ST. LAWRENCE HIGH SCHOOL

A JESUIT CHRISTIAN MINORITY INSTITUTION

STUDY MATERIAL : 8 (Part - 1)

Subject : PHYSICS

Topic : Alternating current

CLASS : XII

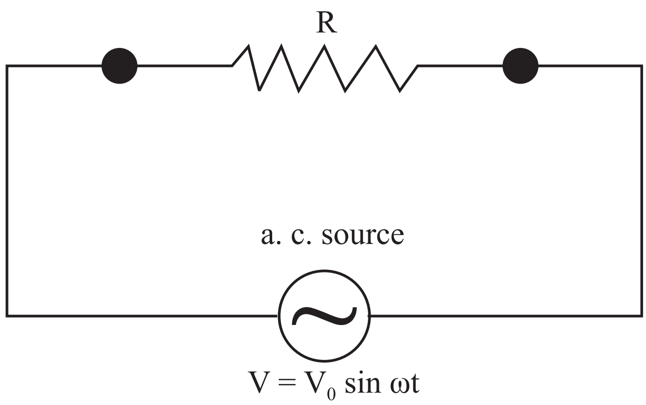
Date : 01.08.2020

A : Various components across a.c. supply

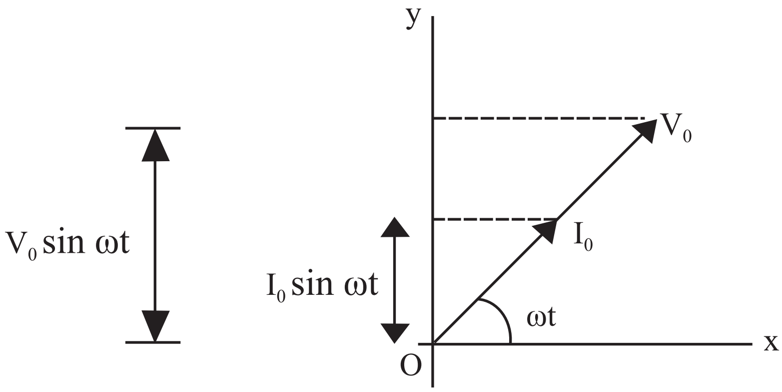
Sl. No.	Alternating voltage	Alternating current	Phase relationship between voltage and current	Impedance	Average Power Loss
1.	***Pure resistance*** $V = V_o \sin \omega t$	$I = I_0 \sin \omega t$	In phase	$Z = R$	$I^2_{rms} R$
2.	***Pure inductance*** $V = V_o \sin \omega t$	$I = I_0 \sin (\omega t - 90^0)$	Current lags by 90^0	$Z = X_L = \omega L = 2\pi\nu L$	nil
3.	***Pure capacitance*** $V = V_o \sin \omega t$	$I = I_0 \sin (\omega t + 90^0)$	Current leads by 90^0	$Z = X_C = \frac{1}{\omega C} = \frac{1}{2\pi\nu C}$	nil
4.	***Series resistance and Pure inductance*** $V = V_o \sin \omega t$	$I = I_0 \sin (\omega t - \Phi)$	Current lags by Φ	$Z = \sqrt{R^2 + X_L^2}$	$V_{rms} I_{rms} \cos \Phi$
5.	***Series resistance and Pure capacitance*** $V = V_o \sin \omega t$	$I = I_0 \sin (\omega t + \Phi)$	Current leads by Φ	$Z = \sqrt{R^2 + X_C^2}$	$V_{rms} I_{rms} \cos \Phi$
6.	***Series resistance inductance and capacitance*** ***(i) Predominantly inductive*** $V = V_o \sin \omega t$	$I = I_0 \sin (\omega t - \Phi')$	Current lags by Φ'	$Z = \sqrt{R^2 + (X_L - X_C)^2}$	$V_{rms} I_{rms} \cos \Phi$
	(ii) Predominantly capacitive $V = V_o \sin \omega t$	$I = I_0 \sin (\omega t + \Phi')$	Current leads by Φ'	$Z = \sqrt{R^2 + (X_C - X_L)^2}$	$V_{rms} I_{rms}$ x $\cos \Phi$

B. GRAPHS AND CIRCUIT DIAGRAMS

B-1. An A. C. source connected to a resistor of resistance R is shown in figure. Such a circuit is known as a resistive circuit.

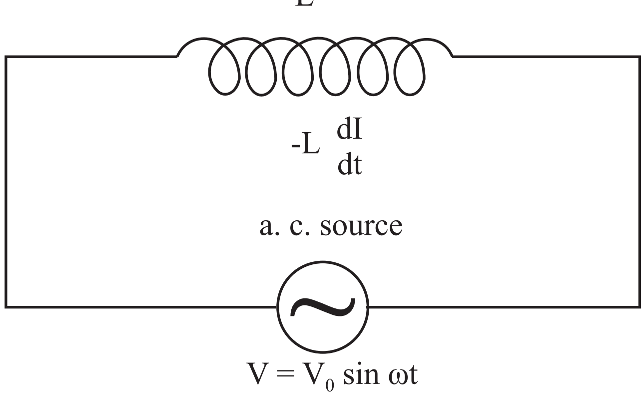


B 2. Phasor diagram for pure resistive circuit is shown in figer

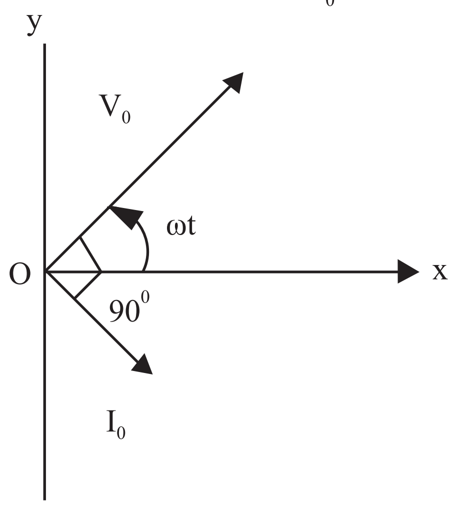


This diagram shows that the phase difference between I and V is zero

B 3. An alternating source is shown connected to an ideal inductor of inductance L in figure. Such a circuit is known as purely ***inductive circuit.***

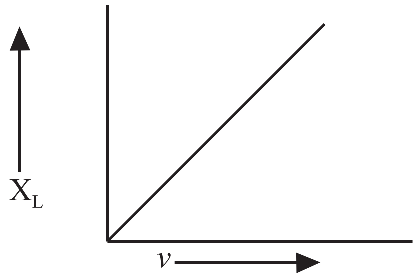


B 4.

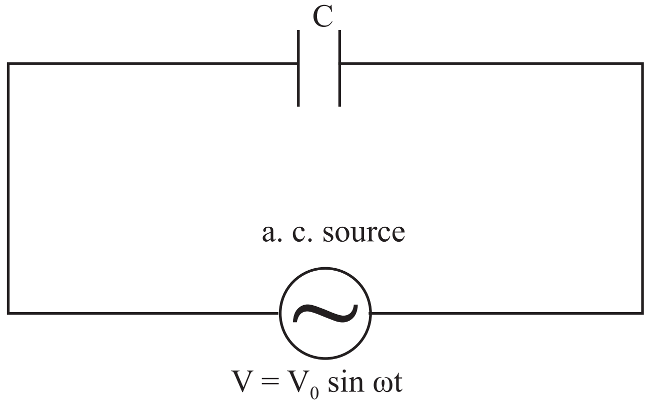


The phasor diagram for purely inductive circuit is shown in figure

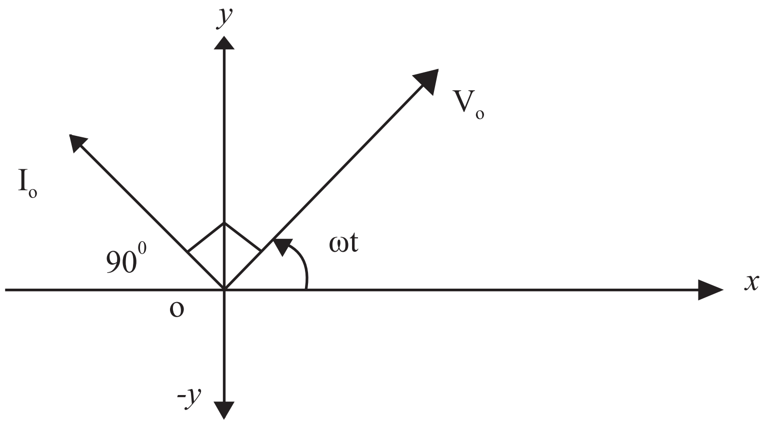
B 5. X_L versus v diagram of a purely inductive circuit is shown figure shows that X_L increases linearly with the increase in the frequency of the current.



B 6. Alternating source connected to a capacitor is shown in Figure. Such a circuit is known as purely **capacitive circuit**. The capacitor is periodically charged and discharged when alternating voltage is applied to it.

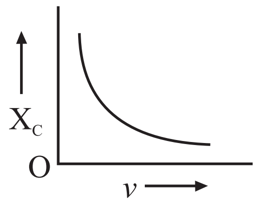


B 7.

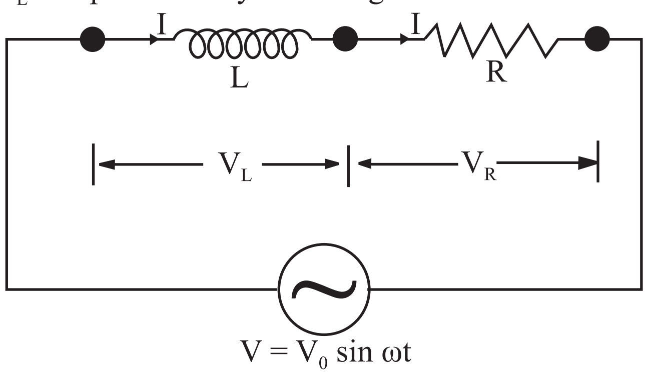


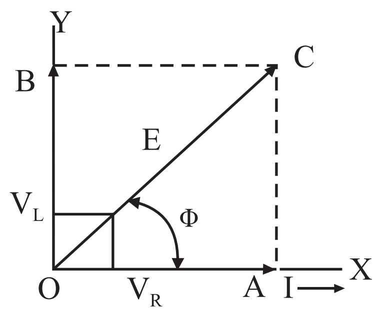
Phasor diagram

B 8. Comparing $I_0 = \frac{V_0}{(I / C\omega)}$ with $I_0 = \frac{V_0}{R}$, we conclude that $\left(\frac{I}{C\omega}\right)$ has the dimension of resistance. The term $(I / C\omega)$ is known as Capacitive reactance (X_C)



B 9. Consider an a.c. source of *e.m.f. E* (r.m.s. value) connected to a series combination of an inductor of pure inductance L. and a resistor of resistance R as shown in Figure.
Let I be the r.m.s. value of current flowing through the circuit.
The potential difference across the inductor is given by. $V_L = IX_L$ ....*(i)*
Voltage V_L leads the current I by an angle of $\pi/2$ when a.c. flows through the inductor. In figure V_L is represented by OB along Y-axis and current I along X-axis





(to be continued ....)

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