(\frac{X_L}{R}\right)$

A capacitor C is connected in parallel with a resistor R across a 120V, 200Hz supply. The supply current is 2A at a power factor of 0.6 leading. Determine the values of C and R.

$\cos\theta = PF$

$\cos\theta = 0.6$





$\cos\theta = I_R / I$

$0.6 = \frac{I_R}{2}$

$I_R = 1.2\,A$

$R = V / I_R =$

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

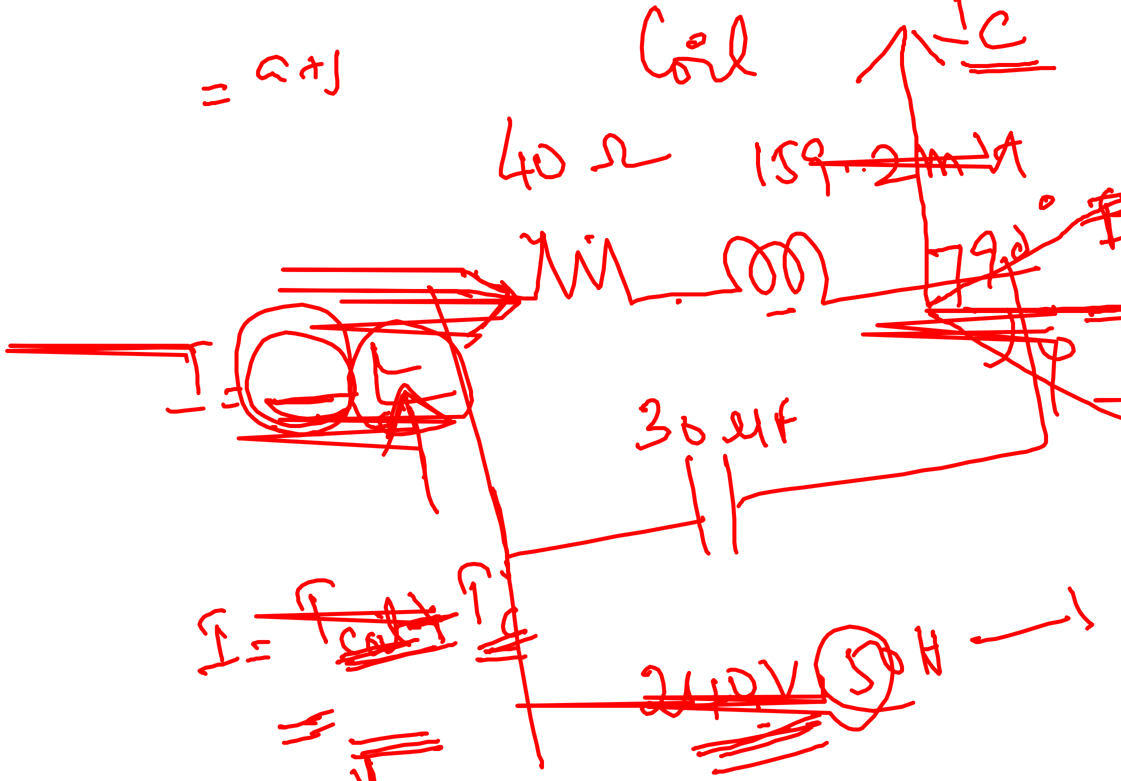
$C = \frac{V}{I_C \times}$

$\sin\theta = \frac{I_C}{I}$

$I_C/2$

$I_C =$

A coil of inductance 159.2mH and resistance 40 is connected in parallel with a 30μF capacitor across a 240V, 50Hz supply. Calculate (a) the current in the coil and its phase angle, (b) the current in the capacitor and its phase angle, (c) the supply current and its phase angle, (d) the circuit impedance. e) the total power consumed. Draw the phasor diagram.

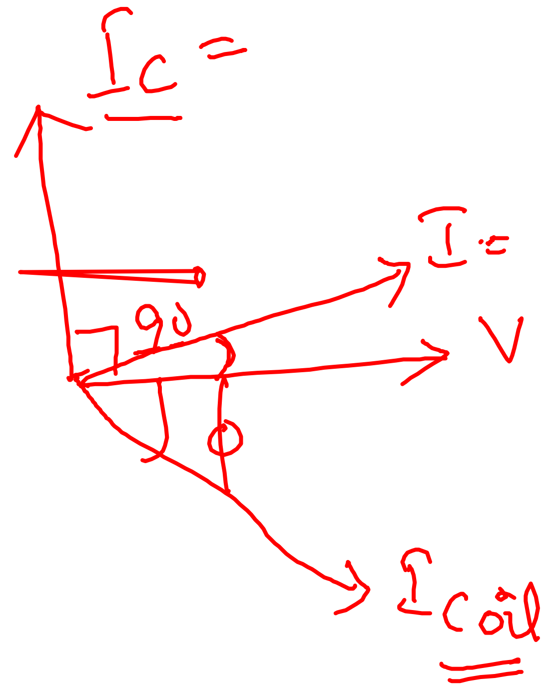


$$Z = V/I$$

$$I_{coil} = \frac{V}{Z_{coil}} = \frac{V}{\sqrt{R^2 + X_L^2}} = A$$

$$\phi_{coil} = \tan^{-1}\left(\frac{X_L}{R}\right)$$

$$\phi_{cap} = -90^\circ \quad I = \frac{V}{X_C}$$



$I_C =$
$I =$
V
90
ϕ
I_{coil}

coil
R
L

$i = 2/Z \cos 10t + \theta$ $A_m \sin \omega t + \theta$

$i = \frac{V}{Z_{total}}$

$\to V$

$Z_{tot} = \frac{1 \times jX_L}{1 + jX_L}$

$\omega = 10$

$f = \frac{\omega}{2\pi} = \frac{10}{2\pi} =$

$X_L = a \angle 90^\circ$

$X_C = \angle -90^\circ$

$= jX_L$ $-jX_C$

$[1\Omega \parallel jX_{L_1}]$

$1 + j \parallel -jX_C$ $+ j$

$= Z_2$

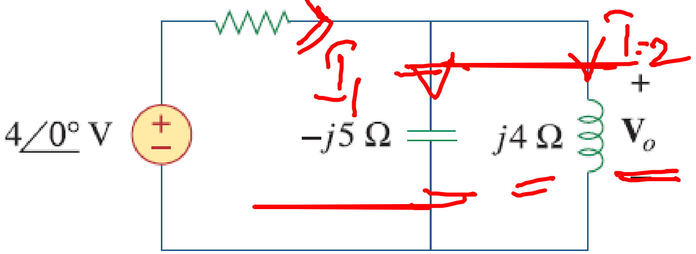
Z_1

$\frac{Z_1 Z_2}{Z_1 + Z_2} + 1\Omega$ $= \frac{\quad}{\quad} + \frac{\quad}{\quad}$

Z_{tot}

$i = \frac{2\angle 0^\circ}{Z\angle\theta} = \frac{1}{|Z|\angle\theta}$ $Z_1 + Z_2$

$Z_{tot} =$



$$Z_{tot} = 2 + \left(\frac{-j5 \times j4}{-j5 + j4} \right)$$

$$= 2 + \frac{20}{-j1}$$

$$= 2 + 20j$$

$$Z_{total} = \sqrt{20^2 + 2^2} \angle \tan^{-1}(20/2) = 20.1 \angle 84.2^\circ \ \Omega$$

$$I = \frac{V}{Z} = \frac{4\angle 0^\circ}{20.1\angle 84.2}$$

$$I = 0.2 \angle -84.2 \ A$$

$$I_2 = I \times \frac{-j5}{}$$

$$I_2 = 1 \angle 84.2 - 81$$

$$V_o = I_2 \times j4$$

$$= 1\angle 84.2 \times 4\angle 90^\circ$$

$$V_o = 4 \angle 5.8^\circ \ V$$

A 110-V rms, 60-Hz source is applied to a load impedance Z. The apparent power entering the load is 120 VA at a power factor of 0.707 lagging.

(a) Calculate the complex power.

(b) Find the rms current supplied to the load.

(c) Determine Z.

(d) Assuming that $z=R+j\omega L$ find the values of R and L.

Consider the circuit of below Fig.

i) Find Z_T.

ii) Determine the current I_1, I_2 and I_3.

iii) Calculate the total power provided by the voltage source.