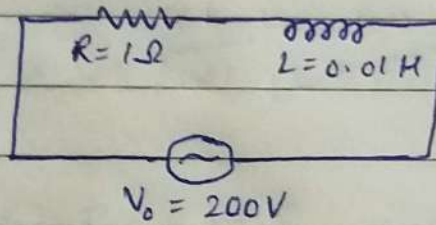**7.23** A coil of 0.01 henry inductance and 1 ohm resistance is connected to 200 volt, 50 Hz ac supply. Find the impedance of the circuit and time lag between max. alternating voltage and current.

23.

$$\nu = 50Hz \ (Given) \Rightarrow \omega = 2\pi\nu$$

$$\omega = \underset{100\pi}{\cancel{100}} \ rad/s$$

$$\therefore \ X_L = \omega L$$
$$= (\underset{100\pi}{\cancel{100}})(0.01)$$
$$X_L = \pi \ \Omega$$

$$\therefore \ Z = \sqrt{X_R^2 + X_L^2}$$
$$= \sqrt{1 + \pi^2}$$
$$\boxed{Z = \cancel{\text{---}} \ 3.3 \ \Omega}$$

$$\therefore \ \tan\phi = \frac{X_L}{R} = \frac{\cancel{2\pi\pi} \ \pi}{1} = \pi \ \cancel{\text{---}}$$

$$\Rightarrow \ \phi = \tan^{-1}(3.14)$$

$$\phi = 72° = \frac{72 \times \pi}{180} \Rightarrow 1.2$$

$$\Rightarrow \ \phi = 1.2 \ radian$$

We know that

$$\phi = \omega t \quad \boxed{(\star \quad \phi \ \& \ \omega \text{ must be in radians})}$$

$$\Rightarrow t = \frac{\phi}{\omega} = \frac{72 \times \pi}{180 \times 2 \times \pi \times 50} = \frac{1 \text{ s.}}{250}$$

$$\Rightarrow \boxed{t = \frac{1}{250} \text{ sec.}} \quad \text{is the time lag between maximum voltage and current.}$$