PRACHAND NEET

ONE SHOT

PHYSICS

Alternating Currents

TANUJ BANSAL SIR (TBS)

Topics *to be covered*

1. Average and RMS Current
2. LCR Series Circuit
3. Resonance, Quality Factor
4. Transformer

चलिए शुरू करते हैं

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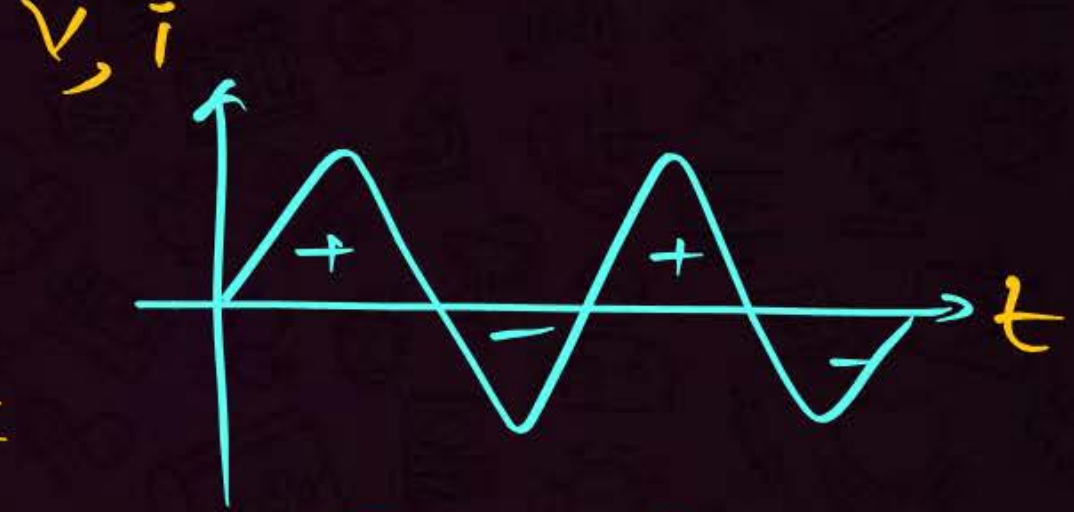
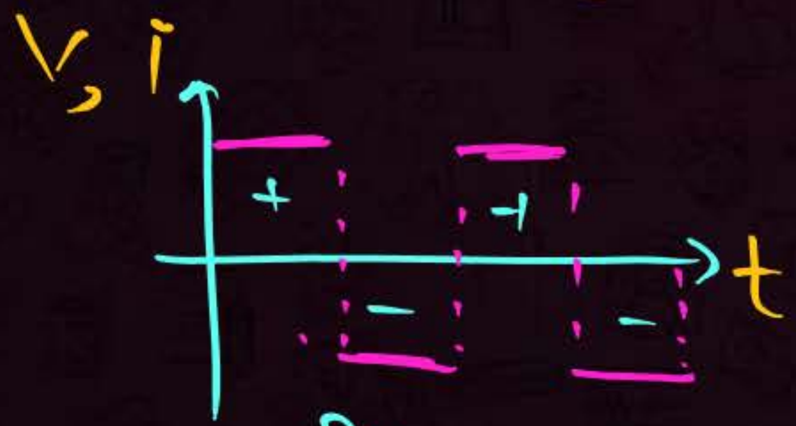
Alternating Current (AC)

The current which changes its direction after a regular interval of time is called alternating current.

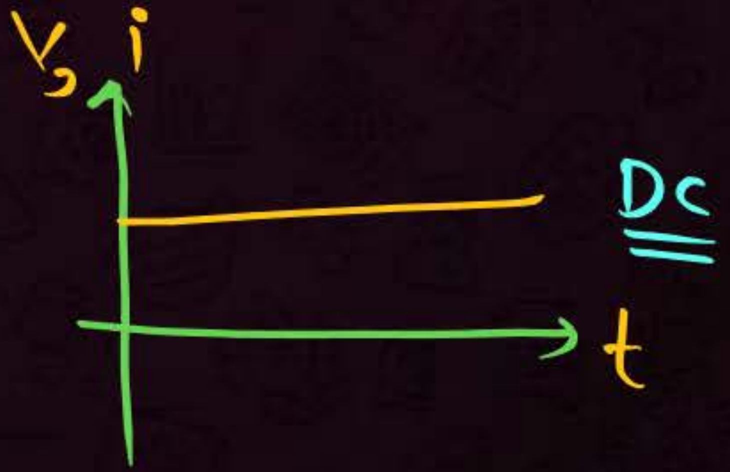
Sinusoidal AC



Triangular wave AC



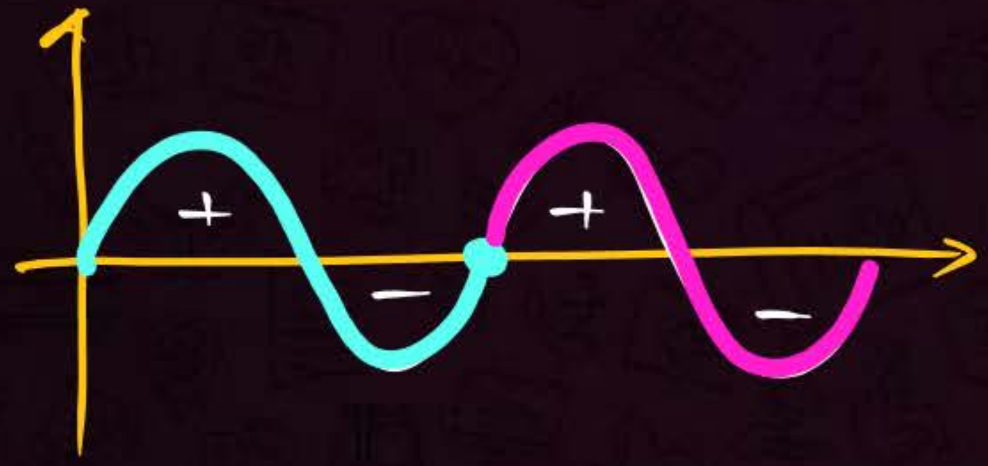
Square wave AC



Home Supply of Alternating Current

→ A C Generator

→ Sinusoidal AC



India → 50 Hz = f

USA → 60 Hz = f

Ques Home supply $\omega = ?$

$\omega = 2\pi f = 2\pi \times 50$

$= 100\pi$ rad/sec

Ques Time period $T = ?$

$T = \frac{1}{f} = \frac{1}{50}$ sec $= \frac{2}{100}$ sec

$= 0.02$ sec.

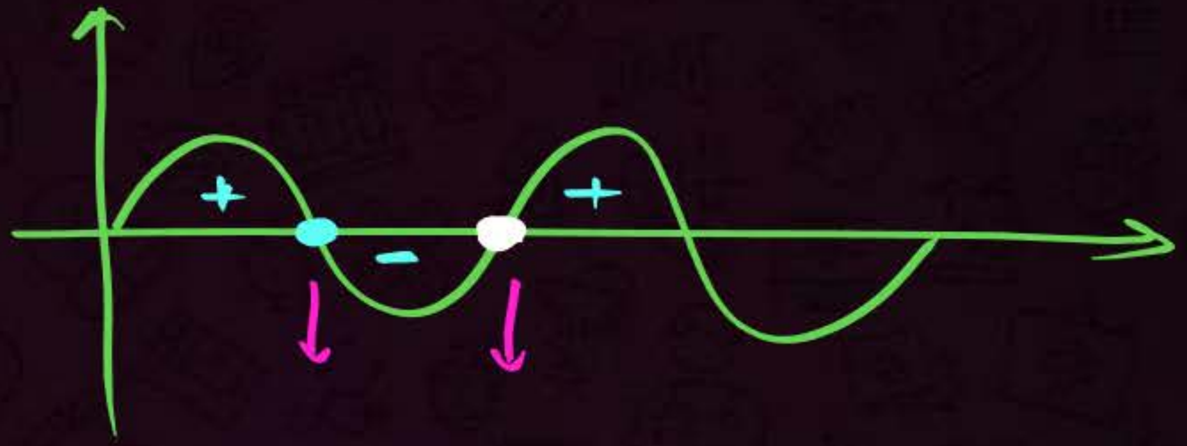
How many times in Indian home supply, the current changes its direction in 1 second?

A) 2

B) 50

C) 1

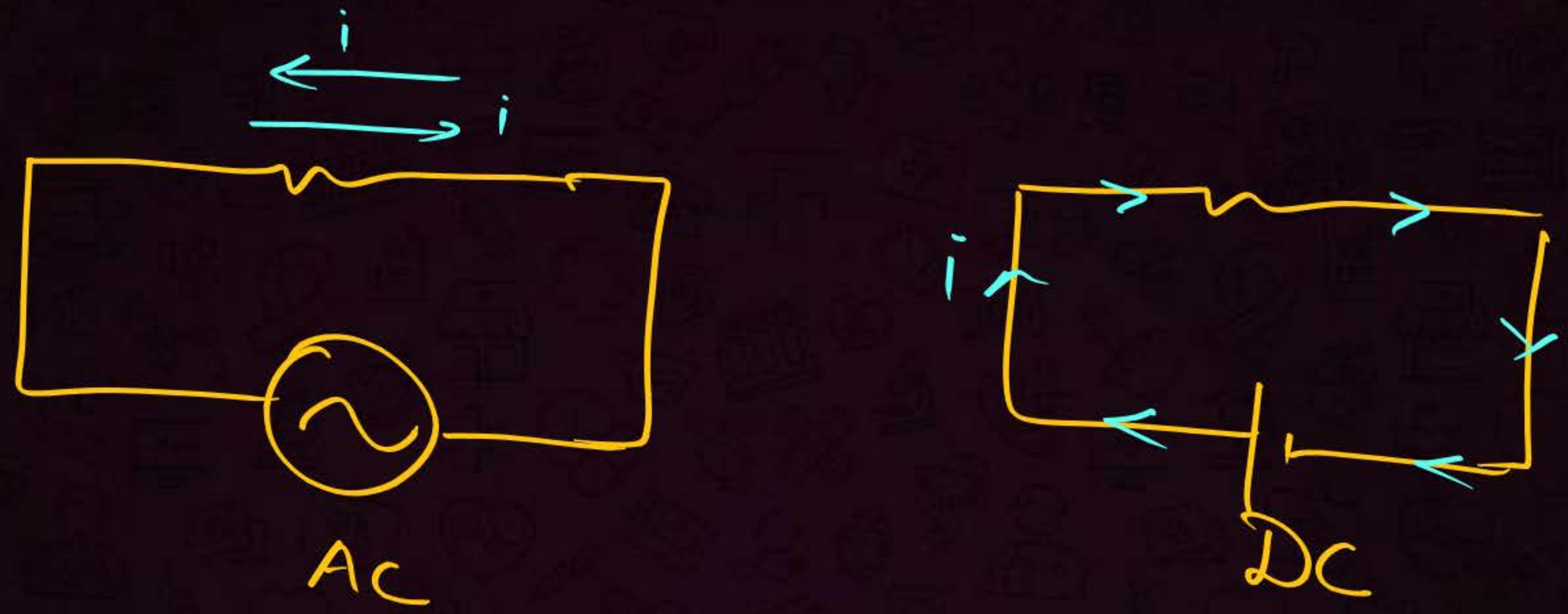
D) 100



1 cycle → 2 change

50 cycle ⇒ 100 change

Feel of AC:



QUESTION

The current flowing through an ac circuit is given by $I = 5\sin(\underbrace{120\,\pi}_{\omega} t)$ A How long will the current take to reach the peak value staring from zero? [27 June, 2022 (S-I)]

(JEE Mains)

1. 1/60 s
2. 60 s
3. 1/120 s
4. 1/240 s

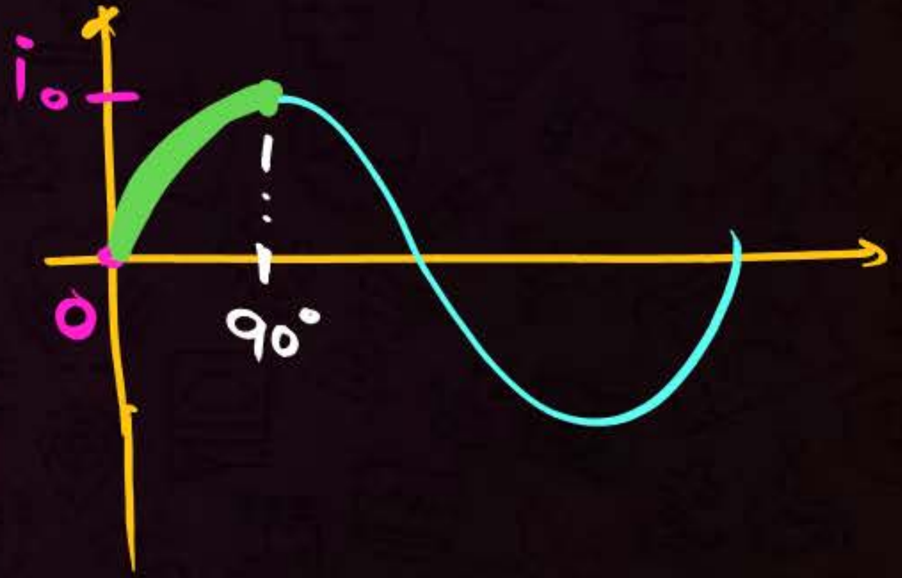
$i = i_0 \sin \omega t$

i → time t

i_0 → maxm/peak value

Put $i = i_0$

$\cancel{i_0} = \cancel{i_0} \sin \omega t$



$\sin \omega t = 1$

$\omega t = \frac{\pi}{2}$

$t = \frac{\pi}{2\omega} = \frac{\cancel{\pi}}{2 \times 120 \cancel{\pi}} = \frac{1}{240}$ sec.

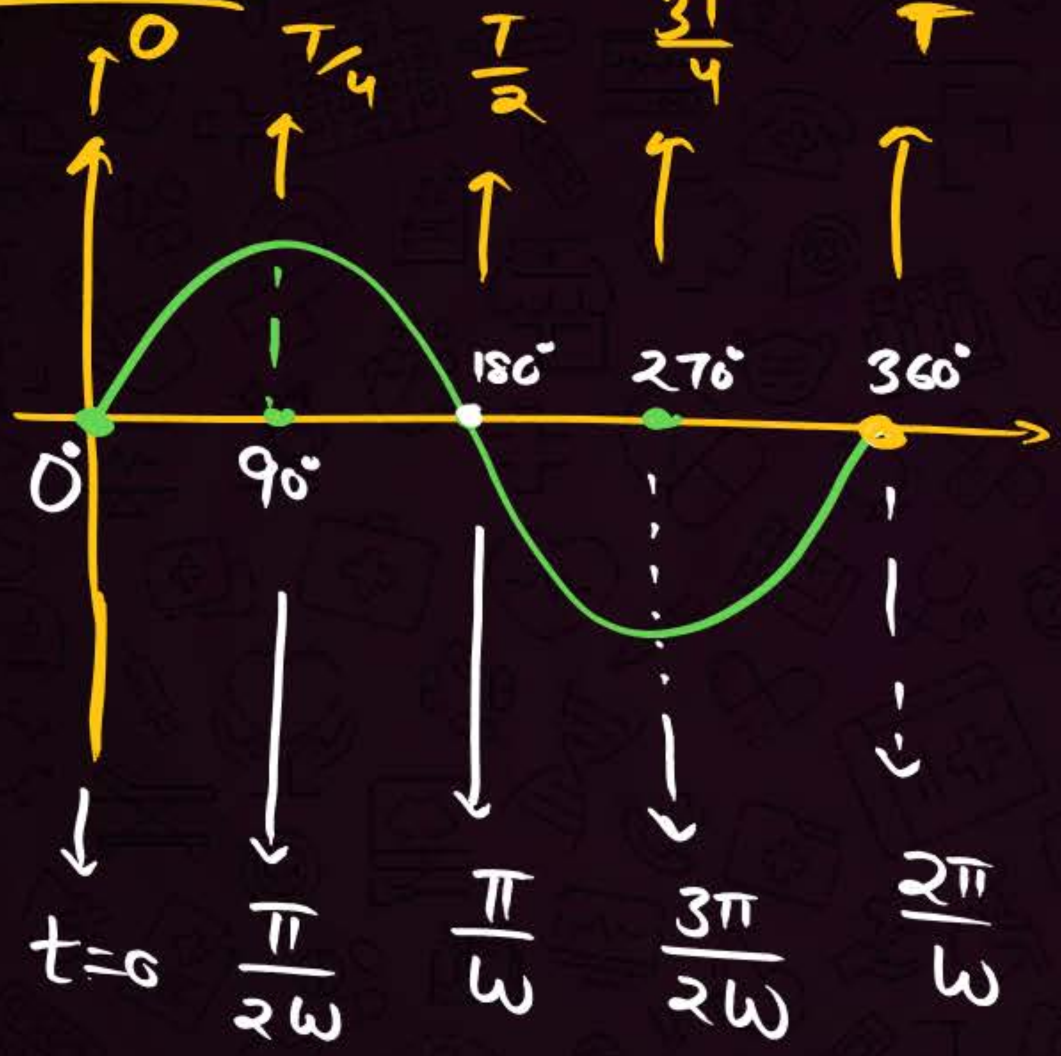
SHM

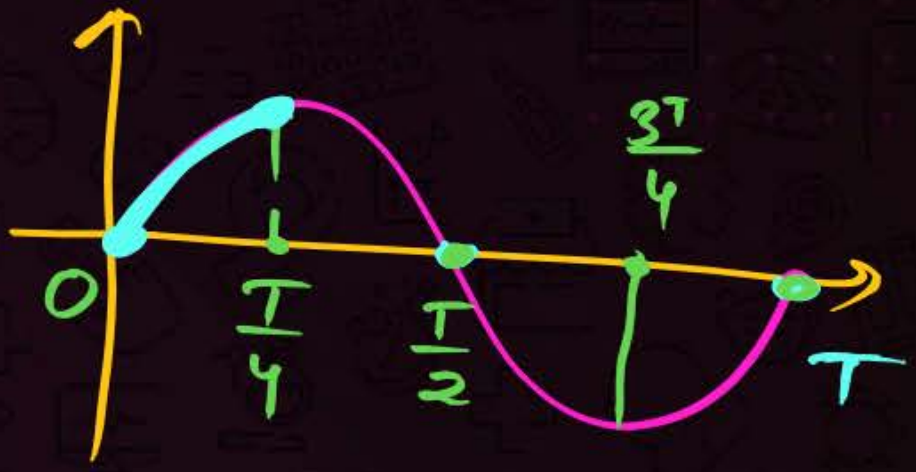
Waves

Wave Optics

AC

TBS Feel





Ques Time period of AC ⇒ 2 sec

Find time taken to reach max^m value from zero.

$\hookrightarrow \frac{T}{4} = \frac{2}{4} = \frac{1}{2} = 0.5$ sec

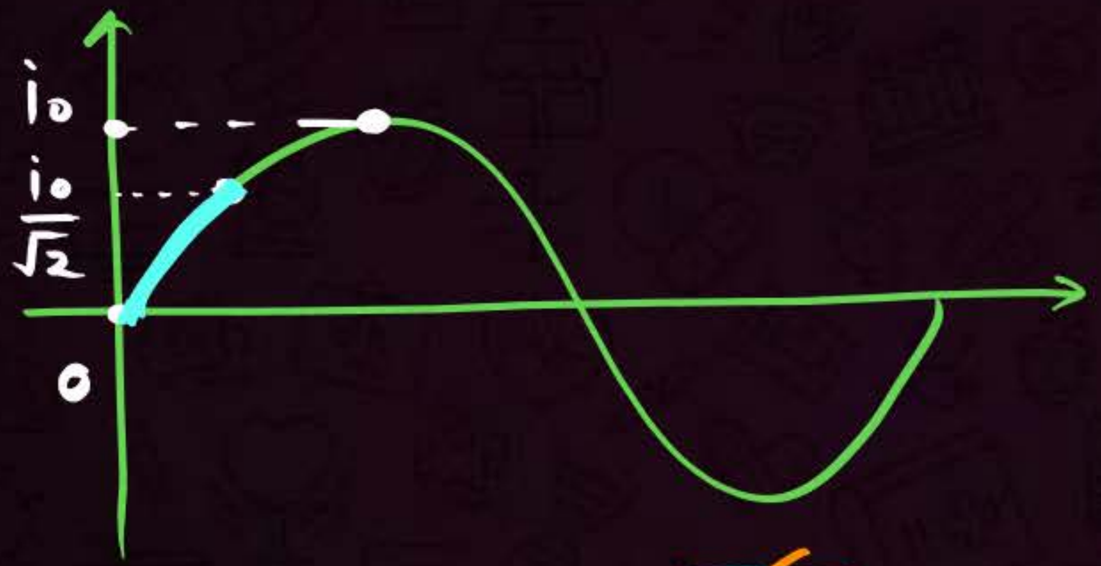
QUESTION

$\rightarrow T = \frac{1}{50}$

The time required for the 50 Hz sinusoidal source alternating current to reach its rms value from zero is

Normal zindagi

Aage Aaga



$i = i_0 \sin\omega t$

$\frac{\cancel{i_0}}{\sqrt{2}} = \cancel{i_0} \sin\omega t$

$i_{rms} = \frac{i_0}{\sqrt{2}}$

$\sin\omega t = \frac{1}{\sqrt{2}}$

$\Rightarrow 45^\circ = \frac{\pi}{4}$

$\omega t = \frac{\pi}{4}$

$t = \frac{\pi}{4\omega} = \frac{T}{8} = \frac{1}{50 \times 8} = \frac{1}{400}$ sec

$T = \frac{2\pi}{\omega}$

$\omega = \frac{2\pi}{T}$

$\omega = 2\pi f$

$t = \frac{\cancel{\pi}}{4 \times \frac{2\cancel{\pi}}{T}}$

$t = \frac{T}{8}$

$$\frac{\text{TBS Mentos}}{\text{Zindagi}} \Rightarrow i_{rms} = \frac{i_0}{\sqrt{2}}$$

$$\frac{1}{\sqrt{2}} \Rightarrow 45^\circ = \frac{\pi}{4}.$$

$$t = \frac{\pi}{4\omega} = \frac{T}{8}$$

Ques Time taken from zero to $\frac{i_0}{2}$.

A) $\frac{\pi}{2\omega}$

B) $\frac{\pi}{4\omega}$

C) $\frac{\pi}{6\omega}$

D) $\frac{\pi}{3\omega}$

$\sin\theta = \frac{1}{2}$

$\theta = 30^\circ = \frac{\pi}{6}$

$t = \frac{\pi}{6\omega}$

$30 \times \frac{\pi}{180}$

$= \frac{\pi}{6}$

Ques time taken from 0 to $\frac{\sqrt{3}\,i_0}{2}$

A) $\frac{\pi}{6\omega}$

B) $\frac{\pi}{4\omega}$

C) $\frac{\pi}{2\omega}$

D) None

$$\sin\theta = \frac{\sqrt{3}}{2}$$

$$\theta = 60^\circ = \frac{\pi}{3}$$

$$t = \frac{\pi}{3\omega}$$

TBS

Summary

0	$i_0/\sqrt{2}$	i_0
$0°$	$45°$	$90°$

$\frac{T}{8} = \frac{\pi}{4\omega}$ $\quad$ $\frac{\pi}{4\omega} = \frac{T}{8}$

$\frac{\pi}{2\omega} = \frac{T}{4}$

0	$\frac{i_0}{2}$	i_0
$0°$	$30°$	$90°$

$\frac{\pi}{6\omega} = \frac{T}{12}$ $\quad$ $\boxed{\frac{\pi}{3\omega} = \frac{T}{6}}$

*

0	$\frac{\sqrt{3}i_0}{2}$	i_0
$0°$	$60°$	$90°$

$\frac{\pi}{3\omega} = \frac{T}{6}$ $\quad$ $\frac{\pi}{6\omega} = \frac{T}{12}$

QUESTION

An alternating voltage $v(t) = 220 \sin \underbrace{100}_{\to \omega} \pi t$ volt is applied to a purely resistive load of 50 Ω. The time taken for the current to rise from half of the peak value to the peak value is:

[8 April, 2019 (S-I)]

1. 2.2 ms
2. 5 ms
3. 3.3 ms
4. 7.2 ms

$$\frac{\pi}{3\omega}$$

$$\frac{\cancel{\pi}}{3 \times 100 \cancel{\pi}} = \frac{1}{300} \text{ sec}$$

$$= \frac{1}{3\cancel{00}} \times 10\cancel{00}$$

$$= \frac{10}{3} = 3.33 \text{ ms.}$$

$$\frac{i_0}{2} \longrightarrow i_0$$

$$30^\circ \xrightarrow{90-30=60^\circ} 90^\circ$$

QUESTION

A resistance of 40 Ω is connected to a source of alternating current rated 220 V, 50 Hz. Find the time taken by the current to change from its maximum value to the rms value:

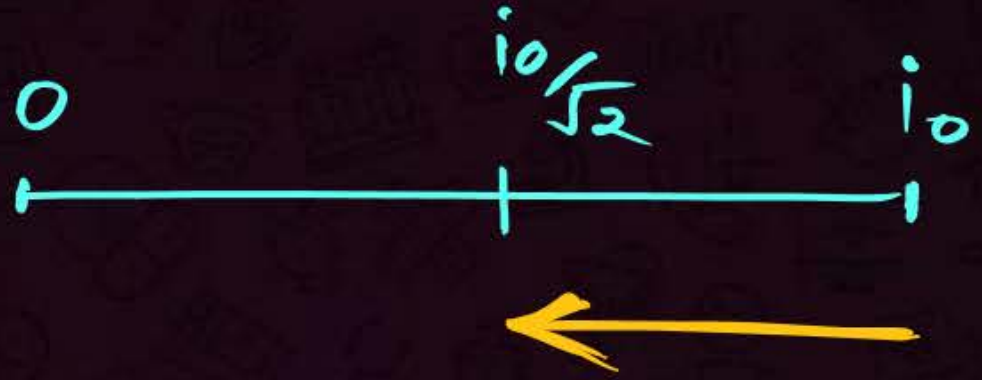
[24 June, 2022 (S-I)]

(1) 2.5 ms

(2) 1.25 ms

(3) 2.5 s

(4) 0.25 s



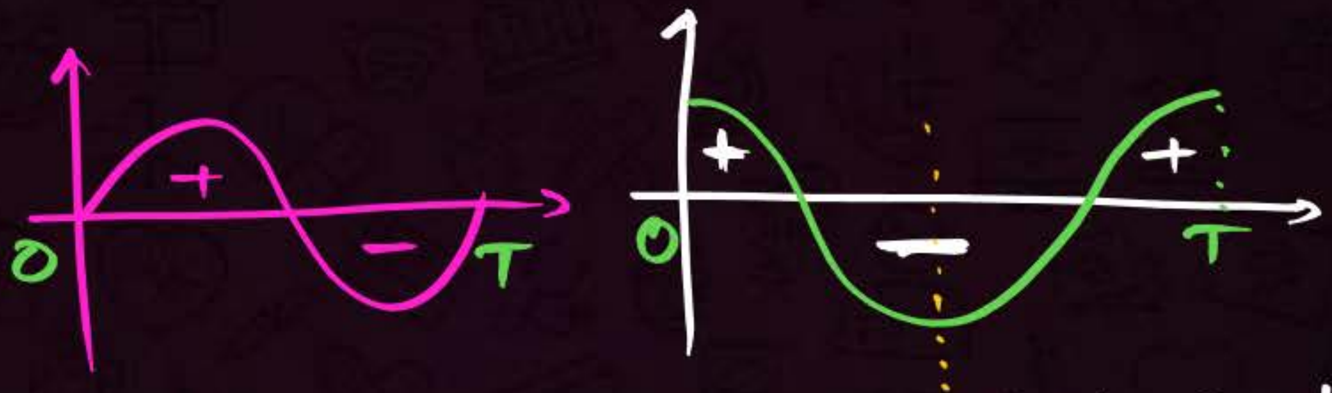
$$t = \frac{\pi}{4\omega} = \frac{T}{8} = \frac{1}{8f} = \frac{1}{8\times 50}$$

$$= \frac{1}{400}\text{ sec} = \frac{1000}{400} = \frac{5}{2} = 2.5\text{ ms}$$

TBS Mathematical Shortcuts

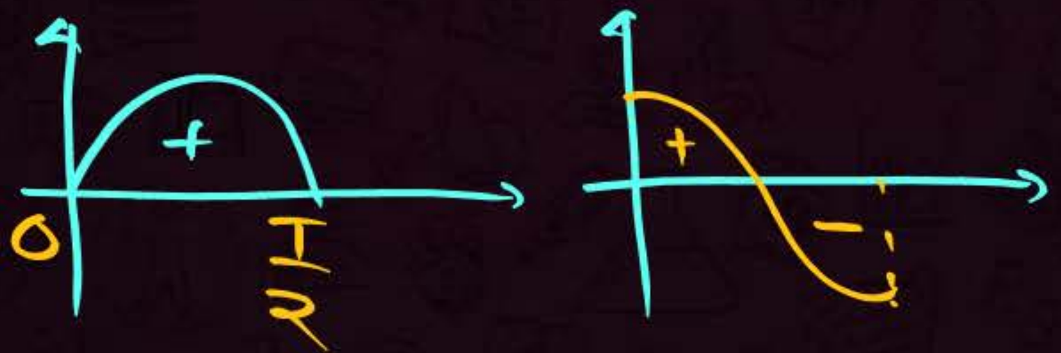
$$i_{av} = \langle i \rangle, \quad V_{av} = \langle V \rangle, \quad P_{av} = \langle P \rangle$$

① Full cycle (0 to T) $\Rightarrow$



$$\langle \sin\omega t \rangle = \langle \cos\omega t \rangle = \langle \sin 2\omega t \rangle = \langle \cos 2\omega t \rangle = 0$$

② Half cycle $\left(0 \text{ to } \frac{T}{2}\right)$



$$\langle \sin\omega t \rangle = \frac{2}{\pi}$$

$$\langle \cos\omega t \rangle = 0$$

③ Full cycle

$$\langle \sin^2\omega t \rangle = \langle \cos^2\omega t \rangle = \frac{1}{2}$$

Average Current

$i_{av} = \langle i \rangle = \dfrac{\text{Total charge flow}}{\text{Total time}}$

(mean)

* Total charge

① If $i = \text{const} \Rightarrow q = i \times t$

eg: $i = 3A$

$t = 5$.

$q = i \times t$.

$= 3 \times 5$

$= 15C$

② If $i \rightarrow$ variable

eg: $i = 2t$

$i = i_0 \sin\omega t$

$q = \int i\, dt$

③ Graph $\Rightarrow$ i-t graph (given)

$\rightarrow$ Area = under i-t graph

$\Downarrow$

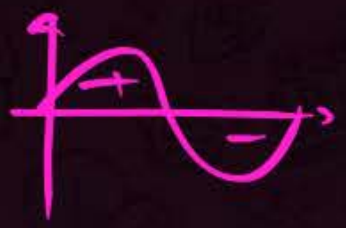
Total charge flow.

Average Current in Sinusoidal AC

$$\boxed{i_{av} = \frac{\int i\,dt}{\int dt}}$$

Here $i = i_0 \sin\omega t$

Full cycle



$$i_{av} = \langle i \rangle = \langle i_0 \sin\omega t \rangle$$

$$= i_0 \langle \sin\omega t \rangle$$

$$i_{av} = i_0 \times 0 = 0 \qquad \boxed{i_{av} = 0}$$

Half Cycle

$\left(0 \text{ to } \frac{T}{2}\right)$

$$\Rightarrow \quad i_{av} = i_0 \langle \sin\omega t \rangle$$

$$\boxed{i_{av} = \frac{2 i_0}{\pi} = 0.637\, i_0}$$

Root Mean Square Current (rms) → virtual or effective current.

Meaning → $i_1, i_2, i_3 \ldots\ldots i_n$.

- $i_{rms} = \sqrt{\dfrac{i_1^2 + i_2^2 + \cdots i_n^2}{n}}$

- $i_{rms} = \sqrt{\dfrac{\int i^2\,dt}{\int dt}}$

* $i = i_0 \sin\omega t$

* $\boxed{i_{rms} = \sqrt{\langle i^2 \rangle}}$

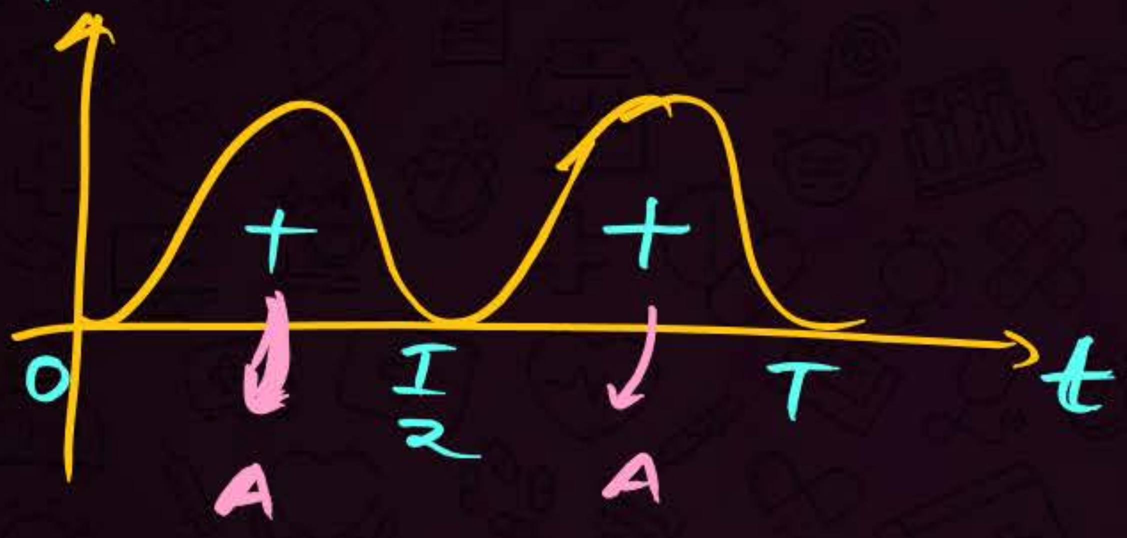
* $i_{rms} = \sqrt{\langle i_0^2 \sin^2\omega t \rangle}$

$i_{rms} = \sqrt{i_0^2 \langle \sin^2\omega t \rangle}$

$i_{rms} = \sqrt{i_0^2 \times \frac{1}{2}} = \boxed{\frac{i_0}{\sqrt{2}} = 0.707\, i_0}$

* Full cycle $\rightarrow$ $\boxed{i_{rms} = \frac{i_0}{\sqrt{2}}}$

$\sin^2\omega t \leftarrow i^2$



* $\boxed{V_{rms} = \frac{V_0}{\sqrt{2}}, \quad V_{av} = \frac{2V_0}{\pi}}$

* TBS Note:- If nothing mentioned, then assume rms value.

Ques $i = i_0 \sin\omega t$

i_{rms} in Half cycle $\left(0 \text{ to } \frac{T}{2}\right)$

Full cycle $\rightarrow \sqrt{\frac{2A}{T}}$

Half cycle $\sqrt{\frac{A}{T/2}} = \sqrt{\frac{2A}{T}}$

$\boxed{i_{rms} = \frac{i_0}{\sqrt{2}}}$

Home Supply

$$\boxed{V_{rms} = 220\,V}$$

Ques Peak value of voltage in Home supply. (V_0)

$$V_{rms} = \frac{V_0}{\sqrt{2}} = 220$$

$$V_0 = 220\sqrt{2}$$

$$\boxed{V_0 \simeq 311\,V}$$

Form Factor

$$\boxed{\frac{i_{rms}}{i_{av}} = \frac{i_0/\sqrt{2}}{2i_0/\pi} = 1.11}$$

TBS Note

- The average value is related to the charge flow.
- The RMS value is related to the heat produced in a circuit.

$\rightarrow H = i^2 R t \Rightarrow H \propto i^2$

$\rightarrow H = \int i^2 R\,dt$

More Examples on Average and Rms Values

Ques $i = \underbrace{3}_{DC} + \underbrace{4\sin\omega t}_{AC}$

a) i_{av} (0 to T) $\Rightarrow$ $i_{av} = \langle 3 + 4\sin\omega t \rangle$

$= \langle 3 \rangle + \langle 4\sin\omega t \rangle$

$= 3 + 4\langle \sin\omega t \rangle$

$= 3 + 4 \times 0 = 3 + 0 = 3A$

b) $i_{av}\left(0 \text{ to } \frac{T}{2}\right) \longrightarrow i_{av} = 3 + 4 \times \frac{2}{\pi} = \left(3 + \frac{8}{\pi}\right)$ Ans

Ques $i = 4 + 3\pi \sin \omega t$

$i_{av} \longrightarrow$ a) 0 to T $\longrightarrow 4 + 3\pi \times 0 = 4 + 0 = 4A$

b) 0 to $\frac{T}{2} \Rightarrow 4 + 3\cancel{\pi} \times \frac{2}{\cancel{\pi}} = 4 + 6 = \underline{\underline{10A}}$

Ques $i = 3 + 4\sin\omega t$

i_{rms} (0 to T)

$$i_{rms} = \sqrt{\langle i^2 \rangle} = \sqrt{\langle (3+4\sin\omega t)^2 \rangle}$$

$$= \sqrt{\langle 3^2 + 4^2\sin^2\omega t + 2\times3\times4\sin\omega t \rangle}$$

$$= \sqrt{\langle 9 + 16\sin^2\omega t + 24\sin\omega t \rangle}$$

$$= \sqrt{9 + 16\times\frac{1}{2} + 24\times0} = \sqrt{9+\frac{16}{2}} = \sqrt{9+8}$$

$$= \sqrt{17}\,A$$

TBS $i = a + b\sin\omega t$

$$\boxed{i_{rms} = \sqrt{a^2 + \frac{b^2}{2}}}$$

Ques $i = 5 + 4\sin\omega t$.

$i_{rms} = ?$

$$i_{rms} = \sqrt{5^2 + \frac{4^2}{2}}$$

$$= \sqrt{25 + \frac{16}{2}}$$

$$= \sqrt{25+8} = 33\ A$$

Ques

JEE Main

$i = \sqrt{42} \sin \omega t + \underline{10}$

$i_{rms} = ?$

A) 11

b) 10

C) 7

D) None

$$\sqrt{10^2 + \frac{(\sqrt{42})^2}{2}}$$

$$= \sqrt{100 + \frac{42}{2}}$$

$$= \sqrt{100 + 21}$$

$$= \sqrt{121} = 11$$

QUESTION

An alternating current is given by I = I_1 cos ωt + I_2 sin ωt. The RMS value of current is given by

↓
PYQ
↓
NEET
↓
JEE Mains (Bhut Baar)
↓
JEE Advanced

1. $\frac{I_1 + I_2}{\sqrt{2}}$
2. $\frac{(I_1 + I_2)^2}{2}$
3. $\sqrt{\frac{I_1^2 + I_2^2}{2}}$
4. $\frac{\sqrt{I_1^2 + I_2^2}}{2}$ ×

TBS $i = a \sin\omega t + b \cos\omega t$

Imp $i_0 = ?$

$\sqrt{a^2+b^2}$

$i_{rms} = \sqrt{\frac{a^2}{2} + \frac{b^2}{2}} = \sqrt{\frac{a^2+b^2}{2}}$

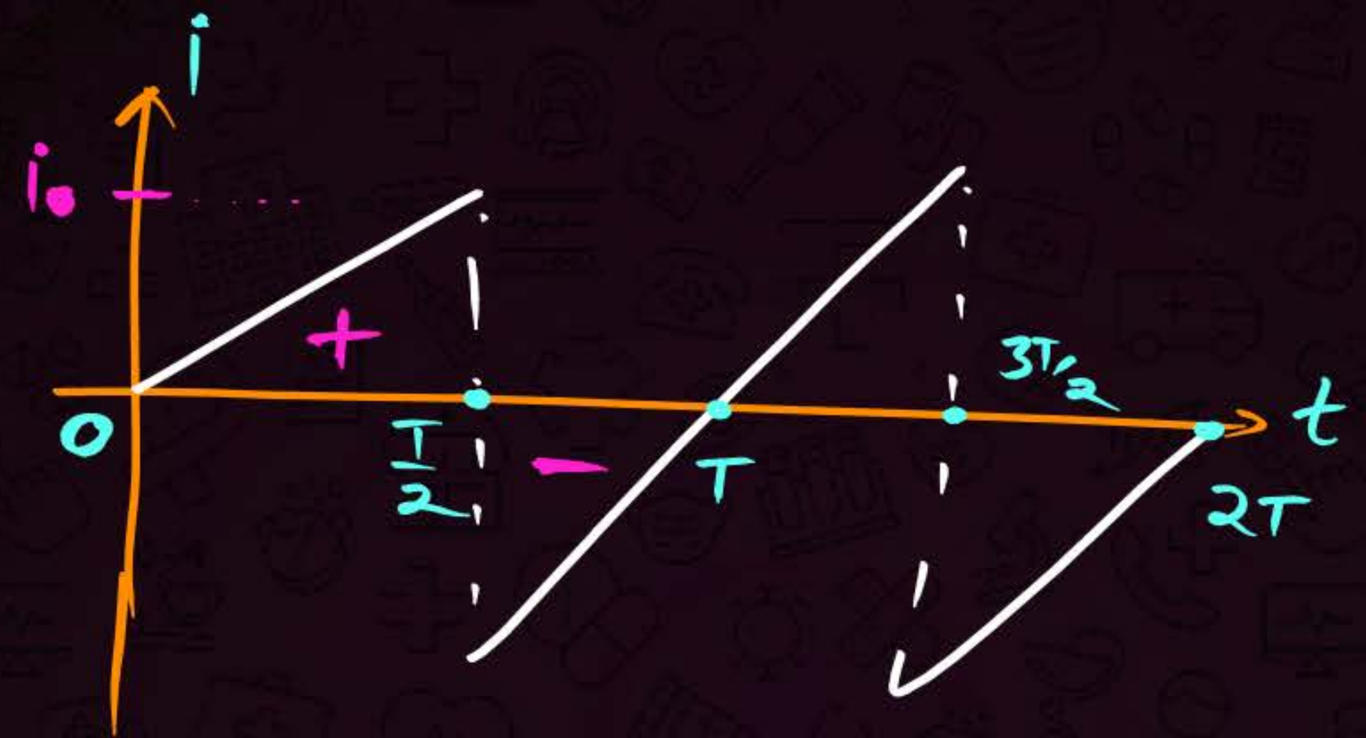
Ques $i = 3\sin\omega t + 4\cos\omega t$

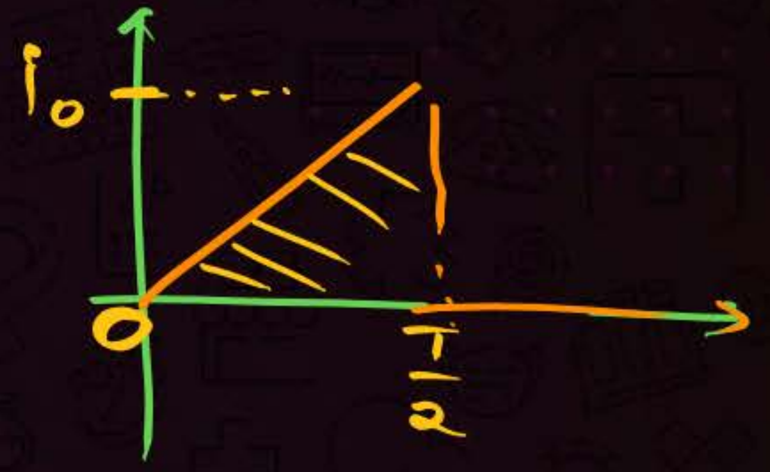
$i_0 = ? \Rightarrow \sqrt{3^2+4^2} = 5.$

$i_{rms} = ? \longrightarrow \frac{5}{\sqrt{2}}$

SHM $\rightarrow$ Amplitude $\Rightarrow$ 5

Ques





Area $= \frac{1}{2} \times \frac{T}{2} \times i_0$

a) i_{av} (0 to T) $\longrightarrow$ zero

$i_{av} = \dfrac{\frac{1}{2} \times \cancel{\frac{T}{2}} \times i_0}{\cancel{\frac{T}{2}}} = \dfrac{i_0}{2}$

b) i_{av} (0 to $T/2$)

c) i_{rms} (0 to T)

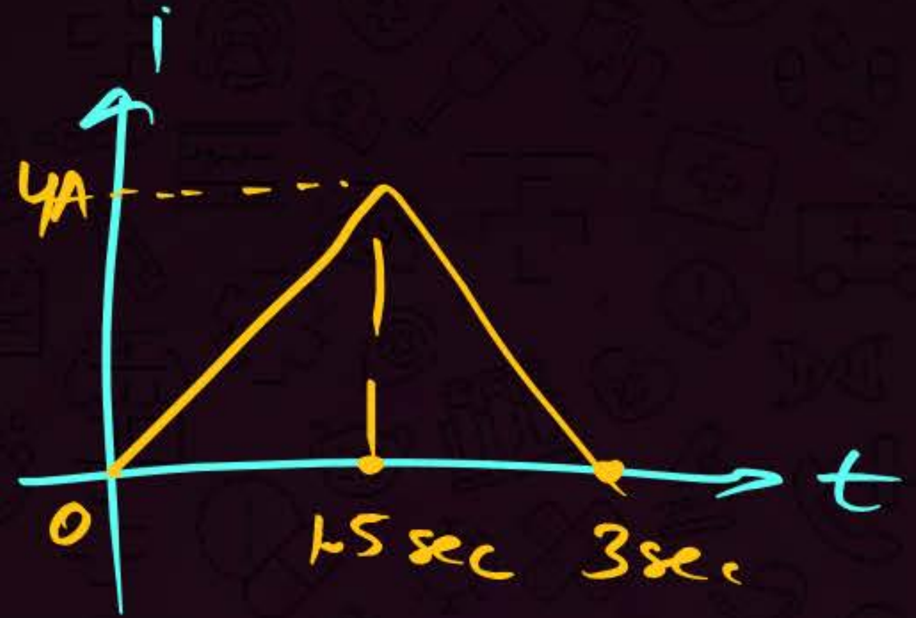
$\downarrow$

0 to $T/2$

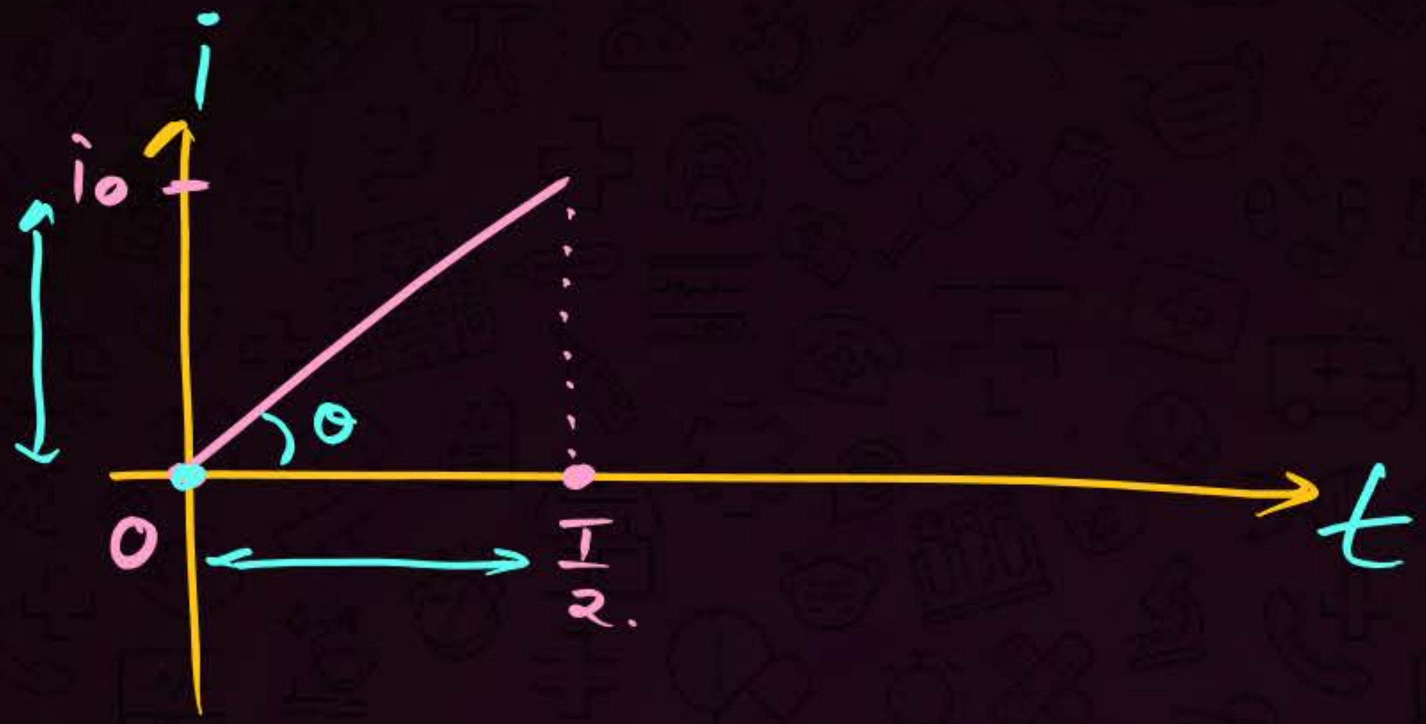
TBS $\rightarrow$ St. line graph

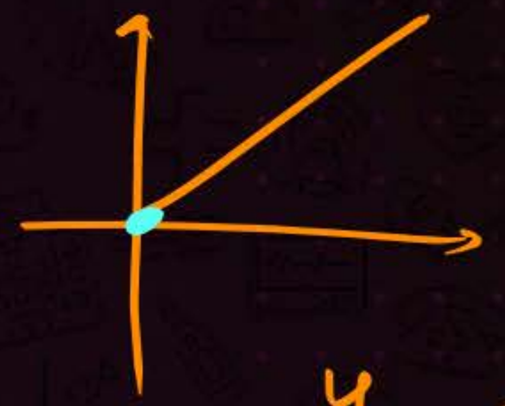
$i_{av} = \dfrac{0 + i_0}{2} = \dfrac{i_0}{2}$

ans



$$i_{av} \Rightarrow \frac{0+4}{2} = 2A \text{ Ans}$$





$$y = mx$$

$$i = \frac{2i_0}{T}t$$

$$i_{rms} = \sqrt{\frac{\int i^2\,dt}{\int dt}} = \sqrt{\frac{\int_0^{T/2}\left(\frac{2i_0}{T}t\right)^2 dt}{\int_0^{T/2} dt}} = \frac{i_0}{\sqrt{3}}$$

→ Learn

$$\tan\theta = \frac{i_0}{T/2} = \frac{2i_0}{T}$$

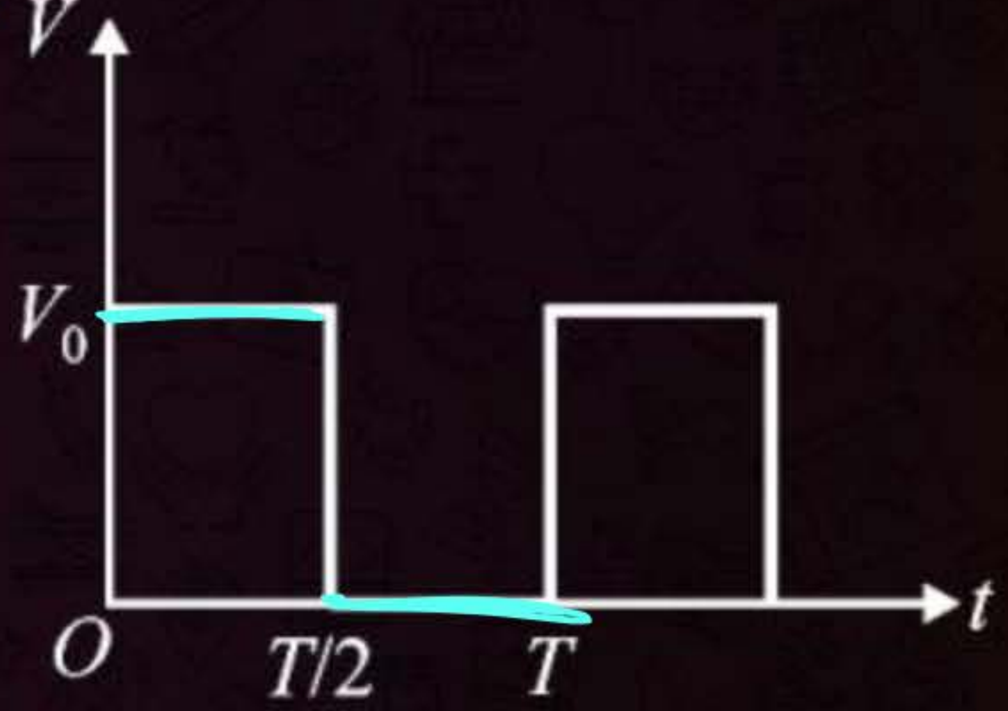
QUESTION

The r.m.s. value of potential difference V shown in the figure is (2011)

1. $V_0/\sqrt{3}$
2. V_0
3. $V_0/\sqrt{2}$
4. $V_0/2$

0 to $\frac{T}{2} \Rightarrow V = V_0$

$T/2$ to $T \Rightarrow V = 0$



$$\int V^2 dt = \int_0^{T/2} V_0^2\, dt + \int_{T/2}^{T} 0^2\, dt$$

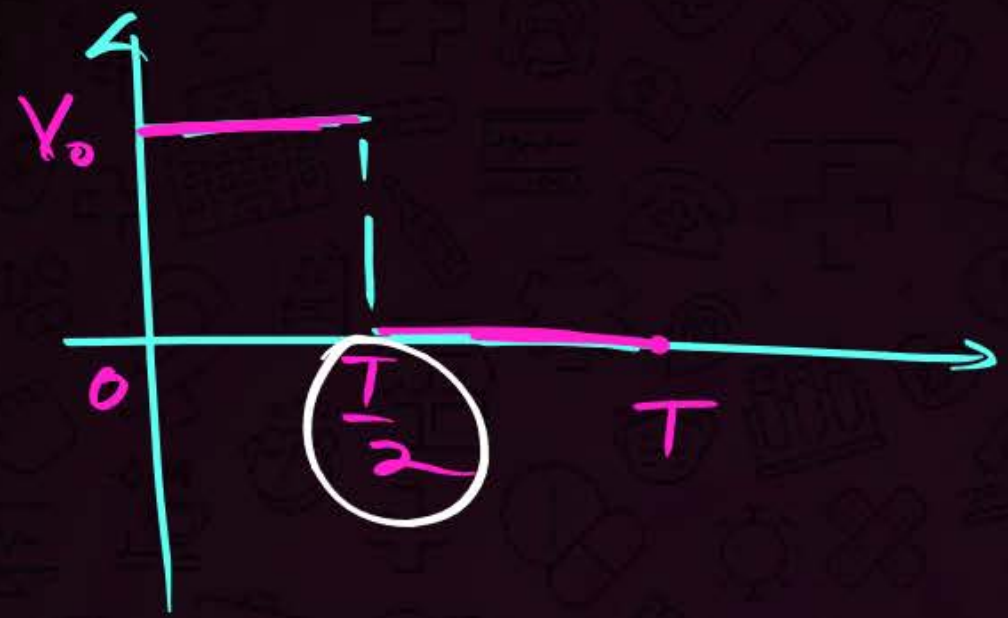
$$= V_0^2 \int_0^{T/2} dt + 0$$

$$= V_0^2 \times [t]_0^{T/2} = V_0^2 \times \frac{T}{2}$$

$$V_{rms} = \sqrt{\frac{\int_0^T V^2 dt}{\int_0^T dt}} = \sqrt{\frac{\int_0^{T/2} V_0^2 dt + \int_{T/2}^{T} 0^2 dt}{\int_0^T dt}}$$

$$= \sqrt{\frac{V_0^2 \cancel{T}/2}{\cancel{T}}} = \sqrt{\frac{V_0^2}{2}} = \frac{V_0}{\sqrt{2}}$$

Soch

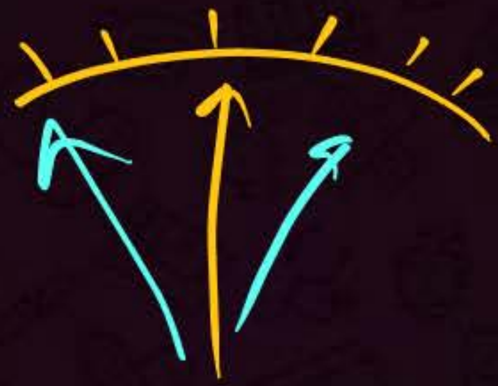


$$V_{rms} = \sqrt{\frac{V_0^2 \times \cancel{T}/2}{\cancel{T}}} = \frac{V_0}{\sqrt{2}}$$

Measurement of AC

AC current → Normal Ammeter → DC ✓

→ AC ✗



$\Rightarrow i_{av} = 0$

→ due to inertia

AC Ammeter (Hot wire)

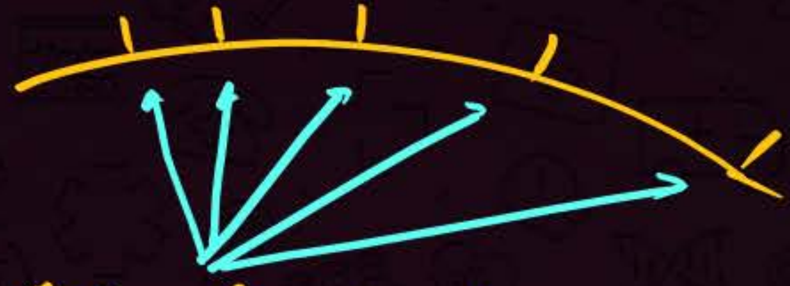
→ i_{rms} reading

DC

$H = \int i^2 R\,dt$ → always +ve

Assertion
Reason

TBS
Note



AC Ammeter

↳ Division gap constant ✗

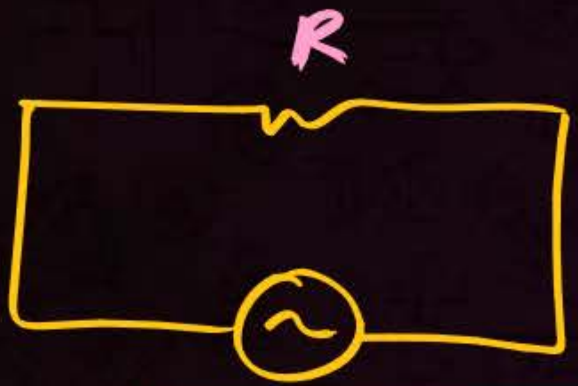
↳ $H \propto i^2$ ✓

$H \propto i$ ✗

$1^2 = 1$
$2^2 = 4$ } 3
$3^2 = 9$ } 5
$4^2 = 16$ } 7
$5^2 = 25$ } 9

Farak
Constant ✗

AC Source connected to Resistor → Purely resistive circuit

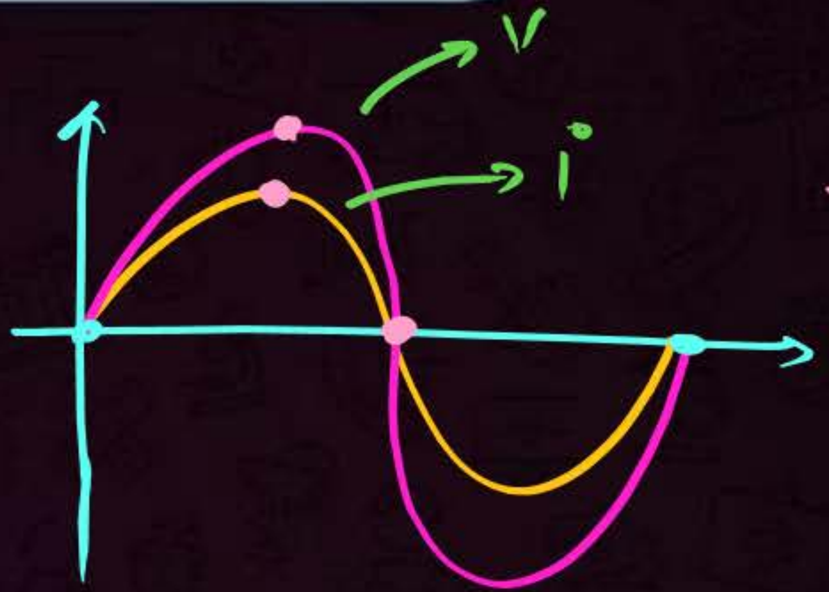


$\boxed{V = V_0 \sin \omega t}$ → given.

$\boxed{i = i_0 \sin \omega t}$

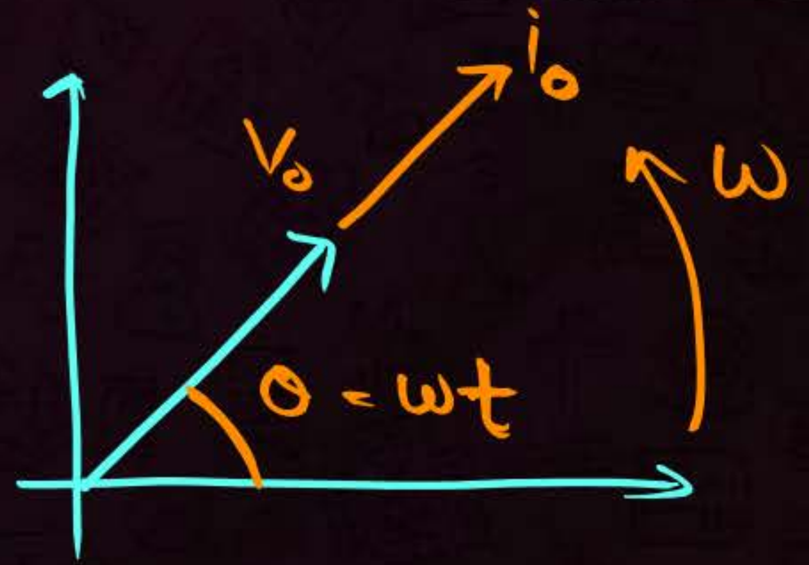
$\boxed{i_0 = \frac{V_0}{R}.}$ $\boxed{i_{rms} = \frac{V_{rms}}{R}.}$

- V & i are in same phase



⇒ values max/min attained at same time

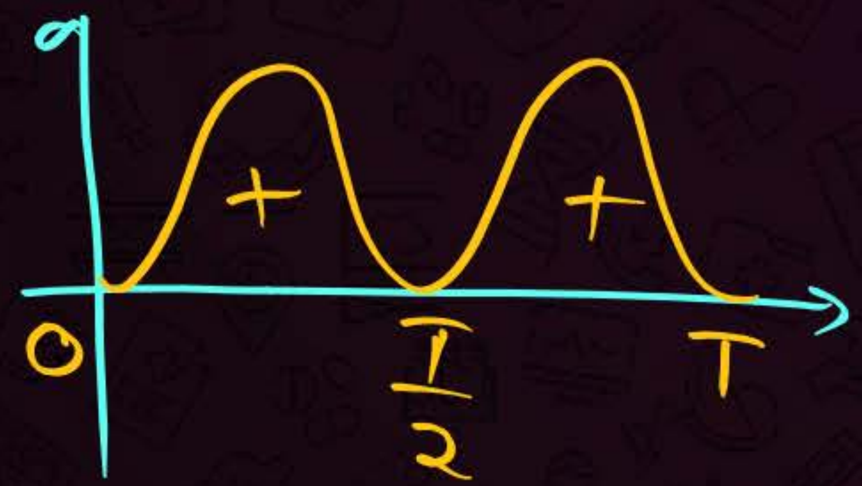
* Phasor diagram (Vector)



$$P = Vi$$

$$P = V_0 \sin\omega t \; i_0 \sin\omega t$$

$$\boxed{P = V_0 i_0 \sin^2\omega t}$$



$$P_{av} = V_0 i_0 \times \frac{1}{2}$$

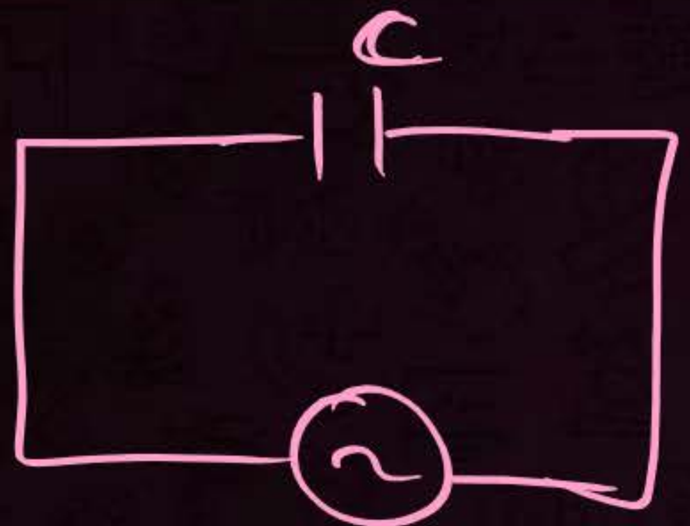
$$\boxed{P_{av} = \frac{V_0 i_0}{2}} \rightarrow \frac{V_0}{\sqrt{2}} \times \frac{i_0}{\sqrt{2}}$$

$$\boxed{P_{av} = V_{rms} i_{rms}}$$

$$P_{av} = i_{rms}^2 R = \frac{V_{rms}^2}{R}$$

AC Source connected to Capacitor

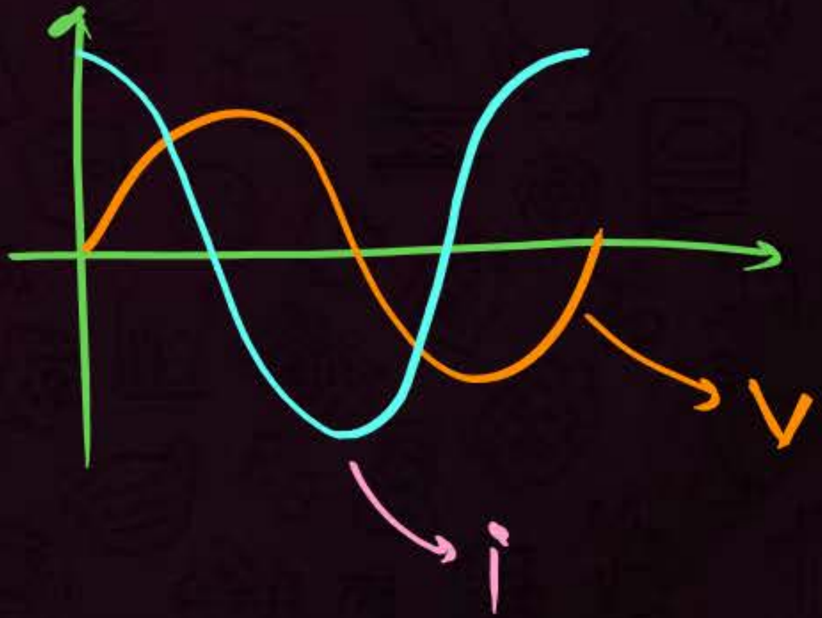
→ Purely capacitive circuit

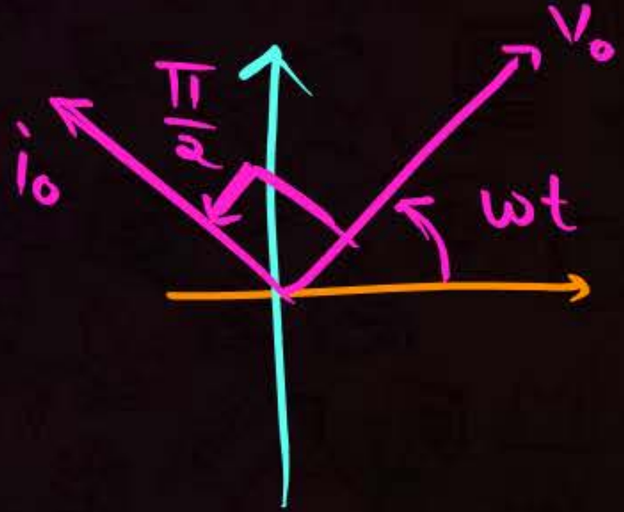


* $\boxed{V = V_0 \sin \omega t}$ → given.

$$\boxed{\begin{aligned} i &= i_0 \cos \omega t \\ i &= i_0 \sin\left(\omega t + \frac{\pi}{2}\right) \end{aligned}}$$

* same phase ✗
* i leads V by 90° $\left(\frac{\pi}{2}\right)$
* V lags i by 90° $\left(\frac{\pi}{2}\right)$
*





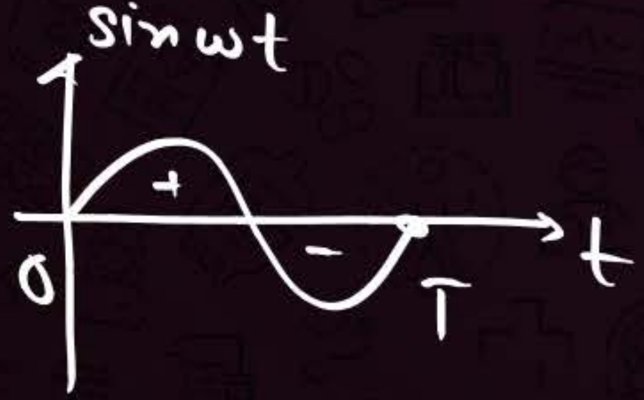
$$P = Vi$$

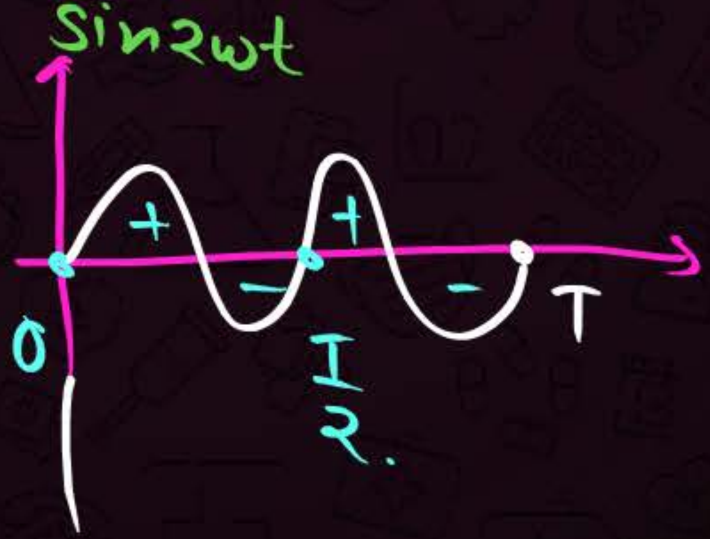
$$P = V_0 \sin\omega t \; i_0 \cos\omega t$$

$$P = V_0 i_0 \frac{\boxed{\sin\omega t \cos\omega t \times 2}}{2}$$

$$\boxed{P = \frac{V_0 i_0}{2} \sin 2\omega t} \longrightarrow \boxed{P_{av} = 0}$$

$$\because \langle \sin 2\omega t \rangle = 0$$





Ques $P_{av} = 0$

(Full cycle)

Ques $P_{av} = ?$

(Half cycle)

↓

$P_{av} = 0$

$$\boxed{i_0 = \frac{V_0}{X_C}}$$

$$\boxed{i_{rms} = \frac{V_{rms}}{X_C}}$$

$X_C \rightarrow$ capacitive reactance.

$\hookrightarrow$ resistance of capacitor.

$$\boxed{X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C}}$$

Ques If ω is doubled,

X_C becomes half.

$X_C \propto \frac{1}{\omega}$

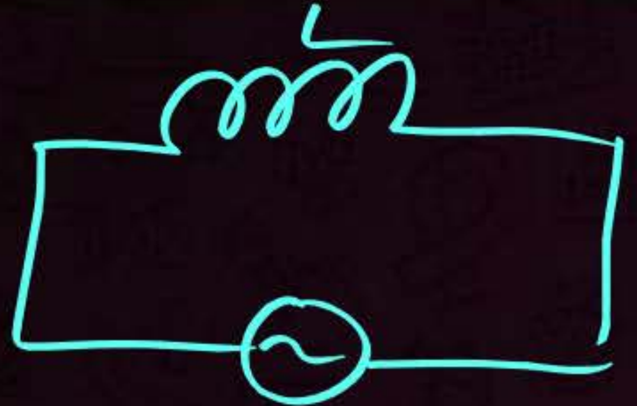
$X_C \rightarrow \frac{X_C}{2}$

$\omega \rightarrow 2\omega$

AC Source connected to Inductor

→ Purely inductive circuit

*



Given. $\boxed{V = V_0 \sin \omega t}$

$$\boxed{\begin{aligned} i &= i_0 \sin\left(\omega t - \frac{\pi}{2}\right) \\ i &= -i_0 \cos \omega t \end{aligned}}$$

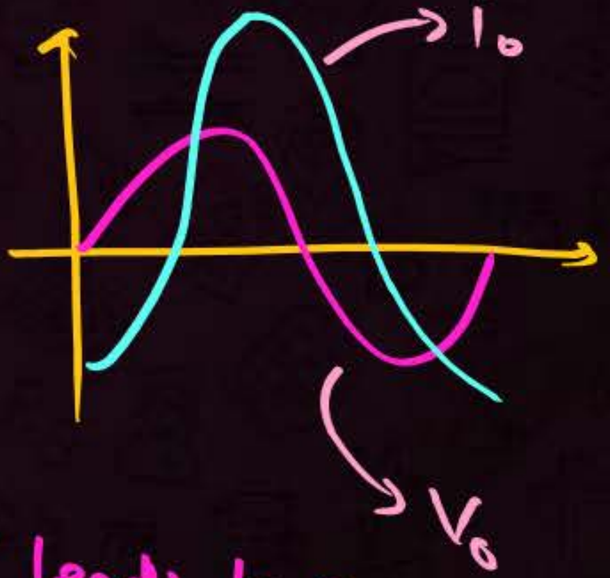
* $\boxed{i_0 = \frac{V_0}{X_L}, \quad i_{rms} = \frac{V_{rms}}{X_L}}$

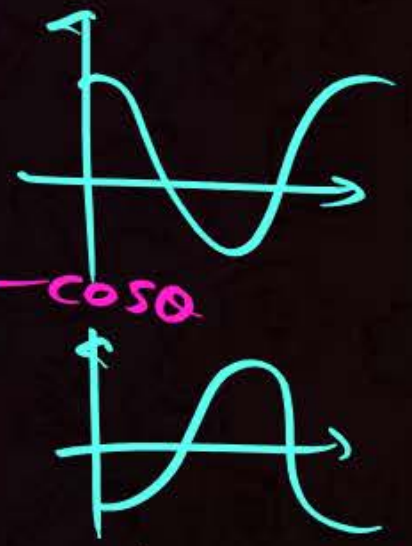
* $X_L \rightarrow$ inductive reactance.

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

* $X_L \propto \omega$

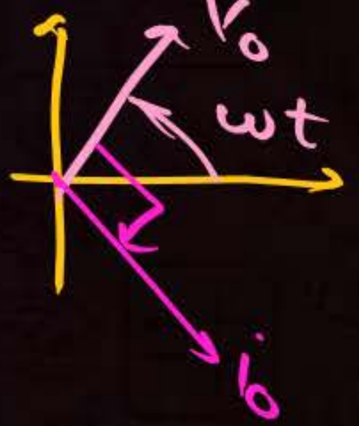
*





* V leads by 90°
i lags by 90°

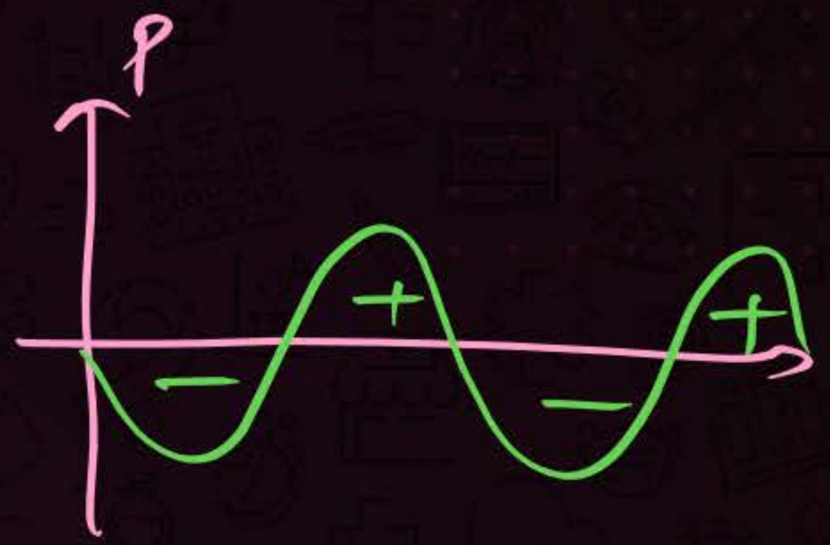
*



* $\boxed{P = -\frac{V_0 i_0}{2} \sin 2\omega t}$

* $P_{av} = 0 \longrightarrow$ full cycle.

$\searrow$ Half cycle



QUESTION

It an AC circuit containing only capacitance, the current (AIIMS 1997)

1. leads the voltage by 180°
2. lags the voltage by 90°
3. leads the voltage by 90°
4. remains in phase with the voltage.

QUESTION

A small signal voltage $V(t) = V_0 \sin \omega t$ is applied across in ideal capacitor C

(NEET 2016)

same phase

1. Current $I(t)$ is in phase with voltage $V(t)$.

2. Current $I(t)$ leads voltage $V(t)$ by 180°.

3. Current $I(t)$ lags voltage $V(t)$ by 90°.

4. Over a full cycle the capacitor C does not consume any energy from the voltage source.

$P_{av} = 0$

QUESTION

In an A.C. circuit, an alternating voltage $\underset{(V)}{e} = \boxed{200\sqrt{2}}\sin(100t)$ volt is connected to capacitor of capacity 1 μF. The r.m.s. value of current in the circuit is (2011)

(1) 10 mA

(2) 100 mA

(3) 200 mA

(4) 20 mA

$V_0 = 200\sqrt{2} \longrightarrow V_{rms} = \frac{200\sqrt{2}}{\sqrt{2}} = 200$

$\omega = 100$

$C = 1\mu F = 10^{-6} F$

$X_C = \frac{1}{\omega C} = \frac{1}{100 \times 10^{-6}} = \frac{10^6}{100} = 10^4 \Omega$

$i_{rms} = \frac{V_{rms}}{X_C} = \frac{200}{10^4}$

$= \frac{2}{100} A = \frac{2}{1\cancel{00}} \times 10\cancel{00} mA = 20 mA$

QUESTION

A 40 μF capacitor is connected to a 200 V, 50 Hz ac supply. The r.m.s. value of the current in the circuit is, nearly (NEET 2020)

f

$\rightarrow V_{rms} = 200\,V$

1. 1.7 A
2. 2.05 A
3. 2.5 A
4. 25.1 A

$$i_{rms} = \frac{200}{X_C}$$

$$X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C}$$

$$= \frac{1}{2\pi \times 50 \times 40 \times 10^{-6}}$$

$$X_C = \frac{\cancel{10^6}\,10^4}{2\pi \times 5\cancel{0} \times 4\cancel{0}} = \frac{10^4}{40\pi} = \frac{10^3}{4\pi}$$

$$i_{rms} = \frac{\cancel{200} \times 4\pi}{\cancel{10^3}\,5} = \frac{4\pi}{5} = \frac{4 \times 3.14}{5}$$

$$= \frac{12.56}{5} = 2.5\ldots$$

QUESTION

$\rightarrow P_{av} = 0$

Assertion: No power loss associated with pure capacitor in ac circuit.

Reason: No current is flowing in this circuit. (AIIMS 2007)

$i \neq 0$

1. Assertion (A) is True, Reason (R) is True; Reason (R) is a correct explanation for Assertion (A)
2. Assertion (A) is True, Reason (R) is True; Reason (R) is not a correct explanation for Assertion (A)
3. Assertion (A) is True, Reason (R) is False.
4. Assertion (A) is False, Reason (R) is True.

QUESTION

Assertion: The alternating current lags behind the e.m.f. by a phase angle of $\pi/2$, when AC flows through an inductor.

Reason: The inductive reactance increases as the frequency of AC source decreases.

$X_L = \omega L = 2\pi f L$ $\quad X_L \propto f \quad f\downarrow \Rightarrow X_L \downarrow$

(AIIMS 2008)

1. Assertion (A) is True, Reason (R) is True; Reason (R) is a correct explanation for Assertion (A)
2. Assertion (A) is True, Reason (R) is True; Reason (R) is not a correct explanation for Assertion (A)
3. Assertion (A) is True, Reason (R) is False.
4. Assertion (A) is False, Reason (R) is True.

QUESTION

The reactance of an inductance of 0.01 H to a 50 Hz A.C. is [AIIMS 1995]

$\frac{1}{100}$

(1) 1.04 Ω

(2) 6.28 Ω

(3) 0.59 Ω

(4) 3.14 Ω

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

$$= \cancel{2}\pi \times \cancel{50} \times \frac{1}{\cancel{100}}$$

$$= \pi = 3.14\,\Omega$$

QUESTION

Statement-I: If the frequency of alternating current in an ac circuit consisting of an inductance coil is increased then current gets decreased.

Statement-II: The current is inversely proportional to frequency of alternating current in purely inductive circuit.

$i_0 = \frac{V_0}{X_L} = \frac{V_0}{2\pi f L} \Rightarrow i_0 \propto \frac{1}{f}$

$f \uparrow \Rightarrow i_0 \downarrow$

1. Both Statement-I and Statement-II are correct
2. Both Statement-I and Statement-II are incorrect
3. Statement-I is correct and Statement-II incorrect
4. Statement-I is incorrect and Statement-II is correct

QUESTION

HW

If R, X_L. and X_C represent resistance, inductive reactance and capacitive reactance. Then which of the following is dimensionless: [31 Jan, 2023 (S-I)]

1. RX_LX_C
2. $\frac{R}{\sqrt{X_LX_C}}$
3. $\frac{R}{X_LX_C}$
4. $R\frac{X_L}{X_C}$

Ques **Purely Capacitive**

$-30+90^\circ = 60^\circ$

$110^\circ - 90^\circ = 20^\circ$

$$V = V_0 \sin(\omega t + 30^\circ) \Rightarrow i = i_0 \sin(\omega t + 120^\circ)$$

$$V = V_0 \sin(\omega t - 30^\circ) \Rightarrow i = i_0 \sin(\omega t + 60^\circ)$$

$$i = i_0 \sin(\omega t + 110^\circ) \Rightarrow V = V_0 \sin(\omega t + 20^\circ)$$

Ques **Purely inductive**

$70^\circ - 90^\circ = -20^\circ$

$$V = V_0 \sin(\omega t + 70^\circ) \Rightarrow i = i_0 \sin(\omega t - 20^\circ)$$

$$i = i_0 \sin(\omega t - 40^\circ) \Rightarrow V = V_0 \sin(\omega t + 50^\circ)$$

$-40^\circ + 90^\circ = 50^\circ$

QUESTION

The equation of current in a purely inductive circuit is $\underbrace{5\sin(\overbrace{49\pi t}^{} - 30^\circ)}$. If the inductance is 30 mH then the equation for the voltage across the inductor, will be:

$\left\{\text{Let } \pi = \frac{22}{7}\right\}$

[28 July, 2022 (S-I)]

(JEE Mains)

$\uparrow i_0$

V leads by 90°

$-30^\circ + 90^\circ = \underline{\underline{60^\circ}}$

(1) 1.47 sin (49 πt – 30°)

(2) 1.47 sin (49 πt + 60°)

(3) 23.1 sin (49 πt – 30°)

(4) 23.1 sin (49 πt + 60°)

$i_0 = 5$

$X_L = \omega L = 49\pi \times 30 \times 10^{-3}$

$= \cancel{49}^{7} \times \frac{22}{\cancel{7}} \times \frac{3\cancel{0}}{100\cancel{0}}$

$= \frac{462}{100} = 4.62$

$i_0 = \frac{V_0}{X_L}$

$V_0 = i_0 X_L = 5 \times 4.62 = 23.1$

Watt-less Currents

The current in purely capacitive and purely inductive circuits are called wattless currents since they consume no power.

$$\left.\begin{matrix} X_C \\ X_L \end{matrix}\right\} \rightarrow i \rightarrow \text{wattless}$$

Variation of Reactance with frequency

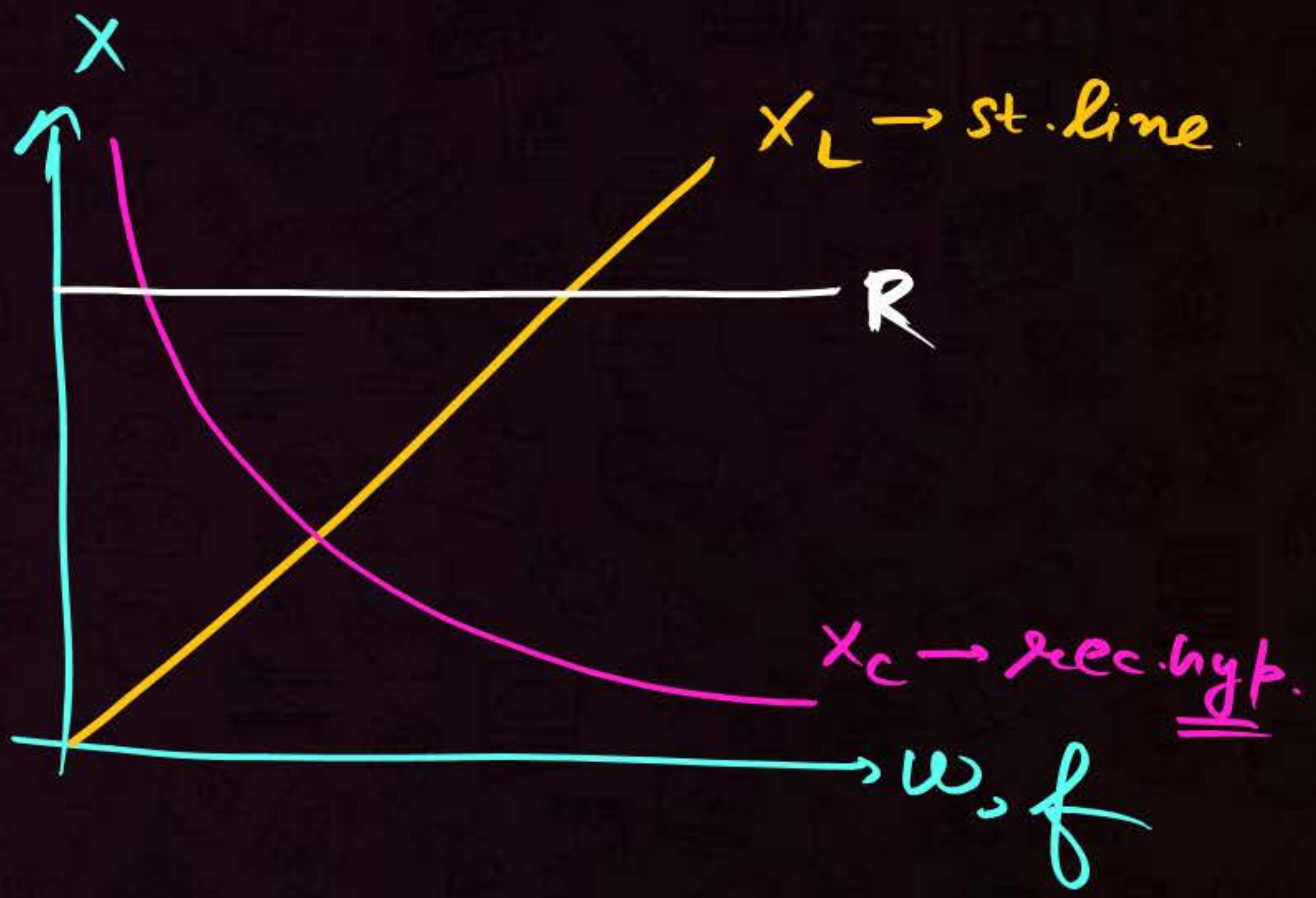
- $X_L = \omega L = 2\pi f L$

  $X_L \propto \omega$ or $X_L \propto f$

- $X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C}$

  $X_C \propto \frac{1}{\omega}$ or $X_C \propto \frac{1}{f}$

- $R \rightarrow$ independent of ω or f



QUESTION

The reactance of a capacitor of capacitance C is X. If both the frequency and capacitance be doubled, then new reactance will be [CBSE AIPMT 2001]

1. X
2. 2X
3. 4X
4. X/4

$$X_C = \frac{1}{2\pi f C}$$

$$X_C' = \frac{1}{2\pi \times 2f \times 2C} = \frac{X_C}{4}$$

High pass and Low pass filter

DC circuit $\Rightarrow f = 0$

High f AC $\Rightarrow f \to \infty$

L $\leftarrow$ Inductor $X_L \propto f$

DC $\to f = 0 \to X_L = 0$

AC $\to f \to \infty \Rightarrow X_L \to \infty$

Blocks AC allows DC.

Low pass fiter

Capacitor

$X_C \propto \frac{1}{f}$

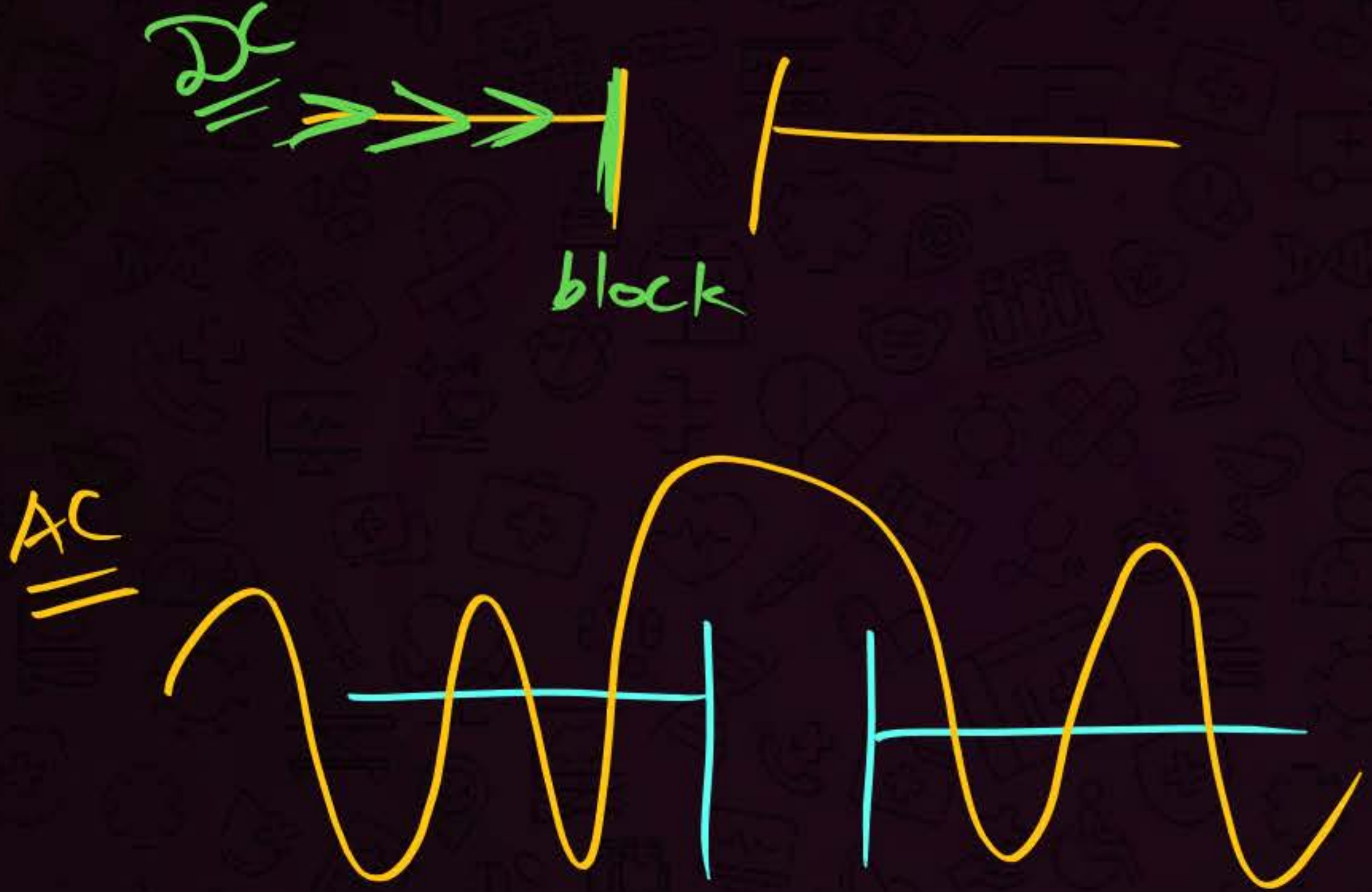
DC $\to f = 0 \Rightarrow \boxed{X_C \to \infty}$

AC $\to f \to \infty \Rightarrow \boxed{X_C \to 0}$

blocks DC, allows AC

* High pass filter

Bkaiti



QUESTION

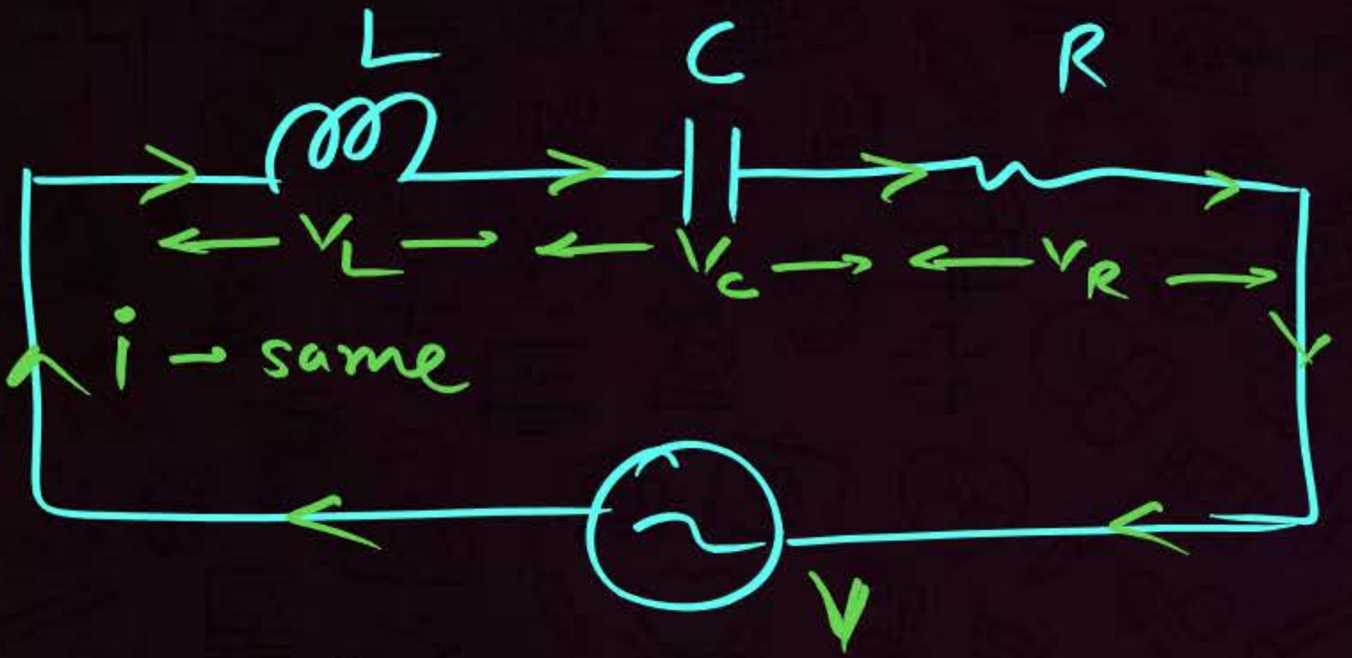
Statement-I : Capacitor serves as a block for dc and offers an easy path to ac.

Statement-II : Capacitive reactance is inversely proportional to frequency.

$X_C \propto \frac{1}{f}$

1. Both Statement-I and Statement-II are correct
2. Both Statement-I and Statement-II are incorrect
3. Statement-I is correct and Statement-II incorrect
4. Statement-I is incorrect and Statement-II is correct

Series LCR Circuit with AC



$i = i_0 \sin\omega t$ (given)

* $V_L, V_C, V_R, V \Rightarrow$ voltages at instant t.

$V_L + V_C + V_R = V$

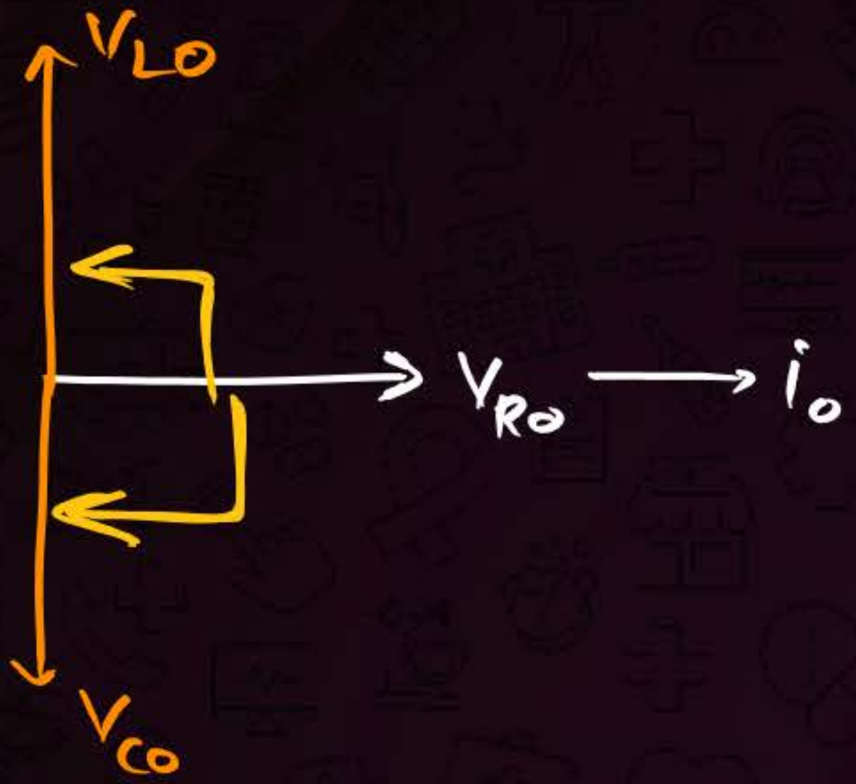
* $V_{L0} + V_{C0} + V_{R0} = V_0$ ✗

(maximum voltages can't be added directly)

* Added by Phasor (vector)

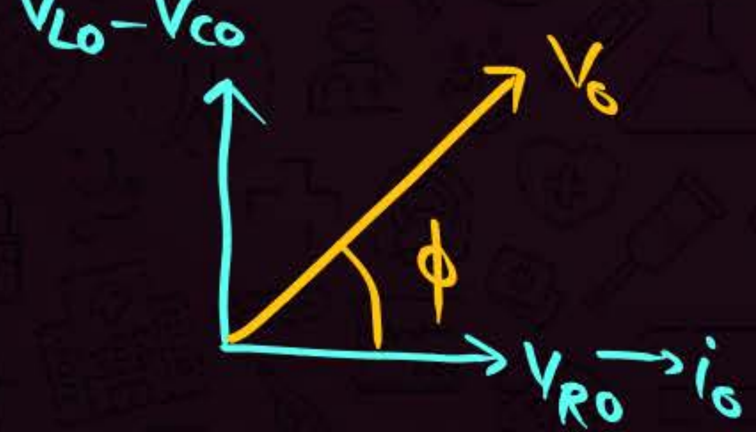
$\Downarrow$

$\vec{V}_{L0} + \vec{V}_{C0} + \vec{V}_{R0} = \vec{V}_0$ ✓



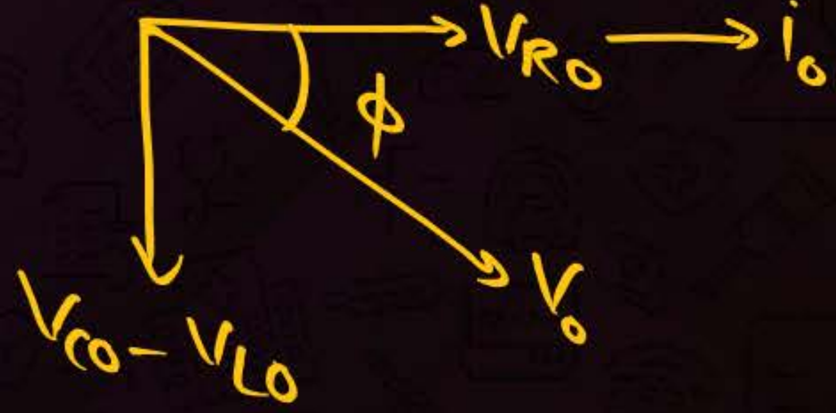
a) L dominated

$V_{L0} > V_{C0}$



b) C dominated

$V_{L0} < V_{C0}$

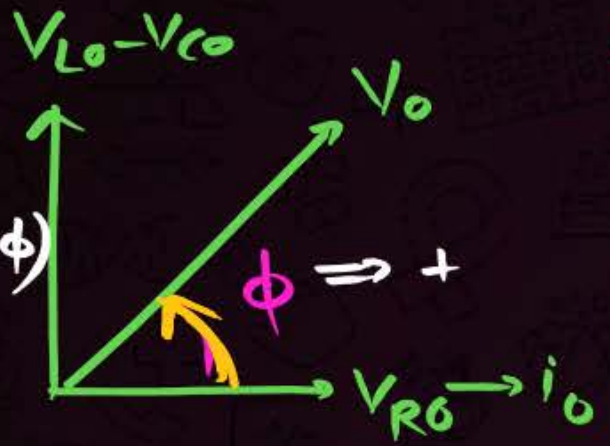


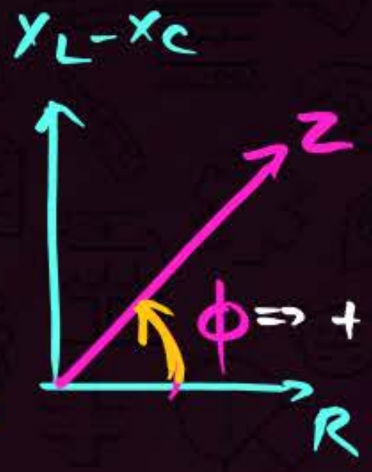
a) L dominated

$V_{L0} > V_{C0}$, $X_L > X_C$

$i = i_0 \sin \omega t$

$V = V_0 \sin(\omega t + \phi)$





$$V_0 = \sqrt{(V_{L0} - V_{C0})^2 + V_{R0}^2}$$

$$Z = \sqrt{(X_L - X_C)^2 + R^2}$$

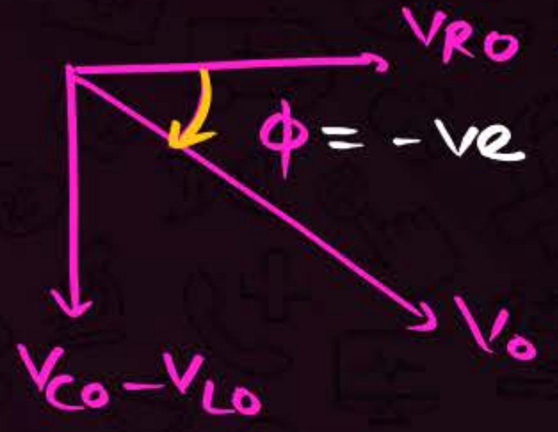
V_0 leads i_0 by ϕ

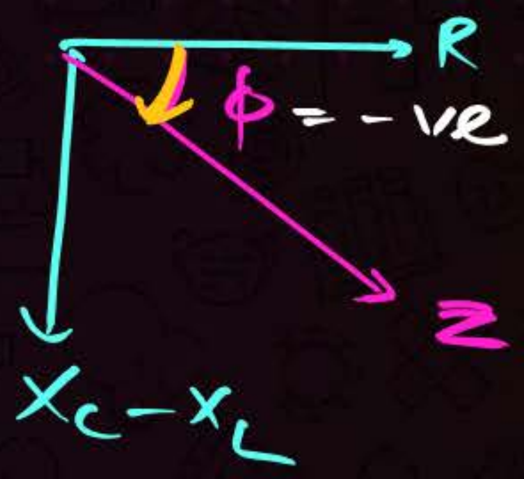
i_0 lags V_0 by ϕ

$$\tan\phi = \frac{V_{L0} - V_{C0}}{V_{R0}} = \frac{X_L - X_C}{R}$$

b) C dominated

$V_{L0} < V_{C0}$, $X_L < X_C$





$$V_0 = \sqrt{(V_{C0} - V_{L0})^2 + V_{R0}^2}$$

$$Z = \sqrt{(X_C - X_L)^2 + R^2}$$

$i = i_0 \sin \omega t$

$V = V_0 \sin(\omega t - \phi)$

* i_0 leads V_0 by ϕ
* V_0 lags i_0 by ϕ
* $\tan\phi = \dfrac{V_{C0} - V_{L0}}{V_{R0}} = \dfrac{X_C - X_L}{R}$

Impedance

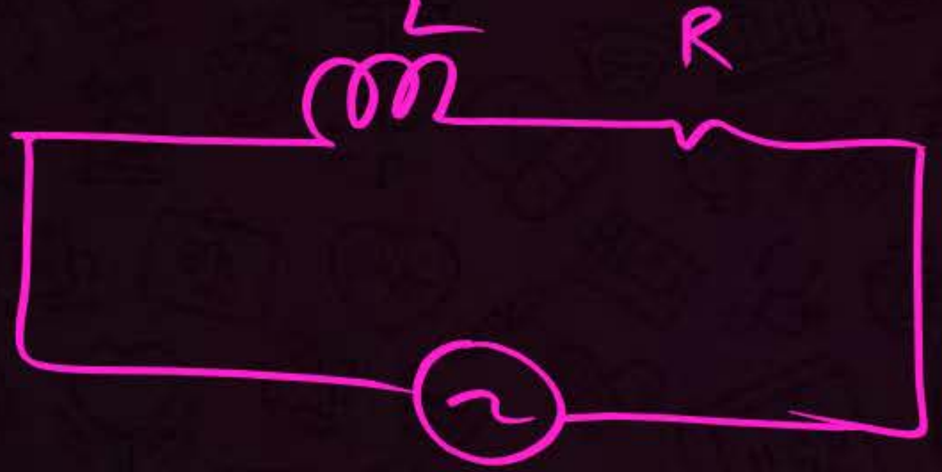
$Z \rightarrow$ net resistance of series LCR circuit.

QUESTION

BPU

An A.C. voltage is applied to a resistance R and an inductor L in series. If R and the inductive reactance are both equal to 3 Ω, the phase difference between the applied voltage and the current the circuit is **(2011)**

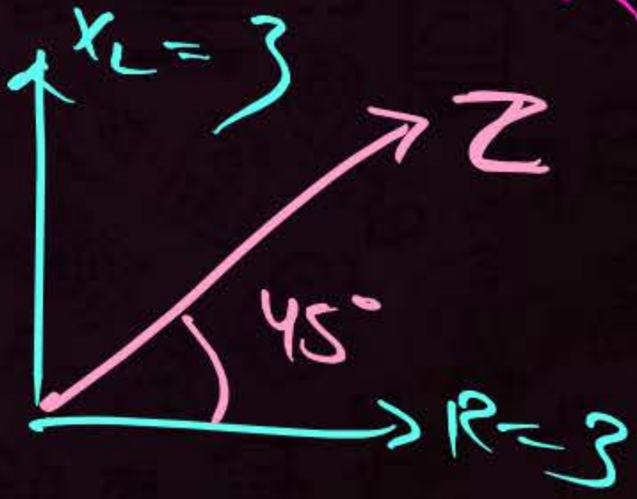
1. zero
2. $\pi/6$
3. $\pi/4$
4. $\pi/2$



$R = X_L = 3\Omega$

$\tan\phi = \dfrac{X_L - X_C}{R} = \dfrac{3-0}{3} = \dfrac{3}{3} = 1$

$\phi = 45^\circ = \dfrac{\pi}{4}$



$Z = 3\sqrt{2}$

$Z = \sqrt{3^2 + 3^2}$

QUESTION

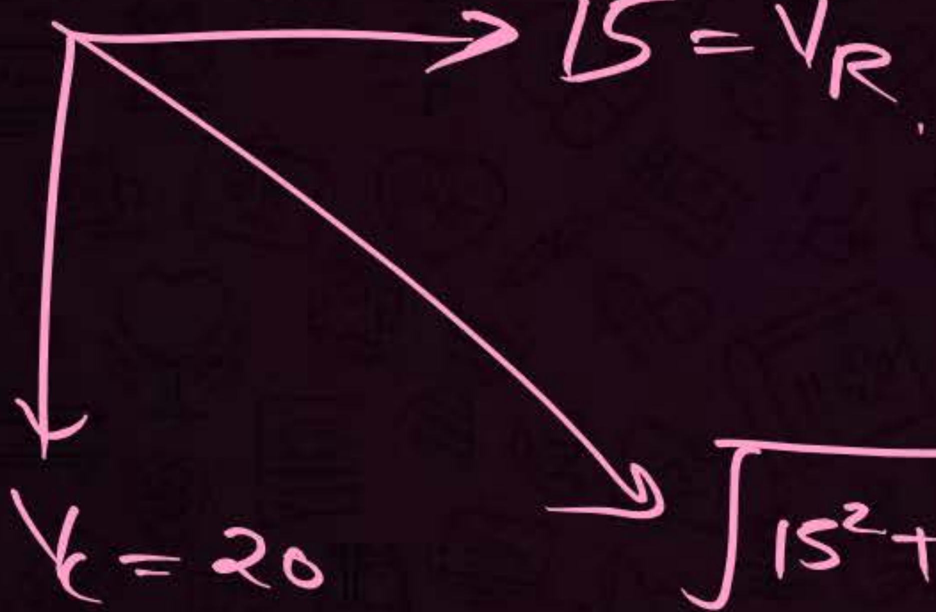
A resistor and a capacitor are connected in series with an a.c. source. If the potential drop, across the capacitor is 15 V and that across resistor is 20 V, the applied voltage is

(1) 25 V

(2) 40 V

(3) 5 V

(4) 12 V



rms value

$$\sqrt{15^2+20^2} = \sqrt{225+400} = \sqrt{625} = 25$$

QUESTION

Match List-I with List-II Choose the most appropriate answer from the options given below :

[17 March, 2021 (S-II)]

1. A – ii, B – iii, C – iv, D – i
2. A – ii, B – iii, C – i, D – iv
3. A – i, B – iii, C – iv, D – ii
4. A – ii, B – iv, C – iii, D – i

	List - I		List –II
p	Phase difference between current and voltage in a purely resistive AC circuit	i (R)	$\pi/2$; current leads voltage
Q	Phase difference between current and voltage in a pure inductive AC circuit	ii	Zero
R	Phase difference between current and voltage in a pure capacitive AC circuit	iii	$\pi/2$; current lags voltage
s	Phase difference between current and voltage in an LCR series circuit	iv	$\tan^{-1}(X_C – X_L/R)$

QUESTION

In an AC circuit the potential differences across an inductance and resistance joined in series are respectively 16 V and 20 V. The total potential difference of the source is

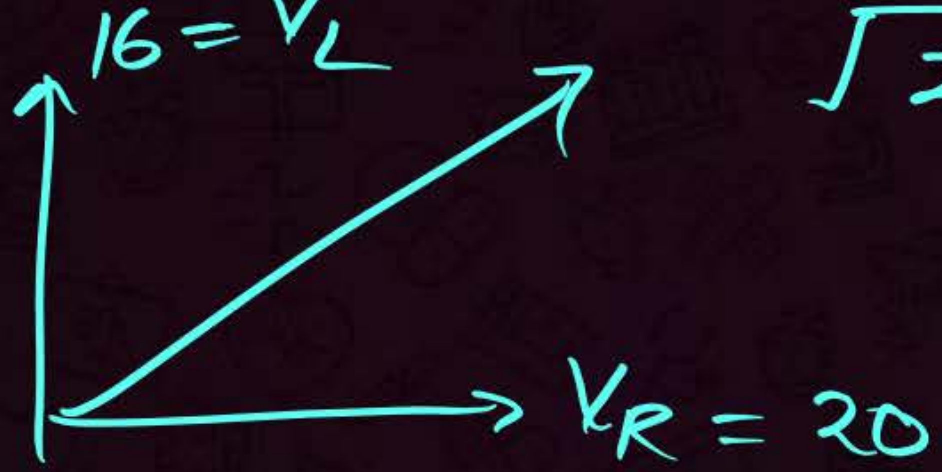
(AIIMS 2007)

(1) 20.0 V

(2) 25.6 V

(3) 31.9 V

(4) 53.5 V



rms value

$$\sqrt{20^2+16^2} = \sqrt{400+256}$$

$$= \sqrt{656}$$

$$= 25.\ldots$$

QUESTION

Statement-I: When capacitive reactance is smaller than the inductive reactance in LCR ~~current~~ circuit, e.m.f. leads the current.

Statement-II: The phase angle is the angle between the alternating e.m.f. and alternating current of the current. (ϕ)

$X_L > X_C \Rightarrow$ Voltage lead

1. Both Statement-I and Statement-II are correct
2. Both Statement-I and Statement-II are incorrect
3. Statement-I is correct and Statement-II incorrect
4. Statement-I is incorrect and Statement-II is correct

QUESTION

BPU

A series LCR circuit consists of $R = 80\,\Omega$. $X_L = 100\,\Omega$, and $X_c = 40\,\Omega$. The input voltage is $2500\cos(100\,\pi t)$ V. The amplitude of current, in the circuit, is ____A.

$\to V_0$

$\to i_0 = ?$

[31 Jan, 2023 (S-II)]]

A) 250

B) 25

C) 2.5

D) None

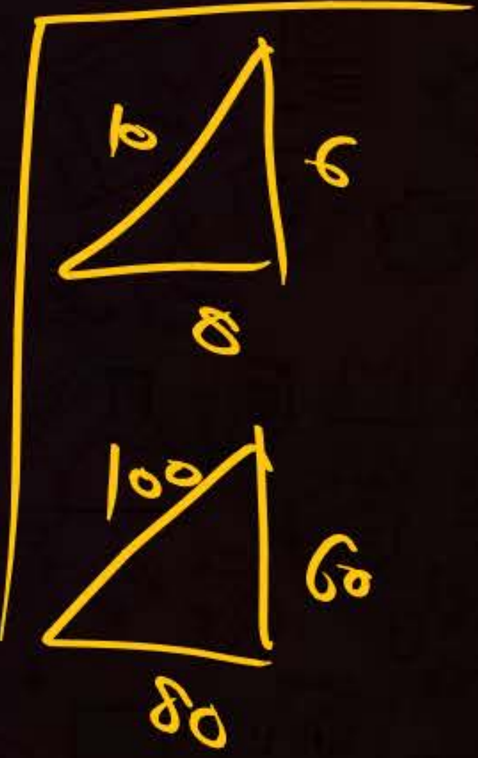
$$\boxed{i_0 = \frac{V_0}{Z}}$$

$$\boxed{I_{rms} = \frac{V_{rms}}{Z}}$$

$$Z = \sqrt{(100-40)^2 + 80^2}$$

$$= \sqrt{60^2 + 80^2}$$

$$= 100$$



$$i_0 = \frac{2500}{100} = 25.$$

QUESTION

HW

In a given series LCR circuit $R = 4\ \Omega$, $X_L = 5\ \Omega$ and $X_C = 8\ \Omega$, the current **(AIIMS 2012)**

1. leads the voltage by $\tan^{-1}(3/4)$
2. leads the voltage by $\tan^{-1}(5/8)$
3. lags the voltage by $\tan^{-1}(3/4)$
4. lags the voltage by $\tan^{-1}(5/8)$

QUESTION

A coil has resistance 30 ohm and inductive reactance $\boxed{20 \text{ ohm at } 50 \text{ Hz}}$ frequency. If an A.C. source, of $\boxed{200 \text{ volt}}$ $\boxed{100 \text{ Hz}}$, is connected across the coil, the current in the coil will be

(2011)

(1) $20/\sqrt{13}$ A

(2) 2.0 A

(3) 4.0 A

(4) 8.0 A

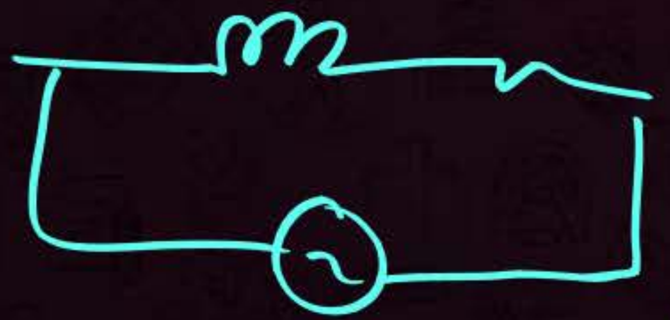
$R = 30\Omega$

$X_L = 20\Omega$ at $50\,Hz \Rightarrow X_L \propto f$

$\rightarrow X_L = 40\Omega$

$V_{rms} = 200V$

$f = 100\,Hz$



$f = 100$

$\rightarrow i_{rms} = \frac{V_{rms}}{Z}$

$Z = \sqrt{30^2 + 40^2} = 50$

$i_{rms} = \frac{200}{50} = 4A$

QUESTION

HW

In a circuit L, C and R are connected in series with an alternating voltage source of frequency f. The current leads the voltage by 45°. The value of C is (2005)

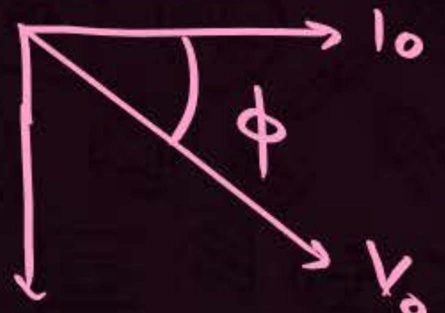
lag

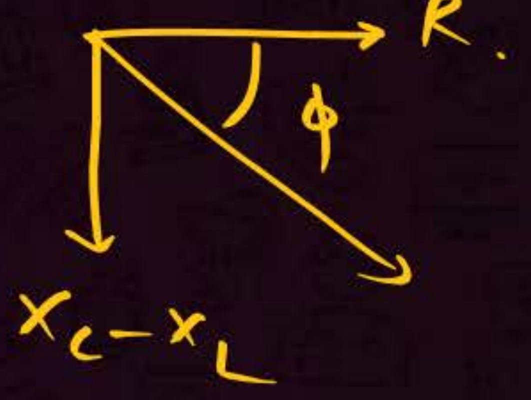
(1) $\dfrac{1}{2\pi f(2\pi fL+R)}$

(2) $\dfrac{1}{2\pi f(2\pi fL-R)}$

(3) $\dfrac{1}{\pi f(2\pi fL-R)}$

(4) $\dfrac{1}{\pi f(2\pi fL+R)}$





$$\tan\phi = \frac{X_C - X_L}{R} = +1$$

$$-1 = \frac{X_L - X_C}{R}$$

$$X_C = R + X_L$$

$$X_C = R + 2\pi f L$$

$$\frac{1}{2\pi f C} = R + 2\pi f L$$

$$\frac{1}{2\pi f(R+2\pi f L)} = C$$

QUESTION

If Wattless current flows in the AC circuit, then the circuit is: [25 June, 2022 (S-I)]

(JEE Mains)

1. Purely Resistive circuit
2. Purely Inductive circuit
3. LCR series circuit
4. RC series circuit only

Power consumed in series LCR circuit

$i = i_0 \sin \omega t$

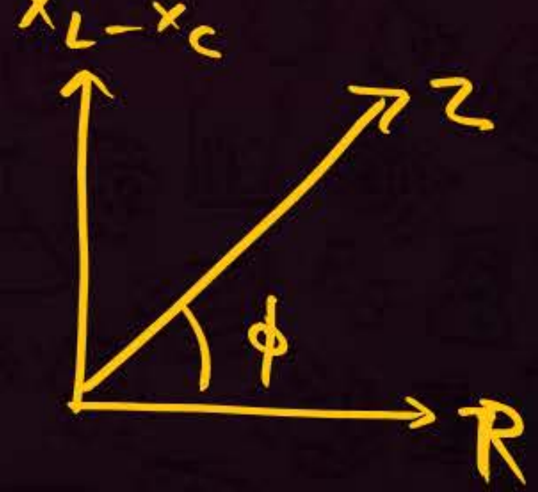
$V = V_0 \sin(\omega t \pm \phi)$

$$\boxed{P_{av} = \frac{V_0 i_0}{2} \cos\phi}$$

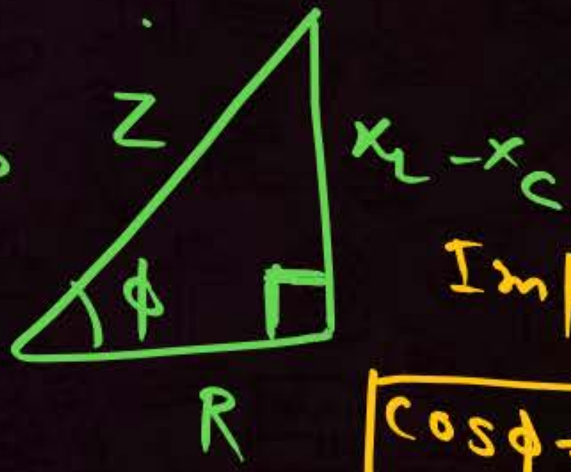
series LCR.

* $P_{av} = \frac{V_0}{\sqrt{2}} \times \frac{i_0}{\sqrt{2}} \cos\phi$

$$\boxed{\underbrace{P_{av}}_{\text{True power}} = \underbrace{V_{rms}\, i_{rms}}_{\text{apparent power}}\ \underbrace{\cos\phi}_{\text{power factor}}}$$



$\Rightarrow$



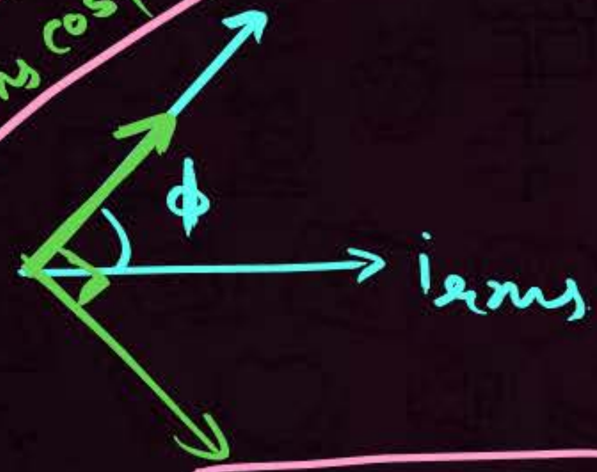
Impedance Δ.

$$\boxed{\cos\phi = \frac{R}{Z}}$$

Watt-less current in series LCR circuit

P_{av}

$\boxed{i_{rms}\cos\phi \; V_{rms}}$



$\boxed{I_{rms}\sin\phi}$

↓

wattless current in LCR series

Purely L or C

↓

sara current wattless hai!

QUESTION

The power factor varies between [AIIMS 1995]

1. 0 to 1
2. 2 and 2.5
3. 1 to 2
4. 3.5 to 5

$$\cos\phi = \frac{R}{Z}$$

$$\phi = 0^\circ \Rightarrow \cos\phi = 1$$

$$\phi = 90^\circ \Rightarrow \cos\phi = 0$$

QUESTION

In an a.c. circuit the e.m.f. (ε) and the current (i) at any instant are given respectively by $\varepsilon = E_0 \sin\omega t$, $i = I_0 \sin(\omega t - \phi)$. The average power in the circuit over one cycle of a.c. is

(2008)

$V_0 \longrightarrow E_0$

1. $\frac{E_0 I_0}{2}\cos\phi$ (Formula)
2. $E_0 I_0$
3. $\frac{E_0 I_0}{2}$
4. $\frac{E_0 I_0}{2}\sin\phi$

QUESTION

In an ac circuit, V and I are given by $V = 100 \sin(100t)$ volts, $I = 100 \sin\left(100t + \frac{\pi}{3}\right)$ mA. The power dissipated in circuit is

$\to V_0$

$\to i_0$

$\to \phi = 60^\circ$

(1) 10^4 watt

(2) 10 watt

(3) 2.5 watt

(4) 5 watt

$i_0 = 100\,mA$

$= \frac{100}{1000} A$

$P_{av} = \frac{100}{2} \times \frac{100}{1000} \times \cos 60^\circ$

$= \frac{10}{2} \times \frac{1}{2}$

$= \frac{10}{4} = 2.5\,W$

QUESTION

In instantaneous values of alternating current and voltage in a circuit are given as $i = \frac{1}{\sqrt{2}}\sin(100\pi t)$ ampere, $e = \frac{1}{\sqrt{2}}\sin(100\pi t)$ volt.

Same phase.

The average power in the watts consumed in the circuit is

1. 1/4
2. $\sqrt{3}/4$
3. 1/2
4. 1/8

$$P_{av} = \frac{\frac{1}{\sqrt{2}} \times \frac{1}{\sqrt{2}}}{2} \cos 0^\circ$$

$$= \frac{1}{2 \times 2} \times 1$$

$$= \frac{1}{4}$$

QUESTION

An ac circuit has an inductor and a resistor of resistance R in series, such that $X_L = 3R$. Now, a capacitor is added in series such that $X_C = 2R$. The ratio of new power factor with the old power factor of the circuit is $\sqrt{5}: x$ The value of x is ______

[27 Aug, 2021 (Shift-II)]

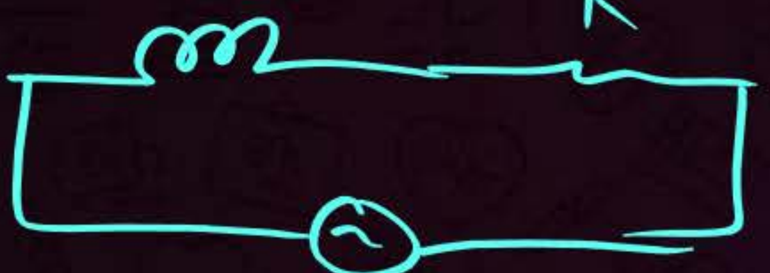
(JEE Mains)

A) 3

B) 2

C) 1

D) None



$Z = \sqrt{(3R)^2 + R^2}$

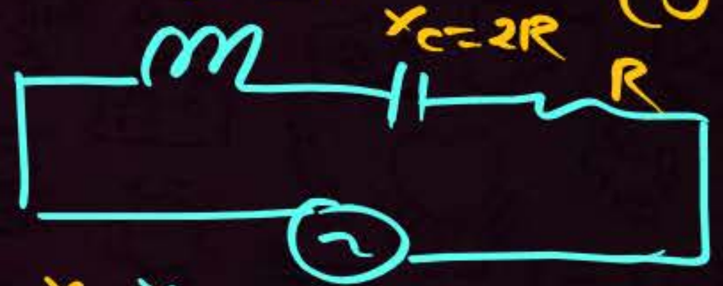
$= \sqrt{9R^2 + R^2}$

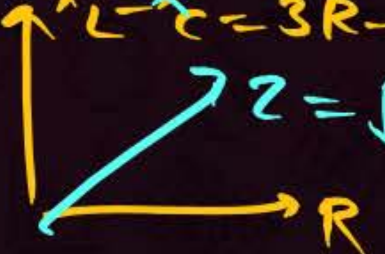
$= \sqrt{10R^2}$

$= \sqrt{10}\,R$

$\cos\phi = \frac{R}{Z} = \frac{R}{\sqrt{10}R}$

$= \frac{1}{\sqrt{10}}$





$X_L - X_C = 3R - 2R = R$

$Z = \sqrt{2}\,R$

$\cos\phi = \frac{R}{\sqrt{2}R} = \frac{1}{\sqrt{2}}$

$$\frac{\frac{1}{\sqrt{2}}}{\frac{1}{\sqrt{10}}} = \frac{\sqrt{10}}{\sqrt{2}} = \frac{\sqrt{5}}{1}$$

x

QUESTION

H/W

A coil of inductive reactance 31 Ω has a resistance of 8 Ω. It is placed in series with a condenser of capacitive reactance 25 Ω. The combination is connected to an A.C. source of 110 volt. The power factor of the circuit is (2006)

$\frac{R}{Z}$

1. 0.80
2. 0.33
3. 0.56
4. 0.64

QUESTION

The potential differences across the resistance, capacitance and inductance are 80 V, 40 V and 100 V respectively in an L-C-R circuit. The power factor of this circuit is

(2016)

(1) 1.0

(2) 0.4

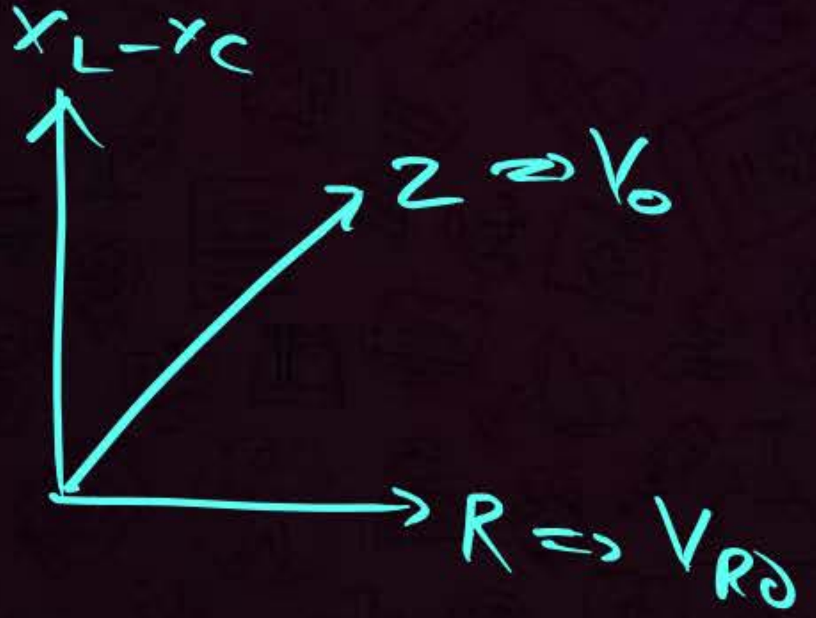
(3) 0.5

(4) 0.8

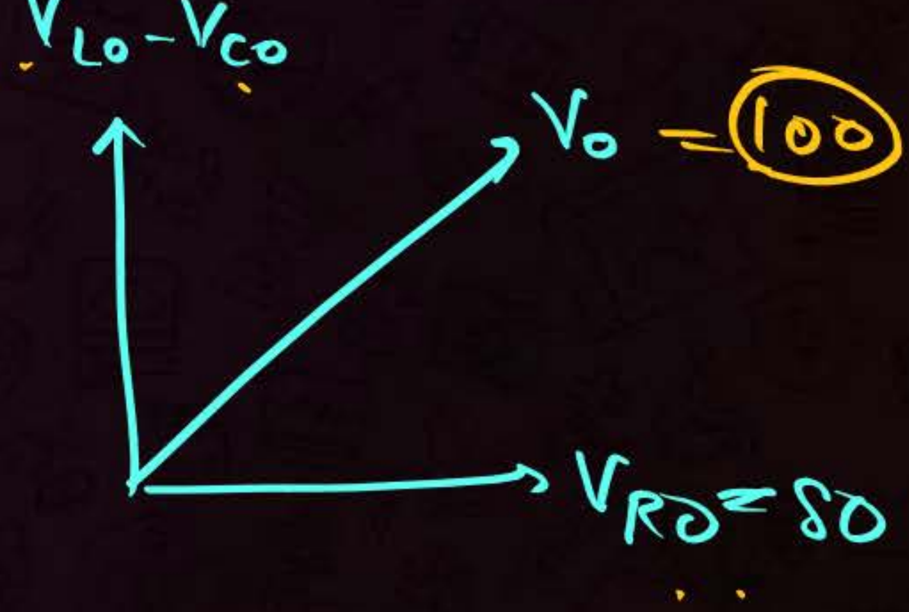
$$\cos\phi = \boxed{\frac{R}{Z}} = \frac{V_{R0}}{V_0} = \frac{80}{100}$$

$$= 0.8$$

$$= 0.80$$



$100 - 40 = 60$



QUESTION

Power ↓

Assertion : A bulb connected in series with a solenoid is connected to ac source. If a soft iron core is introduced in the solenoid, the bulb will glow brighter.

reactance

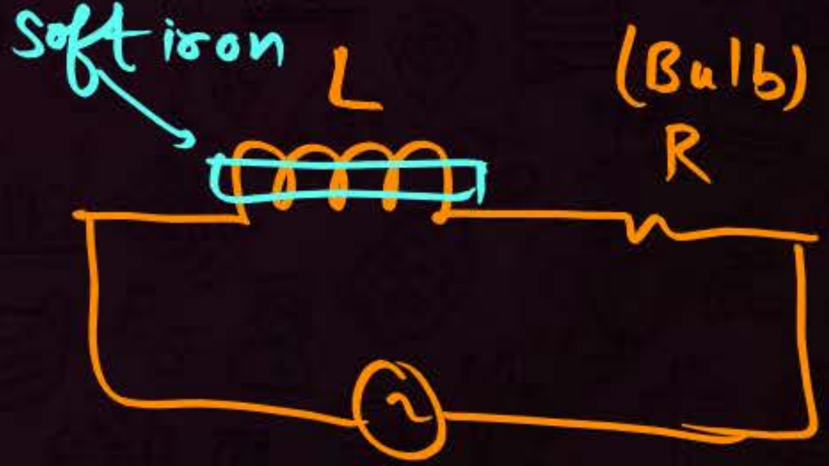
Reason : On introducing soft iron core in the solenoid, the inductance increases. ↑

(1) Assertion (A) is true, Reason (R) is true, Reason (R) is a correct explanation for assertion (A).

(2) Assertion (A) is true, Reason (R) is true, Reason (R) is not a correct explanation for assertion (A).

(3) Assertion (A) is true, Reason (R) is false.

(4) Assertion (A) is false, Reason (R) is true.



soft. iron

$\mu_r >> 1$

EMI

$$L = \frac{\mu_0 N^2 A}{l}$$

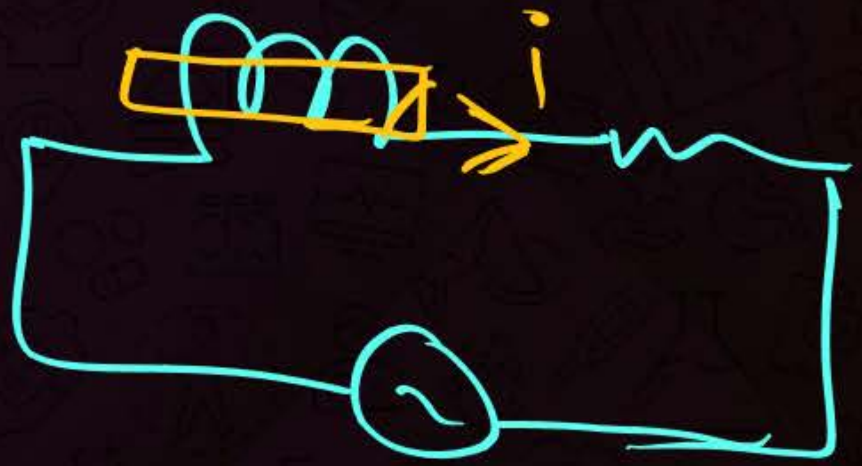
$$L = \mu_r \mu_0 \frac{N^2 A}{l}$$

$$L\uparrow \longrightarrow X_L = \omega L$$

$$\longrightarrow X_L \uparrow$$

$$i_0 = \frac{V_0}{Z} = \frac{V_0}{\sqrt{X_L^2 + R^2}}$$

$$X_L \uparrow \Rightarrow i_0 \downarrow.$$



Resonance in LCR series circuit

↓

frequency match

$$Z = \sqrt{\underbrace{(X_L - X_C)^2}_{\to\, 0} + R^2}$$

$$i_0 = \frac{V_0}{Z} \quad \Rightarrow \min^m$$

Z ↳ min

$$Z_{min} = \sqrt{0^2 + R^2} = R.$$

$$\boxed{Z_{min} = R.}$$

$$\boxed{(i_0)_{max} = \frac{V_0}{(Z)_{min}} = \frac{V_0}{R}.}$$

- $X_L - X_C = 0$

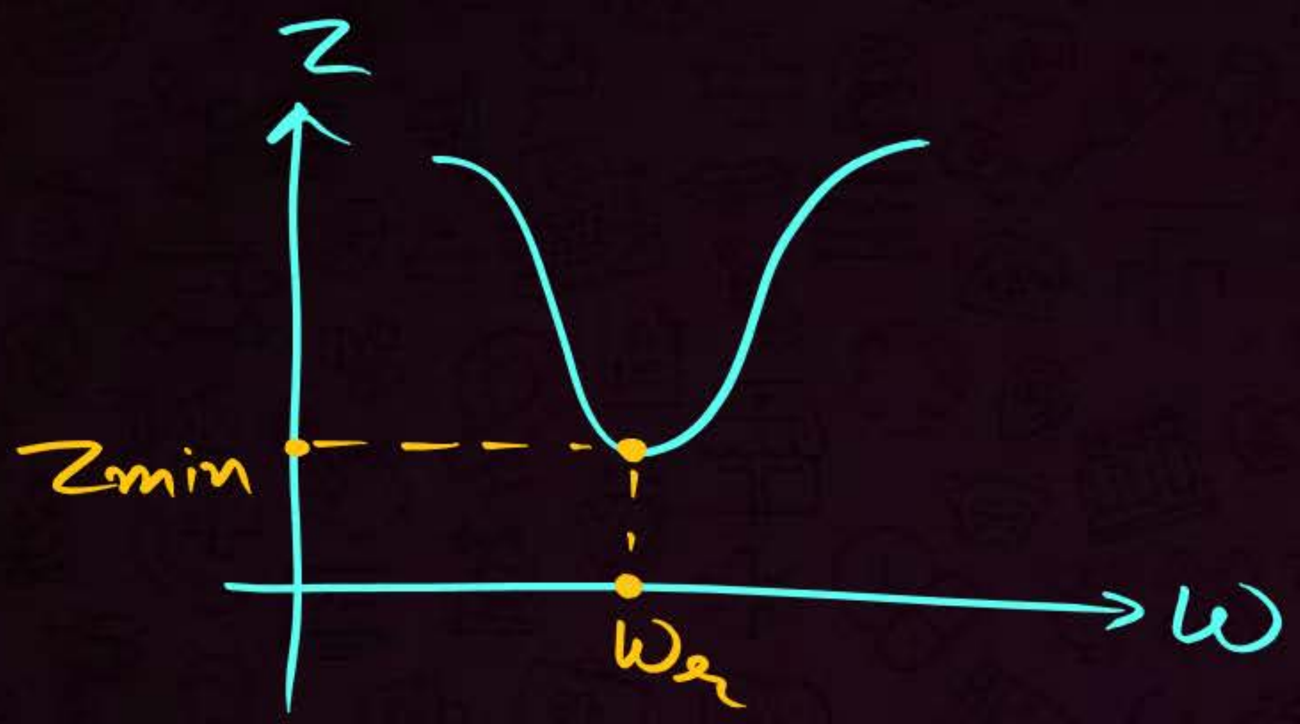
$$X_L = X_C$$

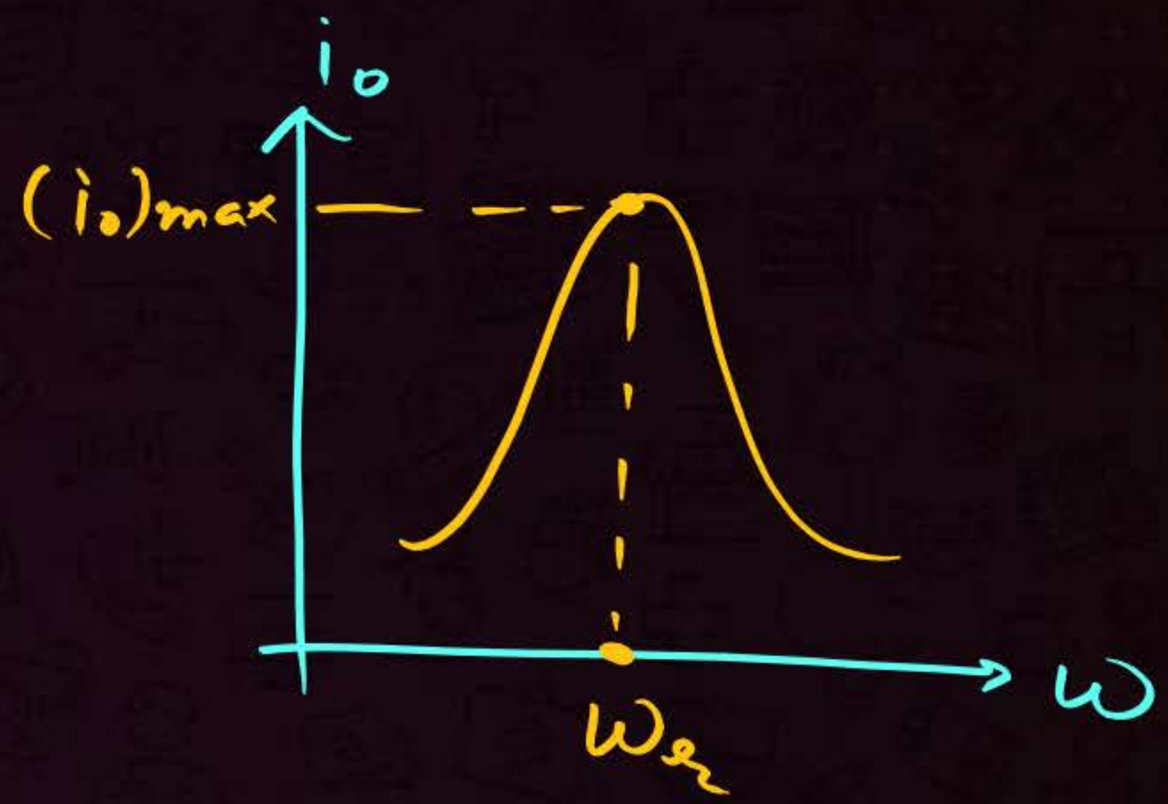
$$\omega L = \frac{1}{\omega C}$$

$$\omega^2 = \frac{1}{LC} \Rightarrow \boxed{\omega = \frac{1}{\sqrt{LC}} = \omega_r} \to \text{Resonance angular freq.}$$

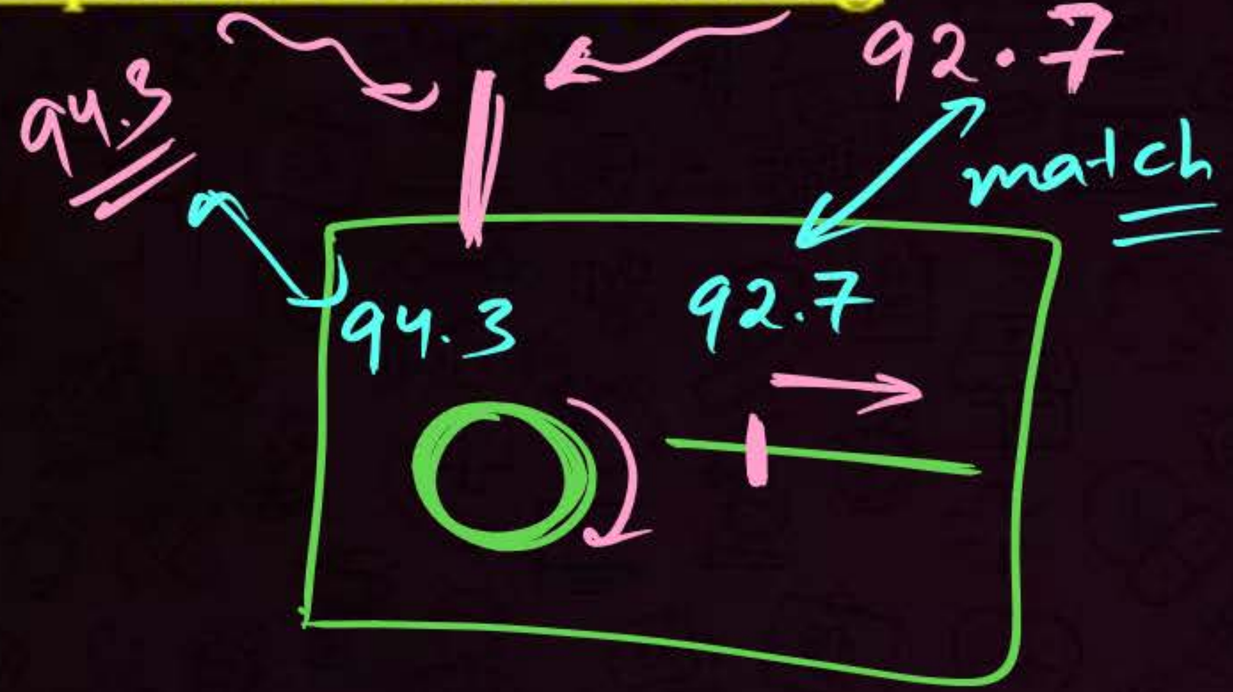
$$2\pi f_r = \frac{1}{\sqrt{LC}} \Rightarrow \boxed{f_r = \frac{1}{2\pi\sqrt{LC}}} \to \text{Resonance freq.}$$

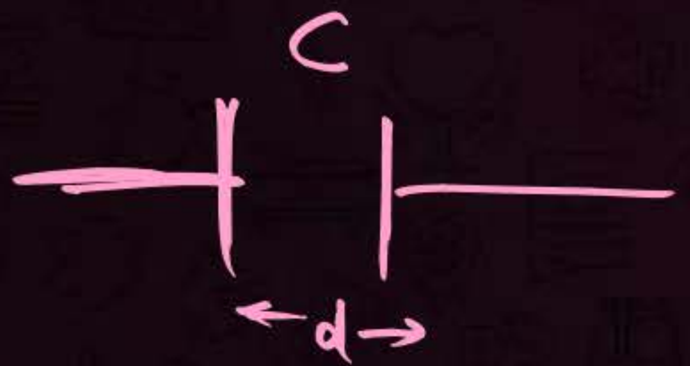
Graph





Example of Radio Tuning





→ change → C change

$\omega_r \to$ change

$$\omega_r = \frac{1}{\sqrt{LC}}$$

Bandwidth of a Circuit

⇓

eg: 92.7 MHz FM

eg: 92.5 — 92.7 — 92.9

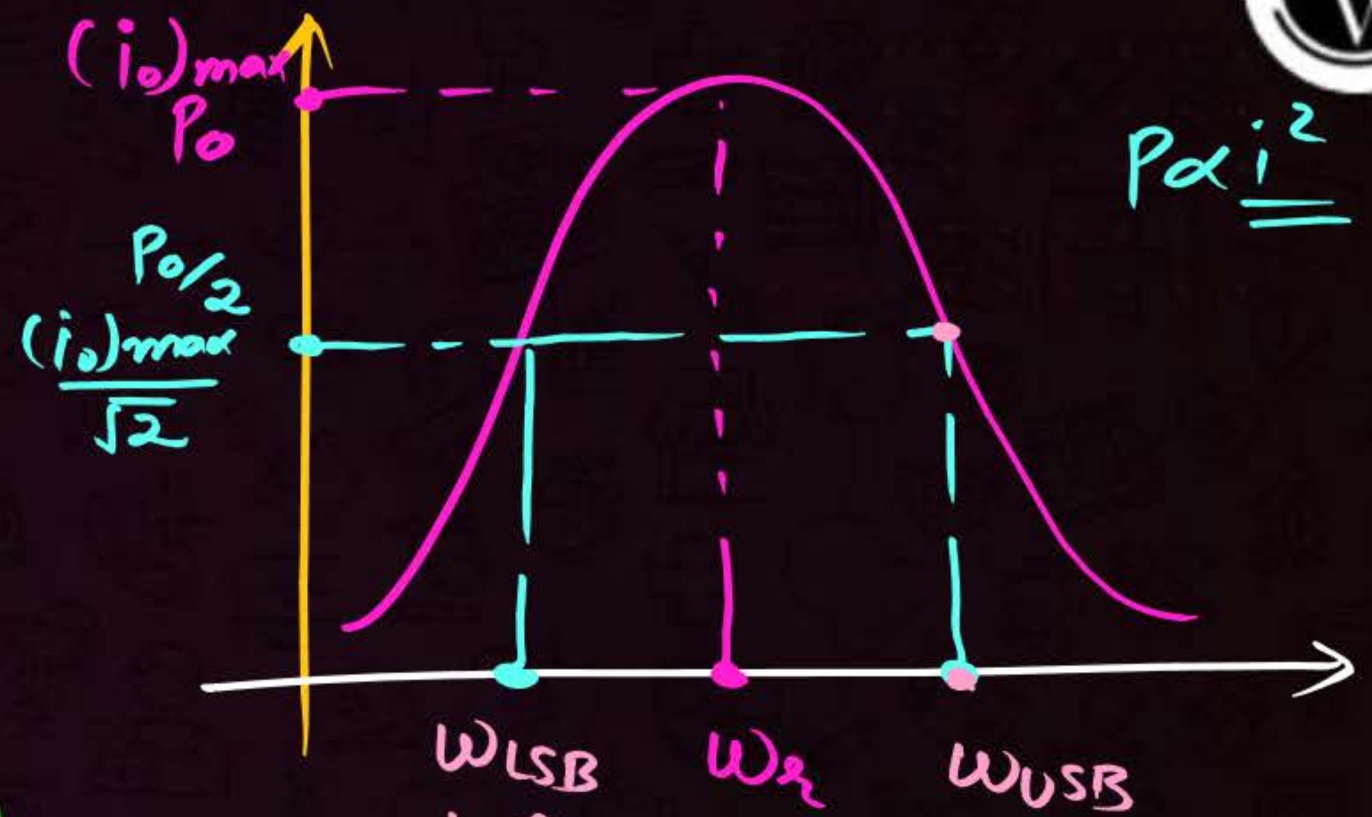
Bandwidth

ω_{LSB} ↓ Lower Side Band

ω_r

ω_{USB} ↓ Upper Side band

$P \propto i^2$



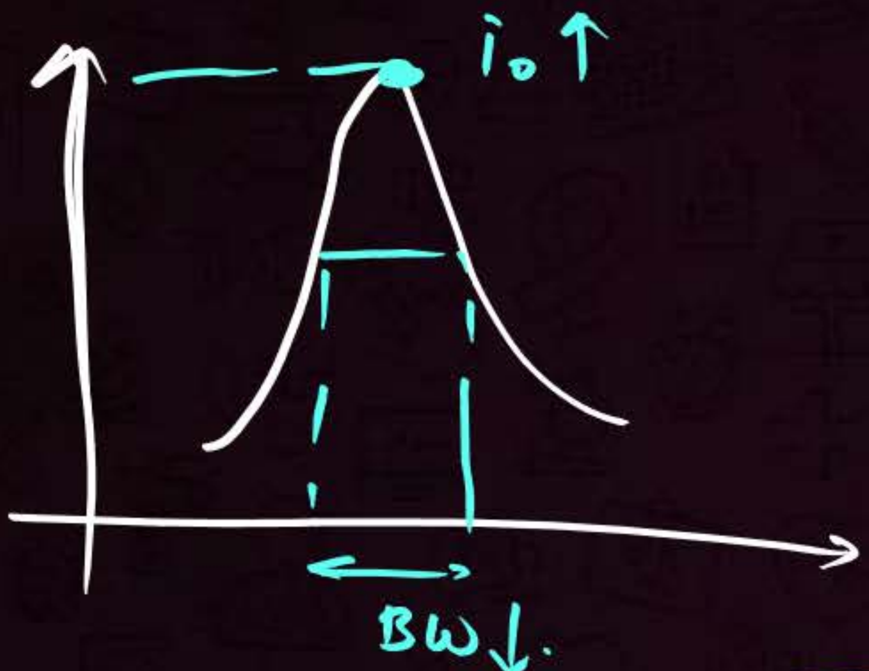
$-\Delta\omega$ $\Delta\omega$

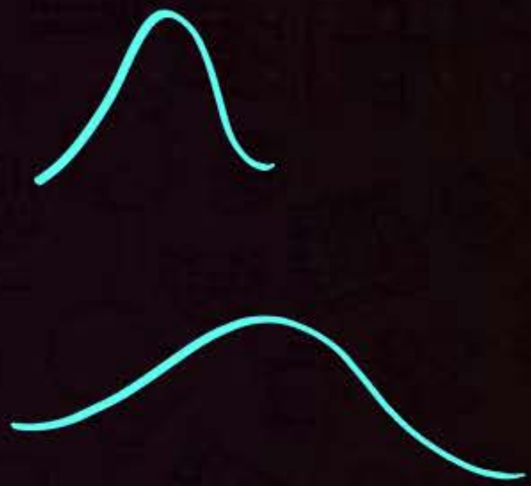
$\omega_r - \Delta\omega$

$\omega_{USB} = \omega_r + \Delta\omega$

$$B.W. = \omega_{USB} - \omega_{LSB}$$
$$= 2\Delta\omega$$

Quality factor / Sharpness of a Circuit (Q)





$$Q = \boxed{\frac{\omega_r}{BW}} = \boxed{\frac{\omega_r}{2\Delta\omega}} = \frac{\omega_r}{R/L} = \boxed{\frac{\omega_r L}{R}} = \boxed{\frac{1}{R\,\omega_r C}} = \boxed{\frac{1}{R}\sqrt{\frac{L}{C}}}$$

$$B.W = 2\Delta\omega = \frac{R}{L}$$

Resonance $\Rightarrow X_L = X_C$

$$\omega_r L = \frac{1}{\omega_r C}$$

QUESTION

In LCR circuit, the capacitance is changed from C to 4C. For the same resonant frequency, the inductance should be changed from L to

1. 2L
2. L/2
3. L/4
4. 4L

$\omega_r = \frac{1}{\sqrt{LC}}$

same

$\frac{L}{\cancel{4}}$

$\cancel{4}C$

QUESTION

HW

What is the value of inductance L for which the current is maximum in a series LCR circuit with $C = 10\ \mu F$ and $\omega = 1000\ s^{-1}$? (2007)

1. 1 mH
2. cannot be calculated unless R is known
3. 10 mH
4. 100 mH.

QUESTION

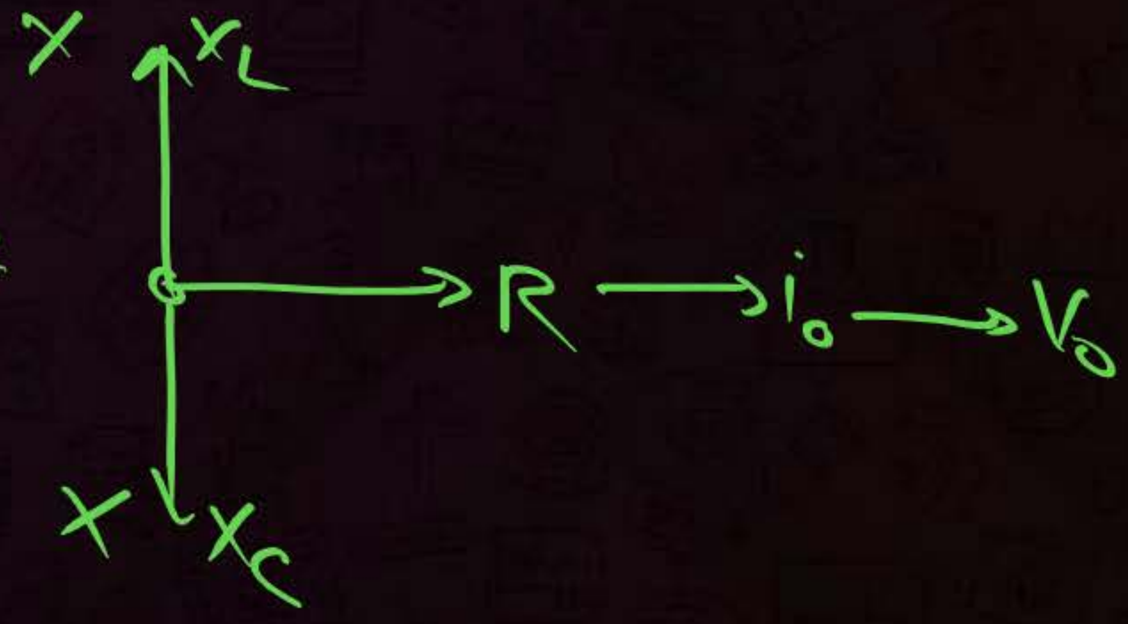
Assertion: At resonance, LCR series circuit have a minimum current.

Reason: At resonance, in LCR series circuit, the current and e.m.f are not in phase with each other.

(AIIMS 2016)

1. Assertion (A) is True, Reason (R) is True; Reason (R) is a correct explanation for Assertion (A)
2. Assertion (A) is True, Reason (R) is True; Reason (R) is not a correct explanation for Assertion (A)
3. Assertion (A) is True, Reason (R) is False.
4. Assertion (A) is False, Reason (R) is ~~True~~. False

$X_L = X_C$



QUESTION

The value of quality factor is (2000)

1. $\omega L/C$ ×
2. $1/\omega_2 RC$
3. $\sqrt{LC}$ × $\Rightarrow \frac{1}{\sqrt{LC}}$ ✓
4. L/R ×

QUESTION

HW

A coil of inductance 8 μH is connected to a capacitor of capacitance 0.02 μF. To what wavelength is this circuit tuned?

(AIIMS 2015)

$\longrightarrow \omega_r = \frac{1}{\sqrt{LC}}$

(1) 9.54×10^3 m

(2) 4.12×10^2 m

(3) 15.90×10^3 m

(4) 7.54×10^2 m

$f_r = \frac{1}{2\pi\sqrt{LC}}$

Light Wave

$c = f\lambda$

$\lambda = \frac{c}{f}$

QUESTION

H/W

If L, C and R are the self inductance, capacitance and resistance respectively, which of the following does not have the dimension of time? [27 June, 2022 (S-II)]

1. RC
2. L/R
3. $\sqrt{LC}$
4. L/C

QUESTION

In an ac circuit, an inductor, a capacitor and a resistor are connected in series with $X_L = R = X_C$. Impedance of this circuit is: [31 Aug, 2021 (Shift-I)]

(JEE Mains)

1. $2R^2$
2. Zero
3. $R\sqrt{2}$
4. R

$$Z = \sqrt{(X_L - X_C)^2 + R^2}$$

$$= \sqrt{0^2 + R^2}$$

$$Z = R$$

QUESTION

HW

A series resonant LCR circuit has a quality factor (Q-factor) 0.4. If $R = 2\ k\Omega$, $C = 0.1\ \mu F$, then the value of inductance is **(AIIMS 2016)**

1. 0.1 H
2. 0.064 H
3. 2 H
4. 5 H

QUESTION

In the circuit shown below, the ac source has voltage $V = 20\cos(\omega t)$ volts with $\omega = 2000$ rad/sec. the amplitude of the current will be

(1) 2 A

(2) 3.3 A

(3) $2/\sqrt{5}$ A

(4) $\sqrt{5}$A

$R = 4 + 6 = 10$

$i_0 = \frac{V_0}{Z}$

R

$i_0 = \frac{V_0}{R} = \frac{20}{10} = 2.$

Resonance

$X_L = \omega L = 5 \times 10^{-3} \times 2000 = 10\Omega$

$X_C = \frac{1}{\omega C} = \frac{1}{2000 \times 50 \times 10^{-6}} = 10\Omega$

QUESTION

HW

In a series LCR circuit the voltage across resistance, capacitance and inductance is 10 V each. If the capacitance is short circuited, the voltage across the inductance will be (AIIMS 2000)

1. $10/\sqrt{2}$ V
2. 10 V
3. $10\sqrt{2}$ V
4. 20 V

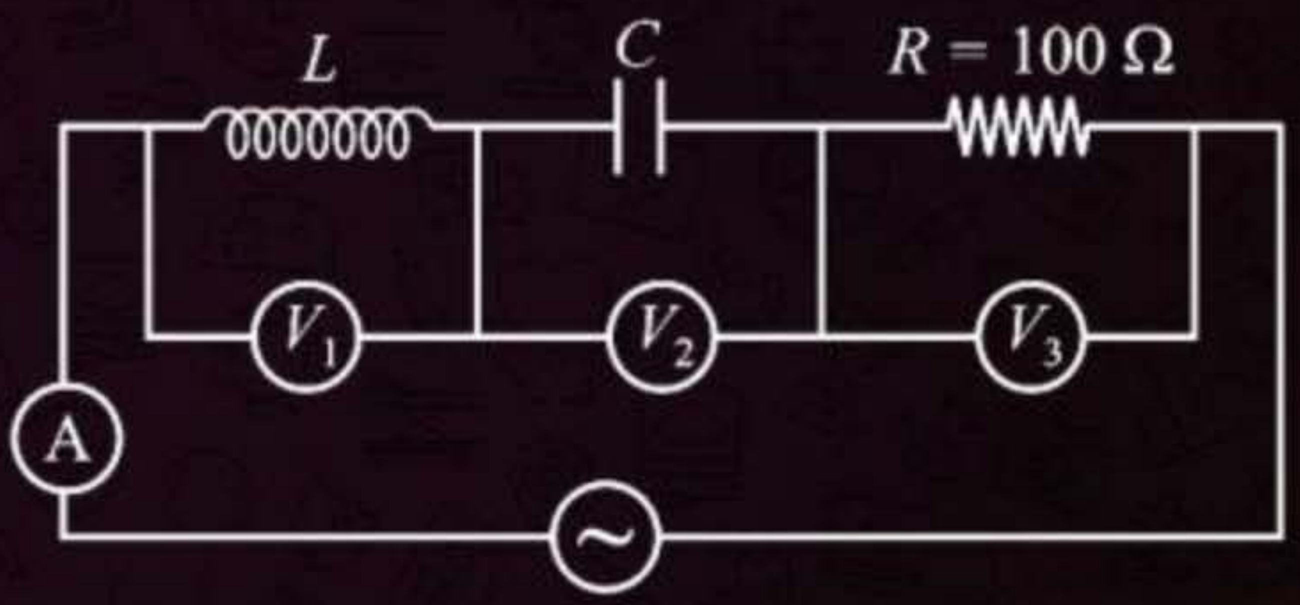
QUESTION

HW

In the given circuit the reading of voltmeter V_1 and V_2 are 300 volts each. The reading of the voltmeter V_3 and ammeter A are respectively. The source voltage is 220 V, 50 Hz

(2010)

1. 150 V, 2.2 A
2. 200 V, 2.2 A
3. 220 V, 2.2 A
4. 100 V, 2.0 A



QUESTION

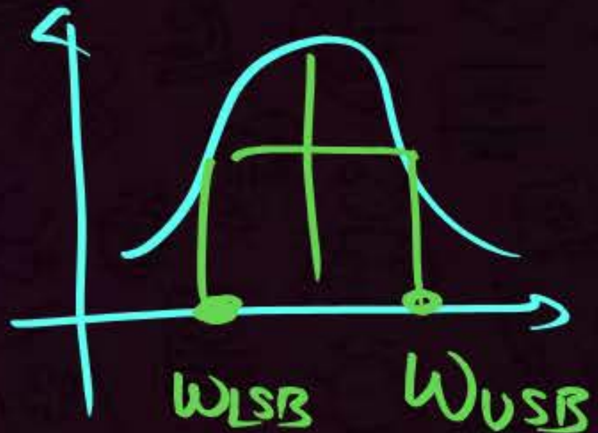
A series L-C-R circuit containing 5.0 H inductor, 80 μF capacitor and 40 Ω resistor is connected to 230 V variable frequency AC source. The angular frequencies of the source at which power transferred to the circuit is half the power at the resonant angular frequency are likely to be **[NEET 2021]**

(1) 25 rad/s and 75 rad/s
50

(2) 50 rad/s and 25 rad/s
25

(3) 46 rad/s and 54 rad/s
8

(4) 42 rad/s and 58 rad/s
16



$$BW = \omega_{USB} - \omega_{LSB} = \frac{R}{L}$$

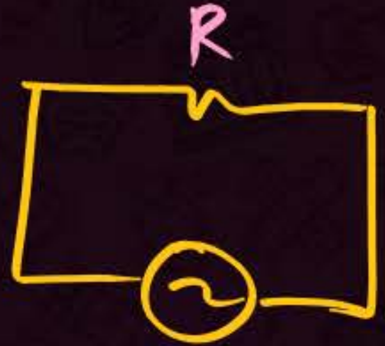
$$= \frac{40}{5} = 8$$

Choke Coil

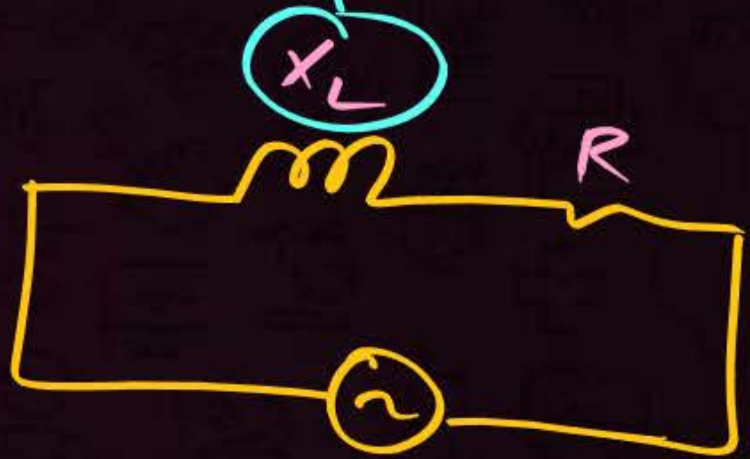
It is used to control the current in a circuit without dissipating any power or energy.

Inductor

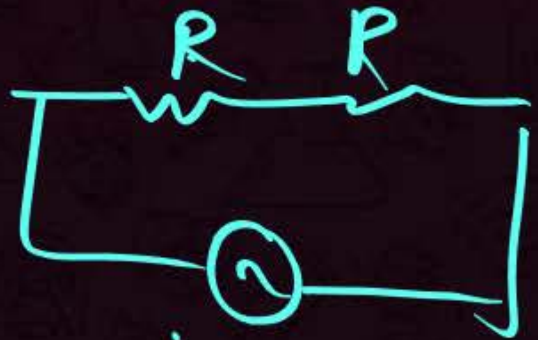
Can be capacitor also



$$i_0 = \frac{V_0}{R}$$



$$i_0 = \frac{V_0}{\sqrt{X_L^2 + R^2}} \downarrow \text{dec}$$



$$i_0 = \frac{V}{2R} \downarrow$$

X

QUESTION

Assertion: A capacitor of suitable capacitance can be used in an AC circuit in place of the choke coil.

Reason: A capacitor blocks DC and allows AC only. (AIIMS 2019)

1. Assertion (A) is True, Reason (R) is True; Reason (R) is a correct explanation for Assertion (A)
2. Assertion (A) is True, Reason (R) is True; Reason (R) is not a correct explanation for Assertion (A)
3. Assertion (A) is True, Reason (R) is False.
4. Assertion (A) is False, Reason (R) is True.

Transformer

To step up or step down the voltage.

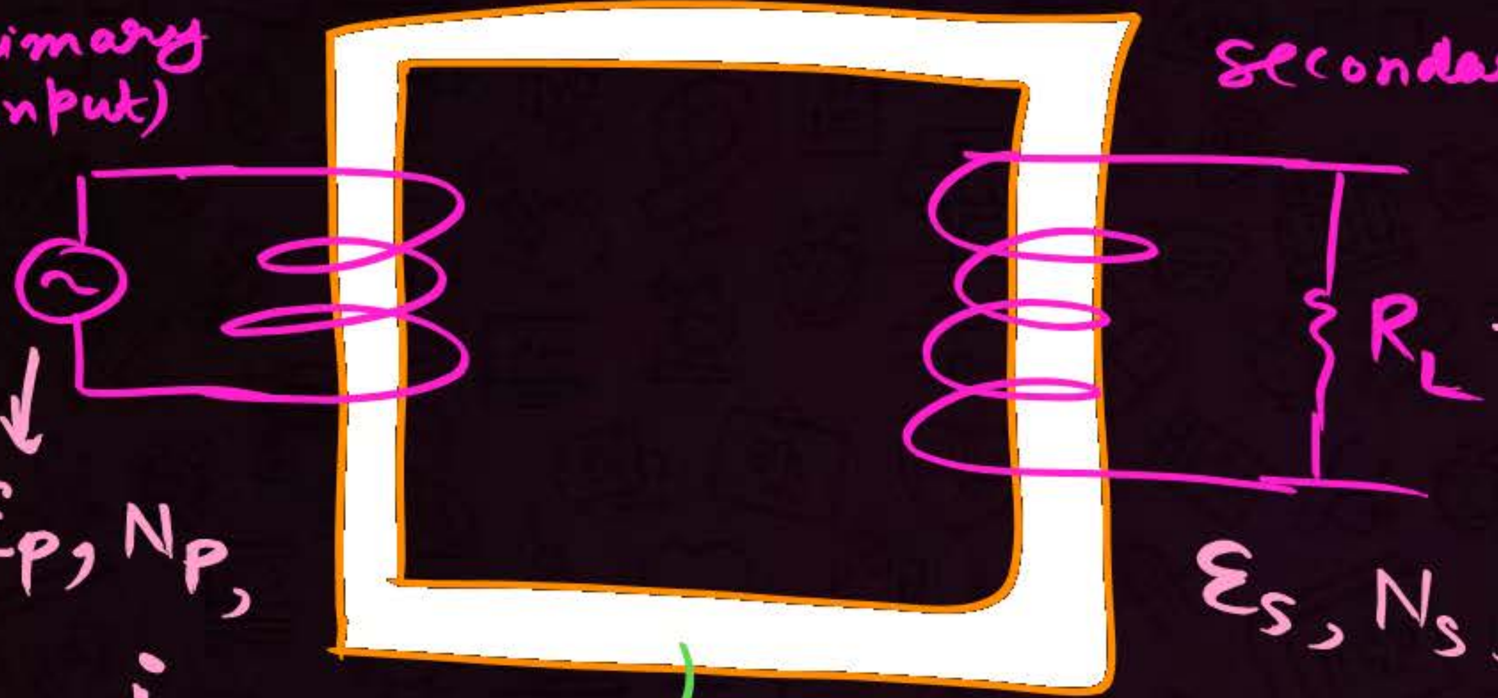
(EMI)

Based on mutual inductance between two coils. Whenever there is change in current in primary coil, there is emf induced in the secondary coil.

Construction and Working

Primary (Input)

Secondary (Output)



R_L → Load/output Resistance

$\mathcal{E}_p, N_p, i_p$

$\mathcal{E}_s, N_s, i_s$

Soft iron core ($B\uparrow$)

$\mu_r \uparrow\uparrow$.

→ energy loss ↓.

Ideal Transformer

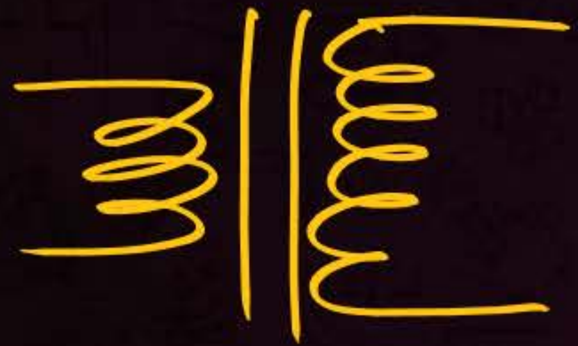
↓

No flux Loss

No Power Loss

★ $$\boxed{\frac{\mathcal{E}_p}{\mathcal{E}_s} = \frac{N_p}{N_s} = \frac{i_s}{i_p}}$$

a) Step-up Transformer

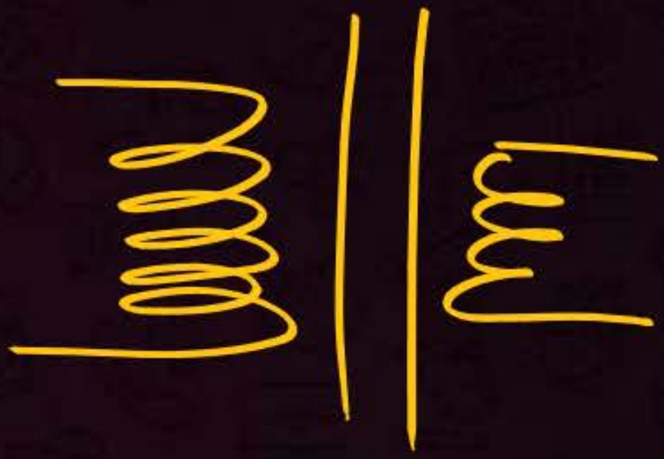


$N_p < N_s$

$\varepsilon_p < \varepsilon_s$ (Up↑)

$i_p > i_s$

b) Step-down Transformer



$N_p > N_s$

$\varepsilon_p > \varepsilon_s$ (Down↓)

$i_p < i_s$

Whatever we gain in votage, we lose in current.

Non - Ideal Transformer

$\hookrightarrow P_s \neq P_p$

$\hookrightarrow P_s < P_p$

$$\eta = \frac{P_s}{P_p} \times 100 = \frac{\varepsilon_s i_s}{\varepsilon_p i_p} \times 100 \Rightarrow \text{efficiency}$$

QUESTION

A transformer works on the principle of (AIIMS 1998)

1. mutual induction
2. invertor
3. convertor
4. self-induction.

QUESTION

Match the List-I with List-II. Choose the correct answer from the options given below:

[1 Feb, 2023 (S-I)]

List – I		List –II	
A	AC generator	i	Presence of both L and C $\frac{1}{\sqrt{LC}}$
B	Transformer	ii	Electromagnetic Induction
C	Resonance phenomenon to occur	iii	Quality factor
D	Sharpness of resonance	iv	Mutual Inductance

(1) $A \rightarrow IV, B \rightarrow II, C \rightarrow I, D \rightarrow III$

(2) $A \rightarrow II, B \rightarrow I, C \rightarrow III, D \rightarrow IV$

(3) $A \rightarrow II, B \rightarrow IV, C \rightarrow I, D \rightarrow III$

(4) $A \rightarrow IV, B \rightarrow III, C \rightarrow I, D \rightarrow II$

QUESTION

Which of the following quantity is increased in a step-down transformer? **(AIIMS 1999)**

$V\downarrow$

$i\uparrow$

(1) Voltage

(2) Current

(3) Power

(4) Frequency.

QUESTION

The primary winding of a transformer has 500 turns whereas its secondary has 5000 turns. The primary is connected to an A.C. supply 20 V, 50 Hz. The secondary will have an output of

→ No change.

$$\frac{\mathcal{E}_P}{\mathcal{E}_S} = \frac{N_P}{N_S}$$

TBS

$500 \xrightarrow{\times 10} 5000$

$20 \xrightarrow{\times 10} 200$

$$\frac{20}{\mathcal{E}_S} = \frac{\cancel{500}\,1}{\cancel{5000}\,10}$$

$$\mathcal{E}_S = 20 \times 10 = 200$$

(1) 2 V, 50 Hz

(2) 2 V, 5 Hz

(3) 200 V, 50 Hz

(4) 200 V, 500 Hz

QUESTION

HW

A step-up transformer operates on a 230 V line and supplies a load of 2 A. The ratio of primary and secondary windings is 1 : 25. Then the current in the primary is

(1) 25 A

(2) 50 A

(3) 15 A

(4) 12.5 A

QUESTION

DC

Turn ratio in a step-up transformer is 1 : 2. If a Lechlanche cell of 1.5 V is connected across the input, what is the voltage across the output? (AIIMS 2000)

(1) 1.5 V

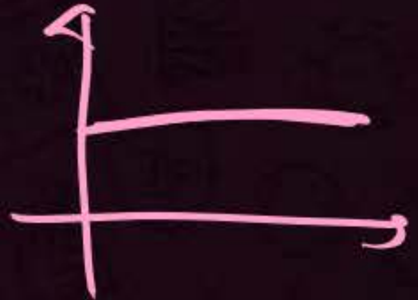
(2) 0.0 V

(3) 3 V

(4) 0.75 V

Transformer → AC ✓

↳ DC ✗



$e = 0$

QUESTION

HW

An ideal transformer has 100 turns in the primary and 250 turns in the secondary. The peak value of the ac is 28 V. The r.m.s. secondary voltage is nearest to

(1) 50 V

(2) 70 V

(3) 100 V

(4) 40 V

QUESTION

HW

A transformer consisting of 300 turns in the primary and 150 turns in the secondary gives output power of 2.2 kW. If the current in the secondary coils is 10 A, then the input voltage and current in the primary coil are [10 April, 2019 (Shift-I)]

1. 220 V and 10 A
2. 440 V and 5 A
3. 440 V and 20 A
4. 220 V and 20 A

QUESTION

The primary an secondary coils of a transformer have 50 and 1500 turns respectively. If the magnetic flux ϕ linked with the primary coil is given by $\phi = \phi_0 + 4t$, where ϕ is in webers t is time in seconds and ϕ_0 is a constant, the output voltage across the secondary coil is

(1) 90 volt

(2) 120 volt

(3) 220 volt

(4) 30 volt

$N_p = 50$

$N_s = 1500$

$\mathcal{E}_p = -\frac{d\phi}{dt} = -(0+4) = -4V$

$\mathcal{E}_s = ?$

$$\frac{\mathcal{E}_s}{\mathcal{E}_p} = \frac{N_s}{N_p}$$

$50 \xrightarrow{\times 30} 1500$

$4V \xrightarrow{\times 30} 120$

QUESTION

A transformer is employed to reduce 220 V to 11 V. The primary draws a current of 5 A and the secondary 90 A. The efficiency of the transformer is

$\uparrow \varepsilon_p$ $\uparrow \varepsilon_s$

$\downarrow i_p$ $\hookrightarrow i_s$

(1) 20%

(2) 40%

(3) 70%

(4) 90%

$$\eta = \frac{\varepsilon_s i_s}{\varepsilon_p i_p} \times 100$$

$$= \frac{11 \times 90}{220 \times 5} \times 100$$

$$= \frac{99}{110} \times 100 = \frac{990}{11}$$

$$= 90\%$$

Non-ideal

$$\boxed{\frac{\varepsilon_p}{\varepsilon_s} = \frac{N_p}{N_s}} \neq \frac{i_s}{i_p}$$

$$\frac{\varepsilon_p}{\varepsilon_s} \neq \frac{i_s}{i_p}$$

QUESTION

HW

A transformer is used to light 100 W - 110 V lamp from 220 V mains. If the main current is 0.5 A, the efficiency of the transformer is approximately

(1) 50%

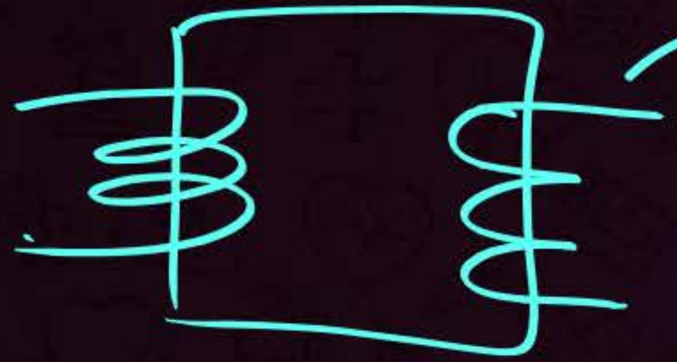
(2) 90%

(3) 10%

(4) 30%

Losses in Transformer:

1. **Copper Loss:** Due to resistance of the windings, the heat is produced. To reduce it, we use thick wires.



$\to$ copper $\to$ Heat

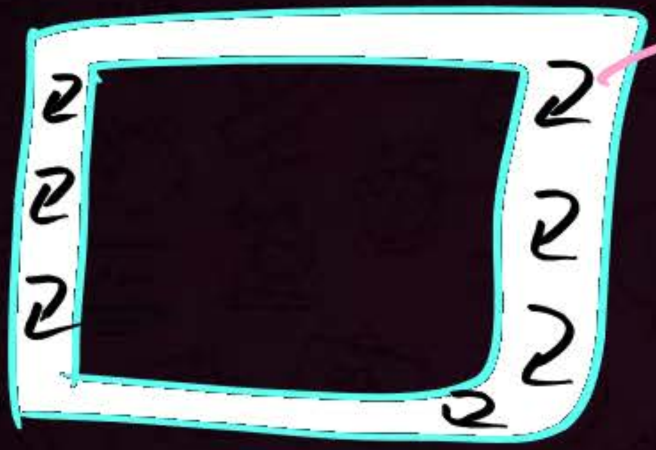
Thick $\Rightarrow R = \frac{\rho l}{A}$

$\downarrow$

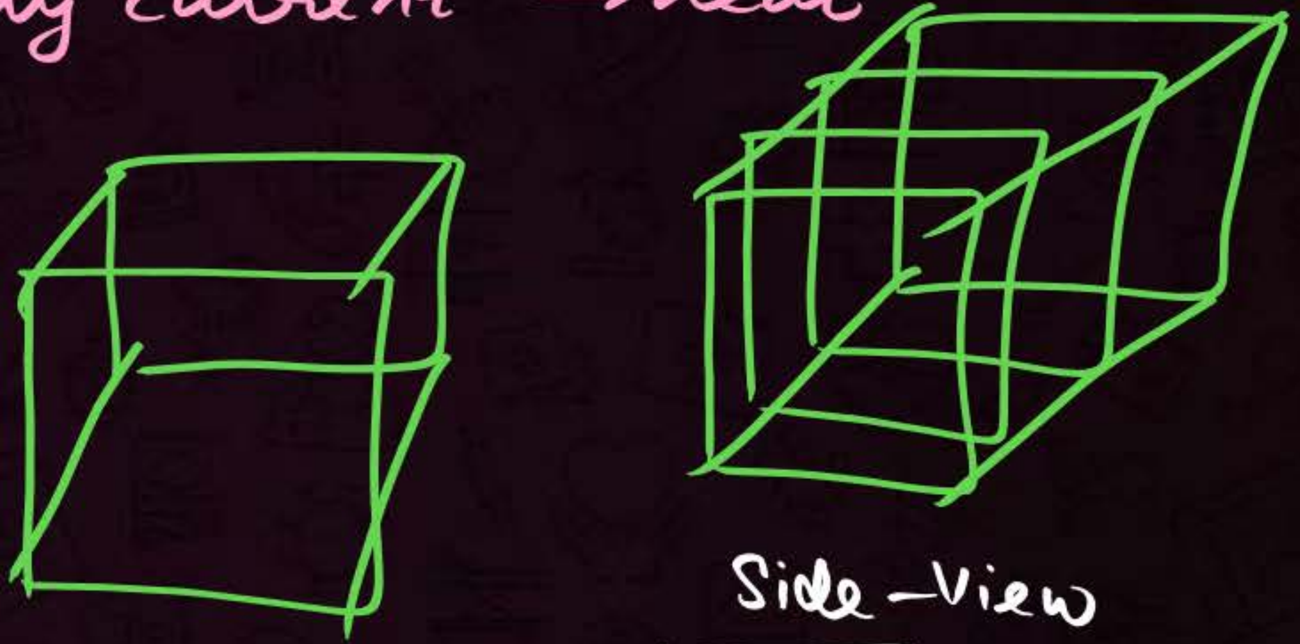
$A\uparrow \Rightarrow R\downarrow \Rightarrow$ heat $\downarrow$.

2. **Iron Losses:** Due to eddy currents being produced in the soft iron core, heat is produced. To reduce it we, use laminated core.

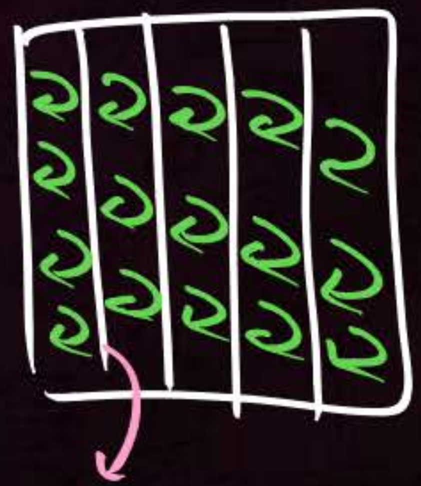
(sheet/slice)



→ Eddy current → heat

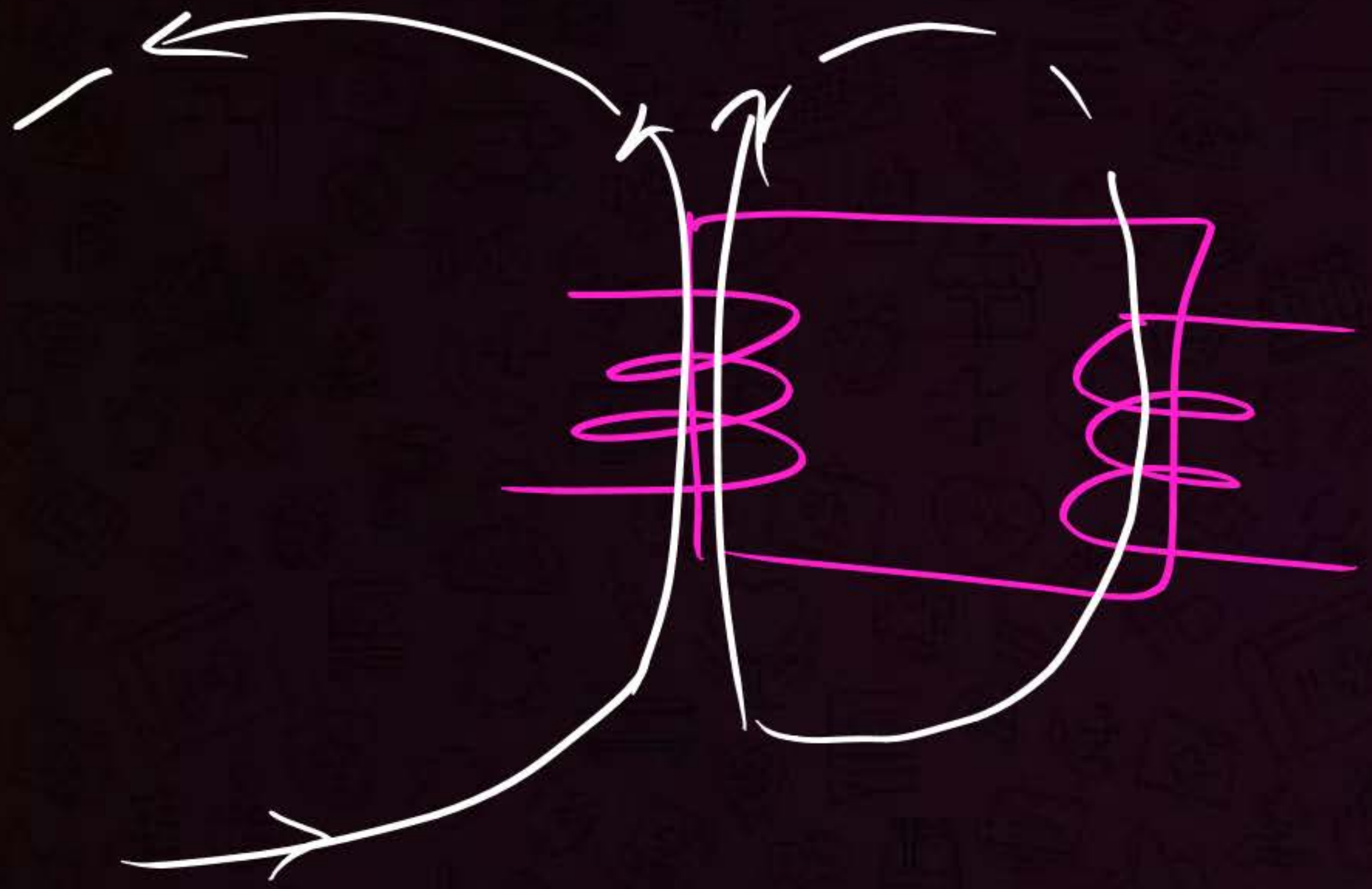


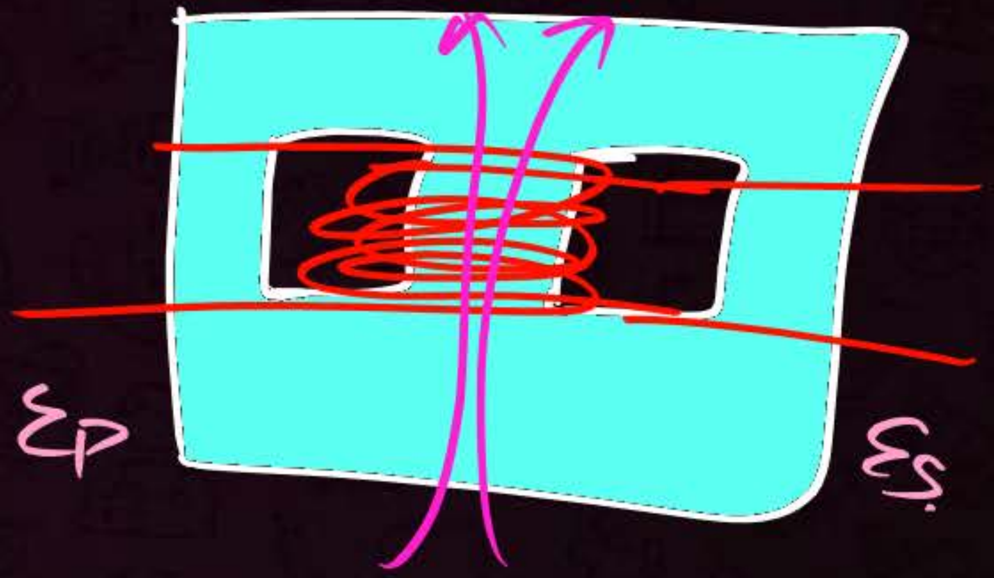
Side-view



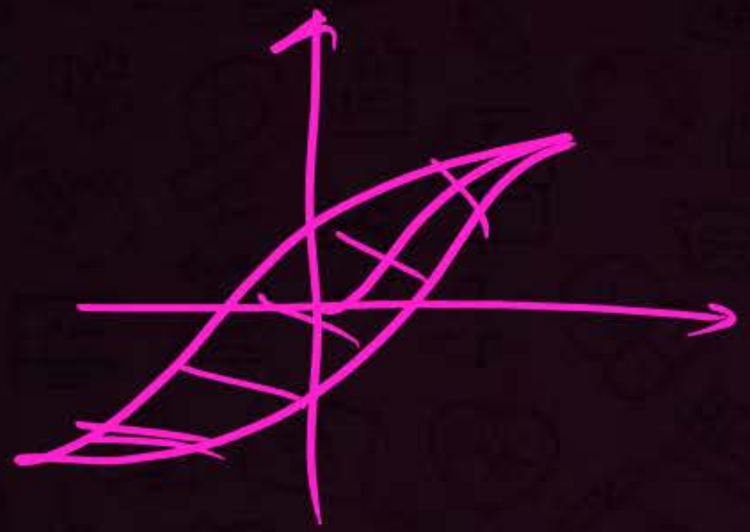
Lacquer (insulating power)

3. **Flux Loss:** To reduce it, we mount both coils on a single vertical pole.





4. **Hysterisis Loss:** Due to repeated magnetization and de – magnetization, there will be magnetic fatigue. There will be more energy losses.



5. **Magneto - striction:** Due to humming noise of the transformer.

QUESTION

Assertion: We use a thick wire in the secondary coil of a step-down transformer to reduce the production of heat.

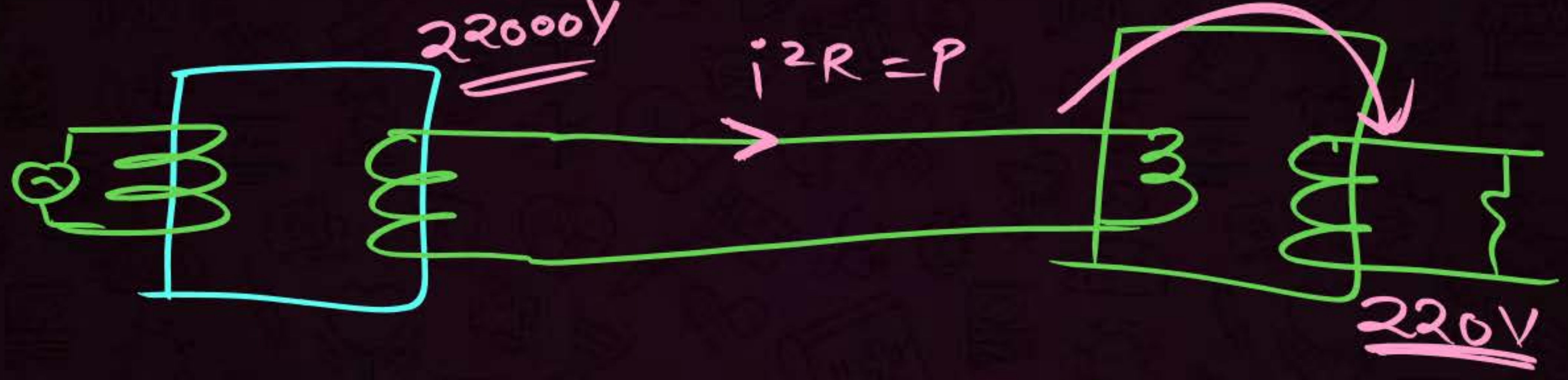
Reason: Eddy currents can be reduced by using laminated cores.

1. Assertion (A) is True, Reason (R) is True; Reason (R) is a correct explanation for Assertion (A)
2. Assertion (A) is True, Reason (R) is True; Reason (R) is not a correct explanation for Assertion (A)
3. Assertion (A) is True, Reason (R) is False.
4. Assertion (A) is False, Reason (R) is True.

Long Distance Power Transmission

Step-up $\varepsilon\uparrow,\ i\downarrow$

Step-down



Power-station

Near Home

$i\downarrow \Rightarrow P\downarrow$

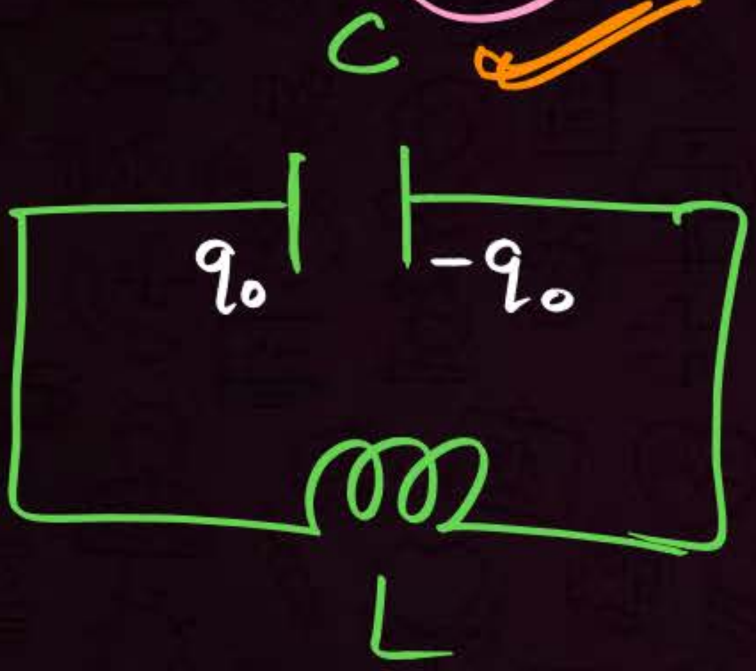
$\rightarrow$ Loss $\downarrow$.

LC Oscillations

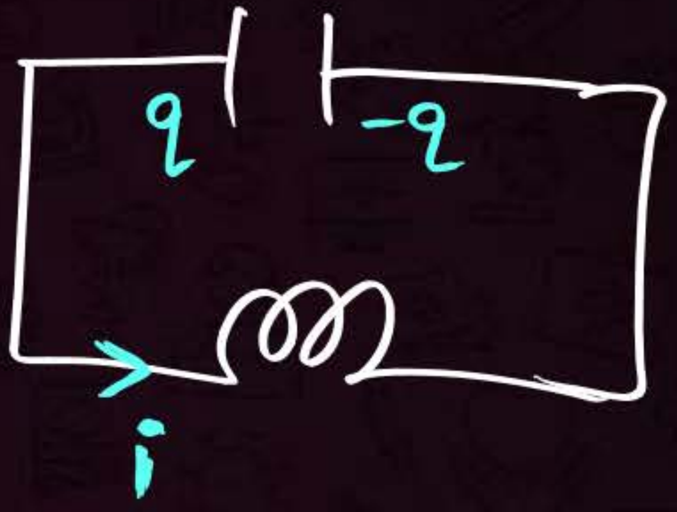
→ syllabus ×
→ Risk cover ✓

$$\boxed{\omega = \frac{1}{\sqrt{LC}}}$$

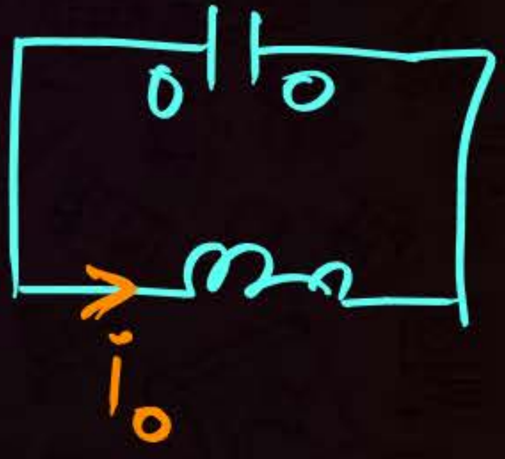
10J



⟹ 6C + 4J



⟹ 10J



JEE Mains

$k \rightarrow \frac{1}{C}$
$m \rightarrow L$

inertia — electrical inertia.

$q_0 \rightarrow$ max^m charge

SHM $\rightarrow \frac{1}{2}kx^2 + \frac{1}{2}mv^2$

$\rightarrow \frac{q^2}{2C} + \frac{1}{2}Li^2$

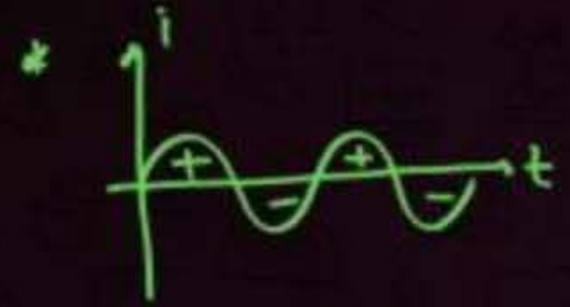
$i_0 \rightarrow$ max^m

$$\boxed{E = \frac{q^2}{2C} + \frac{1}{2}Li^2 = \frac{q_0^2}{2C} = \frac{1}{2}Li_0^2}$$

↓ conserved.

TBS Capsule (1)

* AC → changes its value after regular interval.

* 

Home supply → sinusoidal AC

* $i = i_0 \sin\omega t$, $V = V_0 \sin\omega t$

• India → $f = 50\,\text{Hz}$

• Current changes direction 2 times very cycle.

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* (0°) (30°) (90°)

$0 \qquad i_0/2 \qquad i_0$

$\frac{\pi}{6}\omega = \frac{T}{12}$ $\quad \frac{\pi}{3}\omega = \frac{T}{6}$

$\frac{\pi}{2}\omega = \frac{T}{4}$

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* (0°) (45°) (90°)

$0 \qquad i_0/\sqrt{2} \qquad i_0$

$\frac{\pi}{4}\omega = \frac{T}{8}$ $\quad \frac{\pi}{4}\omega = \frac{T}{8}$

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* (0°) (60°) (90°)

$0 \qquad \sqrt{3}\,i_0/2 \qquad i_0$

$\frac{\pi}{3}\omega = \frac{T}{6}$ $\quad \frac{\pi}{6\omega} = \frac{T}{12}$

TBS Capsule ②

* $i_{av} = \dfrac{\text{Total Charge flow}}{\text{Total time}}$ (Mean)

* **Total charge**

- $i \times t \rightarrow$ if i = const.
- $\int i\,dt \Rightarrow$ If i = variable
- Area under i-t graph
- $i_{av} = \langle i \rangle = \dfrac{\int i\,dt}{\int dt}$

* $i_{rms} = \sqrt{\dfrac{\int i^2 dt}{\int dt}} = \sqrt{\langle i^2 \rangle}$
* virtual or effective current
* Meaning.

$$i_{rms} = \sqrt{\frac{i_1^2 + i_2^2 + \cdots i_n^2}{n}}$$

* $i_{av} \rightarrow$ Based on charge flow.
* $i_{rms} \rightarrow$ Based on heat generated
* Home Supply $\rightarrow i = i_0 \sin \omega t$

Full Cycle (0 to T) $\Rightarrow i_{av} = 0,\ i_{rms} = \dfrac{i_0}{\sqrt{2}}$

- Half cycle (0 to $T/2$)

$$i_{av} = \frac{2i_0}{\pi} = 0.637\, i_0$$

$$i_{rms} = \frac{i_0}{\sqrt{2}} = 0.707\, i_0$$

* Form Factor

$\hookrightarrow \dfrac{i_{rms}}{i_{av}} = 1.11$

* Rms & average values valid for Voltages as well.

* Full cycle

- $\langle \sin\omega t \rangle = \langle \cos\omega t \rangle$

$= \langle \sin 2\omega t \rangle = \langle \cos 2\omega t \rangle = 0$

* Half cycle

$\langle \sin\omega t \rangle = \frac{2}{\pi}$

* $\langle \sin^2\omega t \rangle = \langle \cos^2\omega t \rangle = \frac{1}{2}$

* Normal ammeter → DC measure ✓
  AC measure ×

* AC (Hot wire) Ammeter → AC & DC both measure.
  → Based on heat ⇒ Non-Linear scale
  $(H \propto i^2)$

* $V_{rms} = 220\,V$ (Home Supply)

* If nothing mentioned, assume rms value.

* $i = a + b\sin\omega t$

TBS

$i_{rms} = \sqrt{a^2 + \frac{b^2}{2}}$

* $i = a\sin\omega t + b\cos\omega t$

$i_{rms} = \sqrt{\frac{a^2+b^2}{2}}$

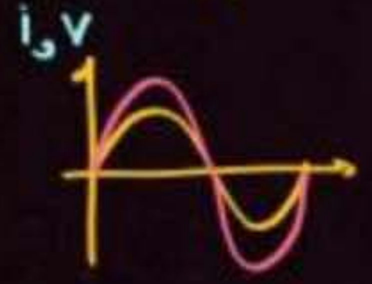
TBS Capsule ③

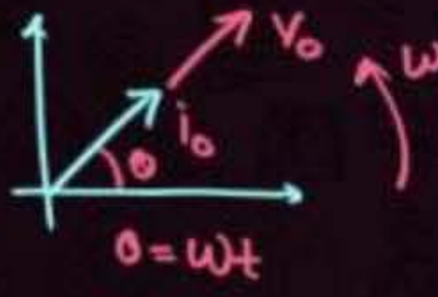
* Purely resistive

$V = V_0 \sin \omega t$

$i = i_0 \sin \omega t$

- Same phase
- $i_0 = \dfrac{V_0}{R}$ & $i_{rms} = \dfrac{V_{rms}}{R}$

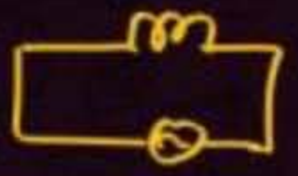




- $P = V_0 i_0 \sin^2 \omega t$

$P_{av} = \dfrac{V_0 i_0}{2} = V_{rms} i_{rms} = i_{rms}^2 R = \dfrac{V_{rms}^2}{R}$

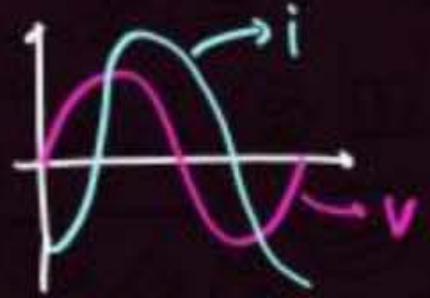
• Purely Inductive

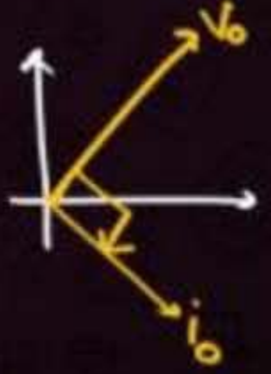


$V = V_0 \sin \omega t$

$i = i_0 \sin\left(\omega t - \dfrac{\pi}{2}\right) = -i_0 \cos \omega t$

- V leads, i lags by 90°
- $i_0 = \dfrac{V_0}{X_L}$, $i_{rms} = \dfrac{V_{rms}}{X_L}$
- $X_L = \omega L = 2\pi f L$





- $P = \dfrac{-V_0 i_0}{2} \sin 2\omega t$
- $P_{av} = 0$ → Full Cycle, → Half Cycle

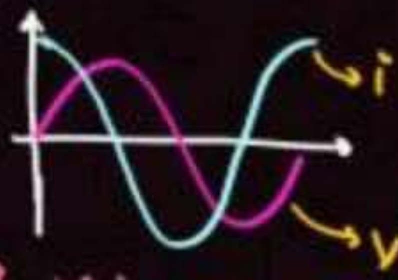
* Purely capacitive

$V = V_0 \sin \omega t$

$i = i_0 \sin\left(\omega t + \dfrac{\pi}{2}\right)$

$i = i_0 \cos \omega t$

- V lags, i leads by 90°
- $i_0 = \dfrac{V_0}{X_C}$, $i_{rms} = \dfrac{V_{rms}}{X_C}$
- $X_C = \dfrac{1}{\omega C} = \dfrac{1}{2\pi f C}$



- $P = \dfrac{V_0 i_0}{2} \sin \omega t$

$P_{av} = 0$
Full/Half Cycle

* Purely C & Purely L circuits have wattless currents.

- Units of X_L, X_C & R are ohm (Ω)

- Capacitor

Blocks DC

DC → $f = 0$

$X_C \to \infty$

High f AC → $f \to \infty$

$X_C \to 0$

High pass filter

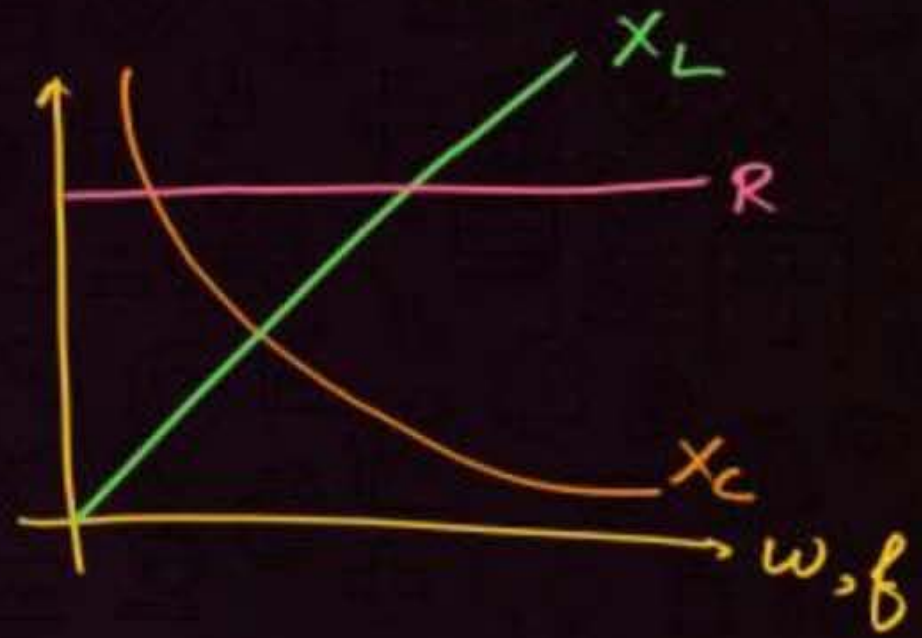
Inductor

DC → $X_C \to 0$

High f AC → Blocks AC

$X_C \to \infty$

Low pass filter

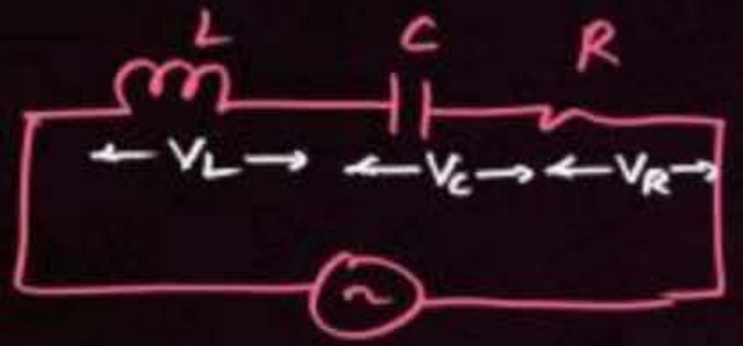


* $X_C \propto \frac{1}{\omega} \propto \frac{1}{f}$

* $X_L \propto \omega \propto f$

* R → independent of ω & f

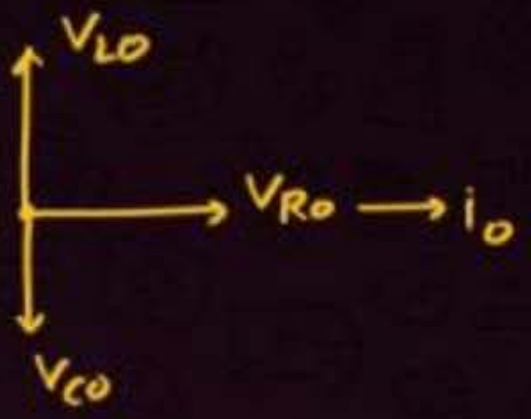
TBS capsule (4)

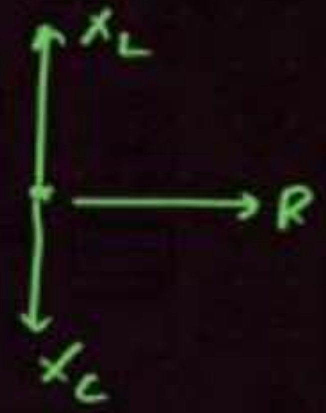


* series → i same.

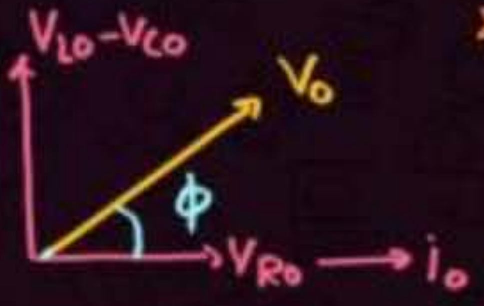
$$i = i_0 \sin \omega t$$

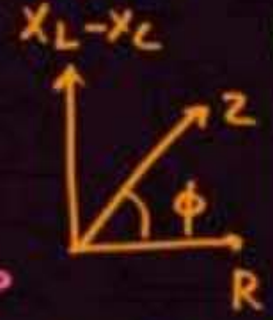
* $V_L + V_C + V_R = V$ ✓
* $V_{L0} + V_{C0} + V_{R0} = V_0$ ✗
* $\vec{V_{L0}} + \vec{V_{C0}} + \vec{V_{R0}} = \vec{V_0}$ ✓





a) L dominated ($X_L > X_C$)



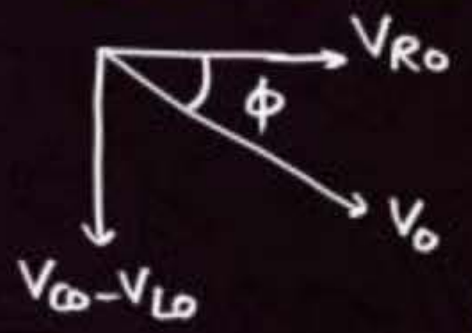


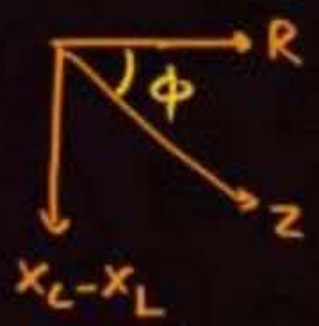
$$V_0 = \sqrt{(V_{L0}-V_{C0})^2 + V_{R0}^2}$$

$$V = V_0 \sin(\omega t + \phi)$$

- $\tan\phi = \dfrac{V_{L0}-V_{C0}}{V_{R0}} = \dfrac{X_L - X_C}{R}$
- V leads

b) C dominated ($X_L < X_C$)





$$V_0 = \sqrt{(V_{C0}-V_{L0})^2 + V_{R0}^2}$$

$$V = V_0 \sin(\omega t - \phi)$$

- $\tan\phi = \dfrac{V_{C0}-V_{L0}}{V_{R0}} = \dfrac{X_C - X_L}{R}$
- V lags

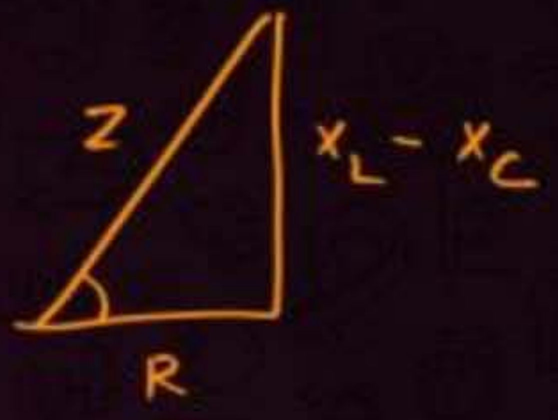
* $Z = \sqrt{(X_L - X_C)^2 + R^2}$

* $i_0 = \frac{V_0}{Z}$, $i_{rms} = \frac{V_{rms}}{Z}$

* $$\boxed{\begin{aligned} P_{av} &= \frac{V_0 i_0}{2}\cos\phi \\ \underbrace{P_{av}}_{\text{True power}} &= \underbrace{V_{rms}\, i_{rms}}_{\text{app. power}}\ \underbrace{\cos\phi}_{\text{power factor}} \end{aligned}}$$

* $\boxed{\cos\phi = \frac{R}{Z}} \rightarrow \frac{V_{R0}}{V_0}$

*



Impedance Δ.

- $i_{wattless} = i_{rms} \sin\phi$

- Phasor diagram → also valid for rms values.

TBS Capsule 5

* Resonance → $i_0 \to \max$
$Z \to \min.$

↓

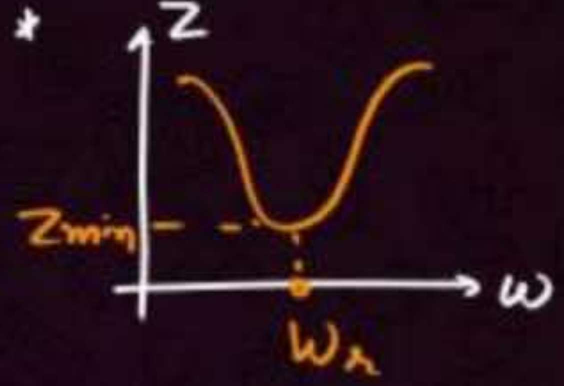
$X_L = X_C \Rightarrow \omega_r = \dfrac{1}{\sqrt{LC}}$

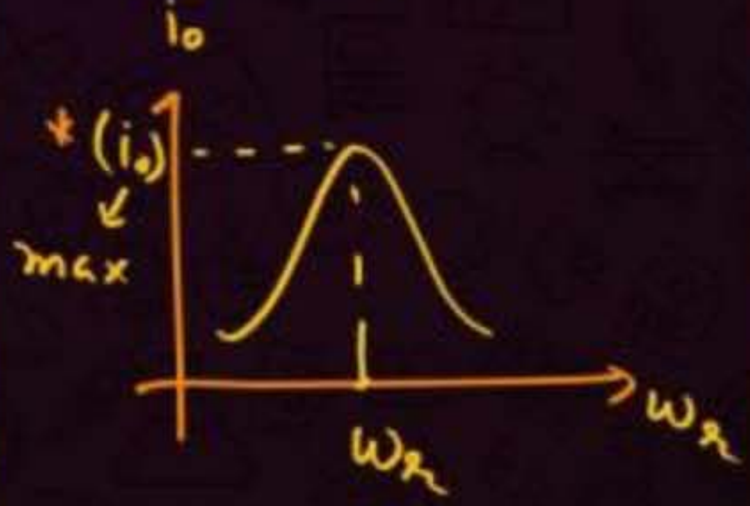
$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

* $Z_{min} = R$

* $(i_0)_{max} = \dfrac{V_0}{R}$

* f → matching at resonance.

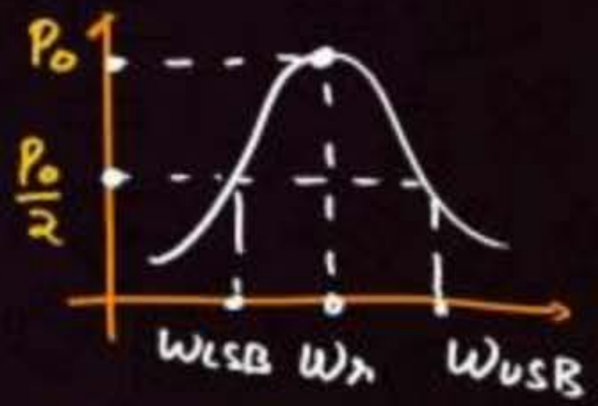
*




* Bandwidth (B.W.)

$= \omega_{USB} - \omega_{LSB}$

$= 2\Delta\omega = \dfrac{R}{L}$



$P_0 \longrightarrow \dfrac{P_0}{2}$

$(i_0)_{max} \longrightarrow \dfrac{(i_0)_{max}}{\sqrt{2}}$

* $Q = \dfrac{\omega_r}{2\Delta\omega} = \dfrac{\omega_r L}{R} = \dfrac{1}{R\omega_r C} = \dfrac{1}{R}\sqrt{\dfrac{L}{C}}$

TBS capsule ⑥

* Transformer → mutual inductance

- $\boxed{\dfrac{\varepsilon_p}{\varepsilon_s} = \dfrac{N_p}{N_s} = \dfrac{i_s}{i_p}}$ → ideal

- **Step-up**

$\varepsilon_s > \varepsilon_p$

$i_s < i_p$

Step-down

$\varepsilon_s < \varepsilon_p$

$i_s > i_p$

* **Non-ideal** → $P_s < P_p$.

$$\eta = \frac{P_s}{P_p} \times 100 = \frac{\varepsilon_s i_s}{\varepsilon_p i_p} \times 100 \qquad \frac{\varepsilon_p}{\varepsilon_s} = \frac{N_p}{N_s} \neq \frac{i_s}{i_p}$$

* **Losses** ÷ ① Copper loss → due to R of wires.
Use thick wires

② Iron Loss → Eddy currents
Use Laminated core, Lacquer.

③ Flux Loss → single pole mounting

④ Hysterisis → Repeated use

⑤ Magnetostriction → Humming Noise.

* Long Distance ⇒ $V\uparrow \Rightarrow i\downarrow$ ⇒ So that power Loss (i^2R) is less.

TBS capsule 7

* Choke-coil ⇒ X_L (inductor)

$\downarrow$

reduces i without power loss.

- Capacitor can also be used.

* LC Oscillations (Extra)

$$E = \frac{q^2}{2C} + \frac{1}{2}Li^2$$

$$E = \frac{1}{2}kx^2 + \frac{1}{2}mv^2$$

$k \to \frac{1}{C}$ & $m \to L$

- Total energy constant.

$$\boxed{\omega = \frac{1}{\sqrt{LC}}}$$

$$E = \frac{q_0^2}{2C} = \frac{1}{2}Li_0^2$$


TBS Army – Tanuj Sir
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Homework

10 am Subah DPP Battle - Ground

Slide No.	option
56	2
75	1
87	1
97	4
100	4
101	4
103	2
105	1

106 → 3

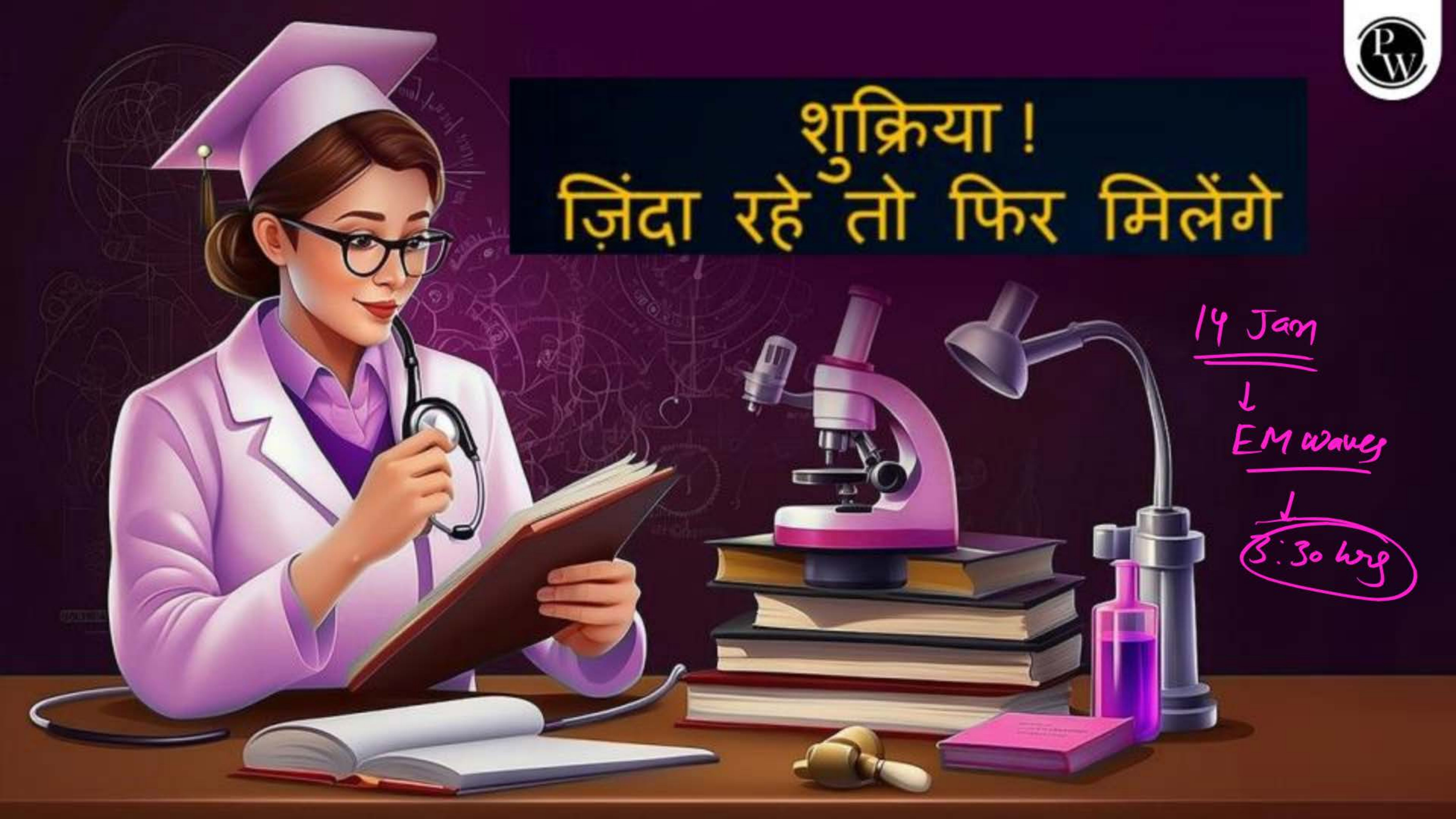
118 → 2

120 → 1

121 → 2

124 → 2

FOR NOTES & DPP CHECK DESCRIPTION


शुक्रिया !
ज़िंदा रहे तो फिर मिलेंगे
14 Jan
↓
EM waves
↓
3:30 hrs