

# AC Tutorial sheet No.3

$$1) \quad v = 80 \cos(10t + 20^\circ) \\ = 80 \sin(10t + 20^\circ + 90^\circ) \\ = 80 \sin(10t + 110^\circ)$$

$$i = 15 \sin(10t + 60^\circ)$$

$$V_m = 80 \text{ V}, I_m = 15 \text{ A}$$

$$V_{\text{rms}} = \frac{80}{\sqrt{2}}, I_{\text{rms}} = \frac{15}{\sqrt{2}}$$

$$p = VI \cos \theta - VI \cos(2\omega t - \theta)$$

$$\omega = 10 \text{ rad/s}$$

$$p = \frac{80 \times 15 \cos 50^\circ}{2} - \frac{80 \times 15}{2} \cos(20t - 50^\circ)$$

$$= 600 \cos 50^\circ - 600 \cos(20t - 50^\circ)$$

$$= 385.7 - 600 \cos(20t - 50^\circ)$$

$$P = VI \cos \theta = 385.7 \text{ Watt}$$

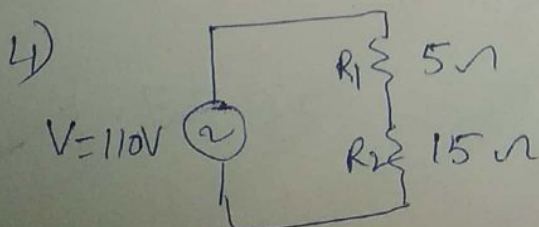
$$2) \quad V_L = L \frac{di}{dt}, V_L = 20 \text{ V}, \frac{di}{dt} = \frac{20 - 12}{2} = 8 \text{ A/s}$$

$$20 = L \frac{8}{2}$$

$$L = 5 \text{ H}$$

$$3) \quad L = 50 \text{ mH}, \frac{di}{dt} = 10000 \text{ A/s}$$

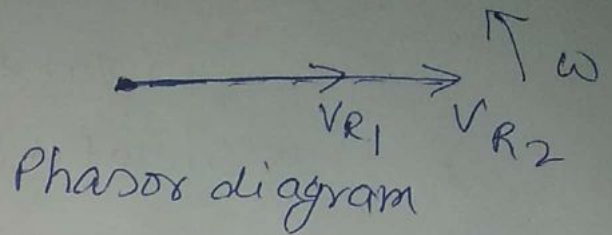
$$V_L = L \frac{di}{dt} = 50 \times 10^{-3} \times 10^4 \\ = 50 \times 10^{-2} = 0.5 \text{ V}$$



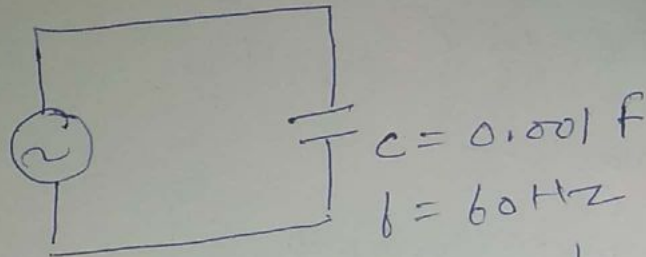
$$V_{R1} = \left( \frac{V_s}{R_1 + R_2} \right) R_1 = \frac{110}{20} \times 5 = 27.5 \text{ V}$$

$$V_{R2} = \left( \frac{V_s}{R_1 + R_2} \right) R_2 = \frac{110}{20} \times 15 = 82.5 \text{ V}$$

$$I = \frac{V_s}{R_1 + R_2} = \frac{110}{20} = 5.5 \text{ A}$$



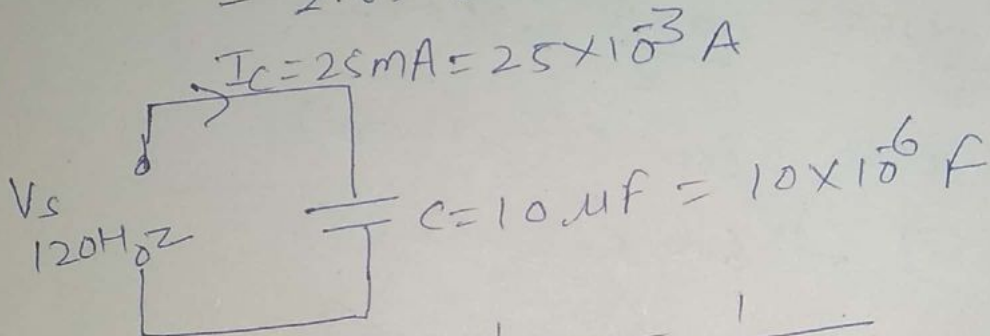
(5)



$$X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C} = \frac{1}{(2\pi \times 60 \times 0.001)}$$

$$= 2.65 \Omega$$

(6)



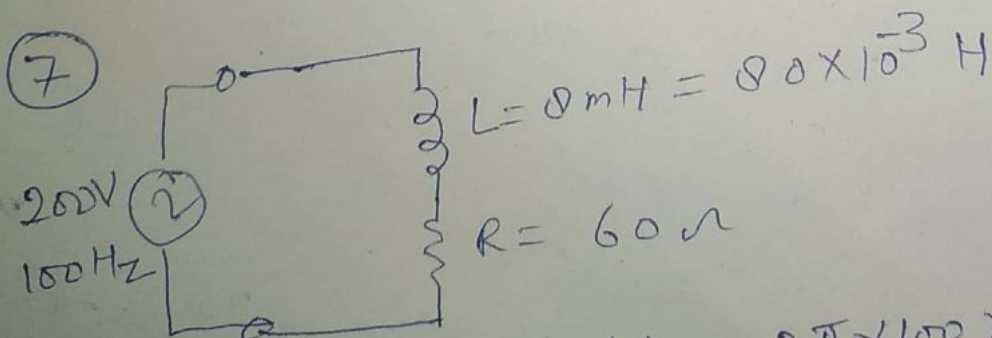
$$X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C} = \frac{1}{(2\pi \times 120 \times 10 \times 10^{-6})}$$

$$= 132.629 \Omega$$

$$V_C = I X_C = 25 \times 10^{-3} \times 132.629$$

$$= 3.3157 \text{ V}$$

(7)



$$X_L = \omega L = 2\pi f L = 2\pi \times 100 \times 80 \times 10^{-3} = 50.26 \Omega$$

$$Z = \sqrt{R^2 + X_L^2} = \sqrt{60^2 + 50.26^2} = 78.27 \Omega$$

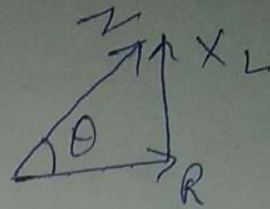


$$I = \frac{V}{Z} = \frac{200}{78.27} = 2.555 \text{ A}$$

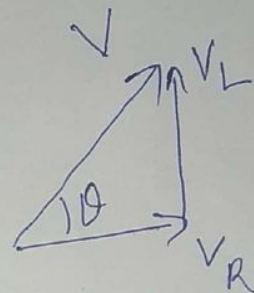
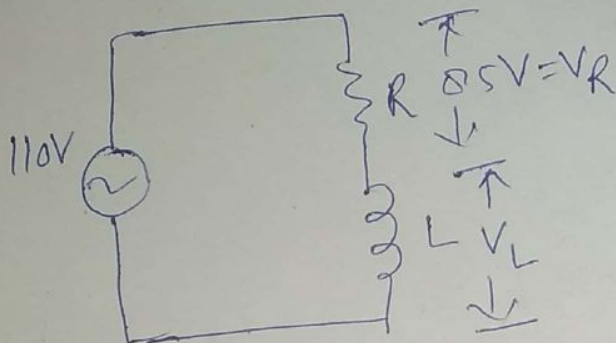
$$\tan \theta = \frac{X_L}{R}$$

$$\theta = \tan^{-1} \left( \frac{X_L}{R} \right) = 39.95^\circ \text{ lagging}$$

$$\cos \theta = \frac{R}{Z} = \frac{60}{78.27} \Rightarrow \theta = \cos^{-1} \left( \frac{R}{Z} \right) = \cos^{-1} \left( \frac{60}{78.27} \right) = 39.9^\circ \text{ lagging}$$



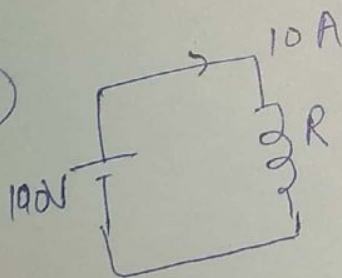
⑧



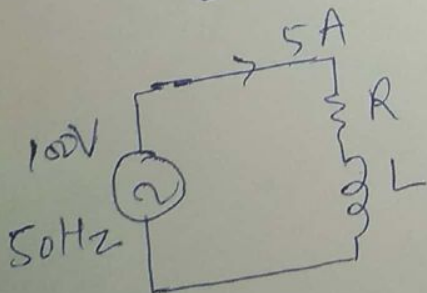
$$V_R^2 + V_L^2 = V^2$$

$$V_L = \sqrt{V^2 - V_R^2} = \sqrt{110^2 - 85^2} = 69.82 \text{ V}$$

⑨



$$R = \frac{V_S}{I} = \frac{100}{10} = 10 \Omega \text{ Ans}$$



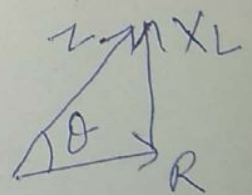
$$Z = \frac{V}{I} = \frac{100}{5} = 20 \Omega$$

$$X_L = \sqrt{Z^2 - R^2}$$

$$= \sqrt{20^2 - 10^2} = 17.32 \Omega$$

$$X_L = \omega L = 2\pi f L$$

$$L = \frac{X_L}{2\pi f} = \frac{17.32}{2\pi \times 50} = 55.13 \text{ mH} \text{ Ans}$$



(10)

$$V_s = 120V, f = 50Hz$$

$$Z = 10 + j20$$

$$= R + jX_L$$

$$R = 10\Omega, X_L = 20\Omega$$

$$\text{Impedance } |Z| = \sqrt{R^2 + X_L^2} \\ = 22.36\Omega$$

$$\theta = \tan^{-1}\left(\frac{X_L}{R}\right) = 63.434^\circ$$

$$Z = 10 + j20 = 22.36 \angle 63.434^\circ$$

$$I = \frac{V_s}{Z} = \frac{120 \angle 0^\circ}{22.36 \angle 63.434^\circ} \\ = 5.36 \angle -63.434^\circ \text{ A}$$

$$P = I^2 R = (5.36)^2 \times 10$$

$$= 288 \text{ watt} \quad \underline{\text{Ans}}$$