Determination of an inductance of a coil by vectors method

Aim:

Determination of an inductance of a coil by vectors method

Apparatus:

1. Low voltage, A.C. source.
2. Voltammeter.
3. coil.
4. resistance.
5. White board

Theory:

In the circuit shown in Fig. (1) the voltage V_3 across the circuit is the vector sum of both the voltage V_1 across the resistor R_1 and the voltage V_2 across the coil (L).
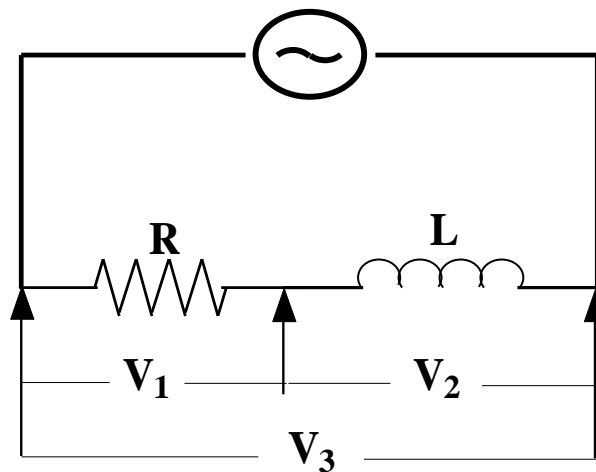
Where $V_1 = IR1$

Fig (1)

The voltage V_2 across the coil is the vector sum of voltage V_R due to the ohmic resistance R and voltage V_L due to inductive reactance X_L, V_R is represented by the vector BD which is phase with V_1 and V_2 is represented by the CD which is $\pi/2$ out of phase with V_1.
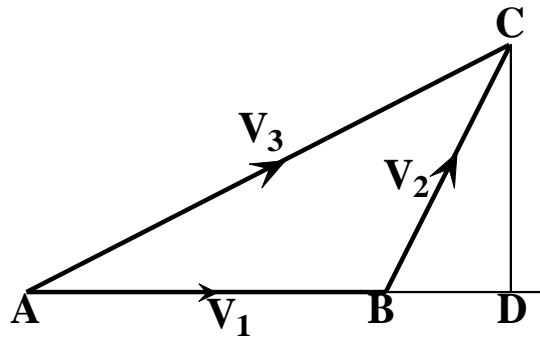

Fig (2)

In Fig. (2)

V1 is represented by the vector AB.

V2 is represented by the BC.

V3 is represented by the AC.

Thus

$$IR = BD \qquad\qquad (2)$$

and

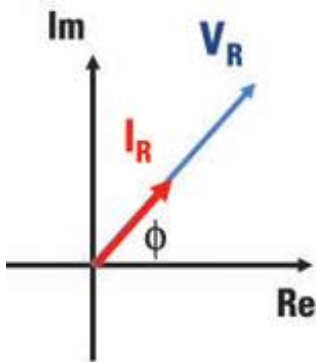$$IX_L = CD \qquad\qquad (3)$$

From (1) and (2) we get

$$R = \frac{BD}{AB} R_1 \qquad\qquad (4)$$

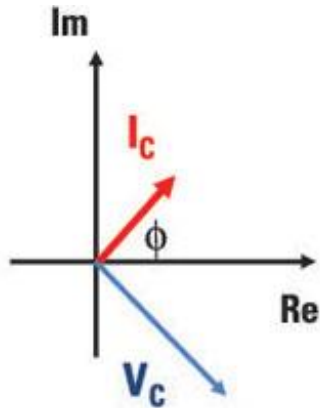From (1) and (3)

$$XL = (CD/AB)\ R_1$$

$$XL = 2\pi f\,L$$

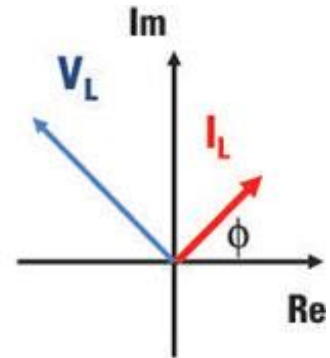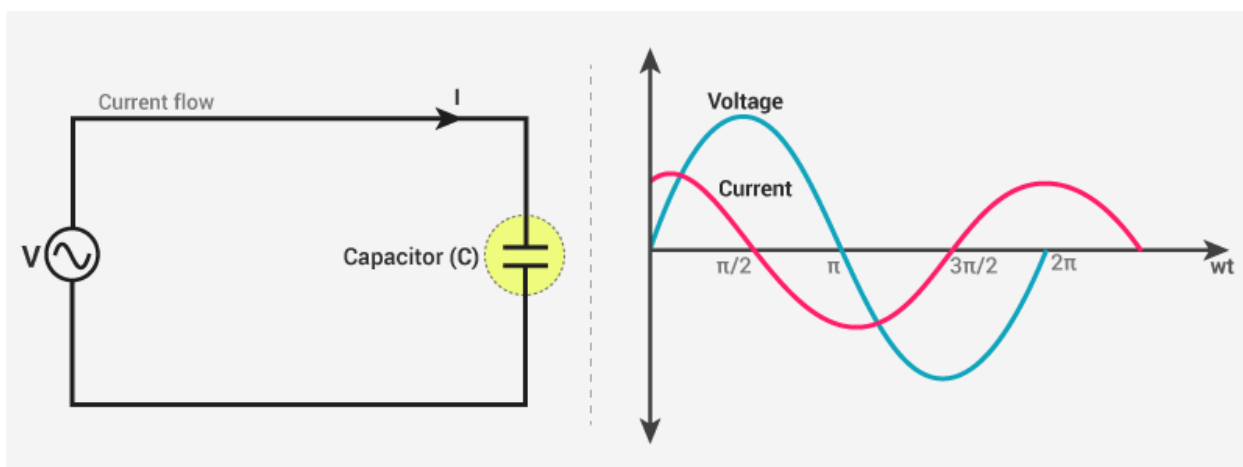$$L = \frac{CD}{AB} \times \frac{R_1}{2\pi f} \qquad\qquad (5)$$

Resistor	Capacitor	Inductor
Im, **V$_R$**, **I$_R$**, ϕ, **Re**	**Im**, **I$_C$**, ϕ, **Re**, **V$_C$**	**Im**, **V$_L$**, **I$_L$**, ϕ, **Re**

Resistor

Voltage in phase
with current

Capacitor

Voltage lags
current by 90°

Inductor

Voltage leads
current by 90°

Current flow   I

V   Capacitor (C)

Voltage

Current

$\pi/2$ π $3\pi/2$ 2π wt

$$V_{C(t)} = V_m \sin(\omega t)$$

$$I_{C(t)} = I_m \sin(\omega t + 90°)$$

$\frac{\pi}{2}$ or 90°

$\theta(\omega t)$
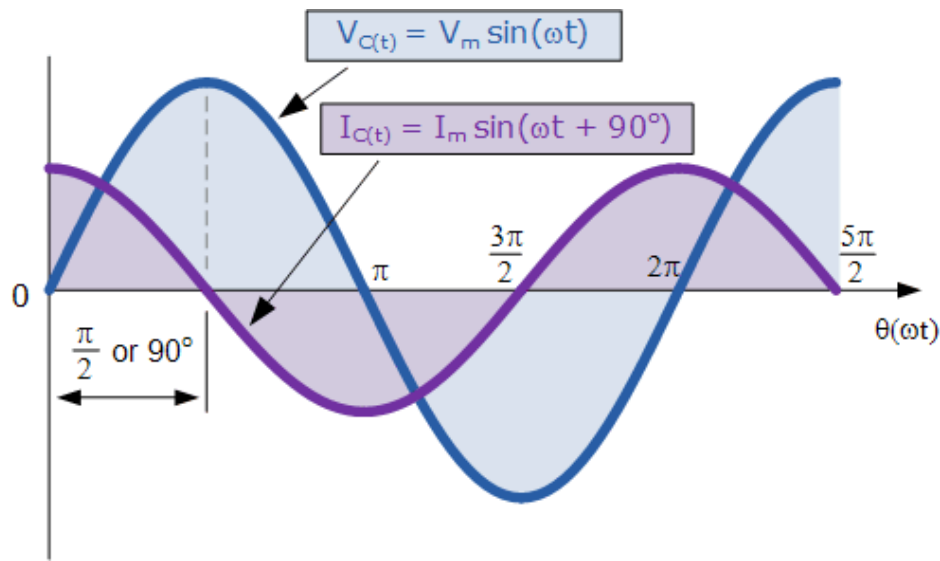
Method:

1. Connect the circuit as shown in Fig. (1).

2. Measure the voltage across the resistor, coil and across the circuit.

3. Draw the vector triangle in case of the coil.
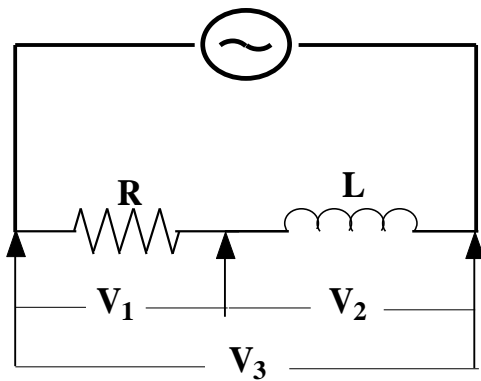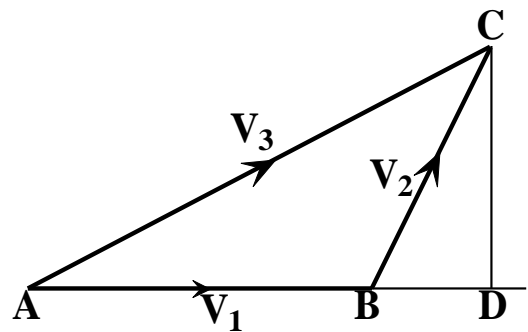
4. Calculate inductance of the coil L.

Fig (1)

Results:

For coil

The Inductance of the coil (L)=