

$$L = 1 \text{ mH} = 1 \times 10^{-3} \text{ H}$$

$$X_L = j\omega L$$

$$= j \times 100 \times 10^{-3} = 0.1j\Omega$$

$$C = 10 \text{ mF} = 10 \times 10^{-3} \text{ F}$$

$$X_C = 1/j\omega C = 1/j \times 100 \times 10^{-3} \times 10 = -j\Omega$$

$$V_{S2} = 100\angle -90^\circ \text{ V}$$

$$10V_{S2} = 1000\angle -90^\circ \text{ A}$$

$$(i) \quad I_C = \frac{V_{S2}}{X_C} = \frac{100\angle -90^\circ}{-j} = \frac{100\angle -90^\circ}{\angle -90^\circ} = 100\angle 0^\circ \text{ A}$$

in time domain:-

$$i_C(t) = 100 \cos(100t) \text{ A}$$

(ii) Complex power across independent sources:-

At node V_{S2}

$$10\angle 30^\circ + I_{S2} = \frac{V_{S2}}{-j} + \frac{V_{S2}}{10} + 1000\angle -90^\circ$$

$$\Rightarrow 10\angle 30^\circ + I_{S2} = \frac{100\angle -90^\circ}{\angle -90^\circ} + \frac{100\angle -90^\circ}{10} + 1000\angle -90^\circ$$

$$\Rightarrow I_{S2} = -10\angle 30^\circ + 100\angle 0^\circ + 10\angle -90^\circ + 1000\angle -90^\circ$$

$$= 100 - j10 - j1000 - 8.66 - j5$$

$$= 91.34 - j1015$$

magnitude:- $\sqrt{(91.34)^2 + (1015)^2}$

$$= \sqrt{8342.99 + 1030225} = 1019.10$$

$$\text{angle} = \tan^{-1}(-1015/91.34)$$

$$= -84.85$$

$$\Rightarrow 1019.10 \angle -84.85 \text{ A} \quad (1)$$

\Rightarrow Complex power through voltage source:-

$$= \frac{1}{2} \times V_{s2} \times I_{s2}^*$$

$$= \frac{1}{2} \times 100 \angle -90^\circ \times 1019 \angle 84.85$$

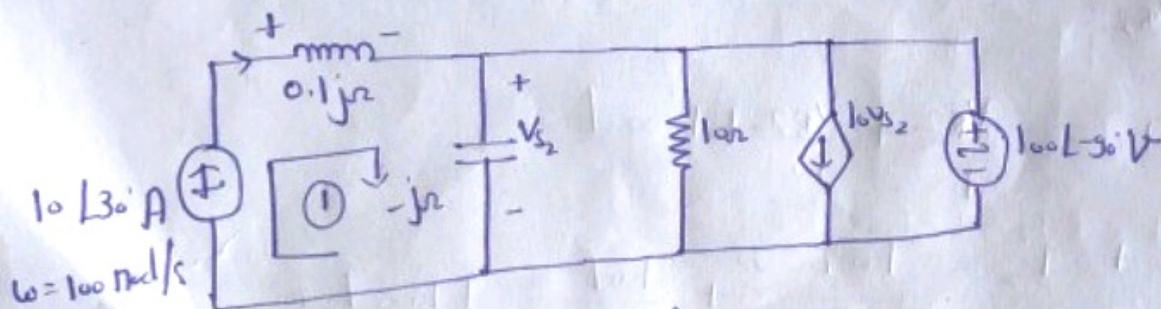
$$= 50,950 \angle -5.15 \text{ VA}$$

$$\Rightarrow 50744.43 - j4573.4 \text{ VA} \quad (1)$$

\Rightarrow Time Average power = 50744.43 watts (0.5)

Reactive power = -4573.4 VAR. (0.5)

\Rightarrow Complex power due to current source:-



Applying equation in loop 1:-

$$\Rightarrow 10 \angle 30^\circ \times 0.1 \angle 90^\circ + 100 \angle -90^\circ = V_{S1}$$

$$= 1 \angle 120^\circ + 100 \angle -90^\circ = V_{S1}$$

$$= -j100 - 0.5 + j0.86$$

$$= -0.5 - j99.14$$

$$= \sqrt{0.25 + 9828.73}$$

$$= 99.14$$

$$\cos^{-1} \left(\frac{99.14}{0.5} \right) = 89.71$$

$$\Rightarrow 99.14 \angle 89.71^\circ \text{ V} \quad (1)$$

Watch out for
-ve sign here.

Complex power

$$\Rightarrow \frac{1}{2} \times V_{S1} \times I_{S1}^*$$

$$= \frac{1}{2} \times 99.14 \angle 89.71^\circ \times 10 \angle -30^\circ$$

$$= 495.7 \angle 59.71^\circ \text{ VA}$$

$$= 250.01 + j428.02 \text{ VA} \quad (1)$$

Time Average power = 250.01 watts (0.5)

Reactive power = 428.02 VAR (0.5)

(iii) Power factor due to current source

$$= \cos(0^\circ) = \cos(89.71^\circ - 30^\circ)$$

$$= \cos(59.71^\circ)$$

$$(1) = 0.5 ; \text{ ~~leading~~ ~~lagging~~ leading}$$

Power factor due to voltage source:-

$$\cos(0^\circ) = \cos(-90^\circ + 84.85^\circ)$$

$$= \cos(-5.15^\circ)$$

$$= 0.995 ; \text{lagging}$$

①