026 624

Fundamental AC circuit.

① AC through pure resistance

② AC through pure inductance

③ AC through pure capacitance

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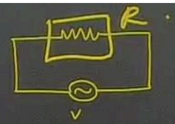
AC Circuit Containing resistance only.

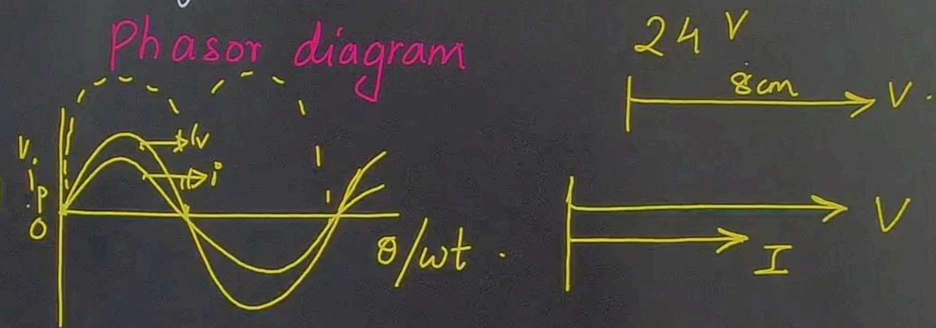


Scale $1\,cm = 3V$.

Voltage $v = V_m \sin(\omega t + \phi)$

Current $i = I_m \sin(\omega t + \phi)$

Phasor diagram



power $P = V \times I$.

$V = \frac{V_m}{\sqrt{2}}$ $I = \frac{I_m}{\sqrt{2}}$

Impedance $(Z) = \frac{V}{I} = R$

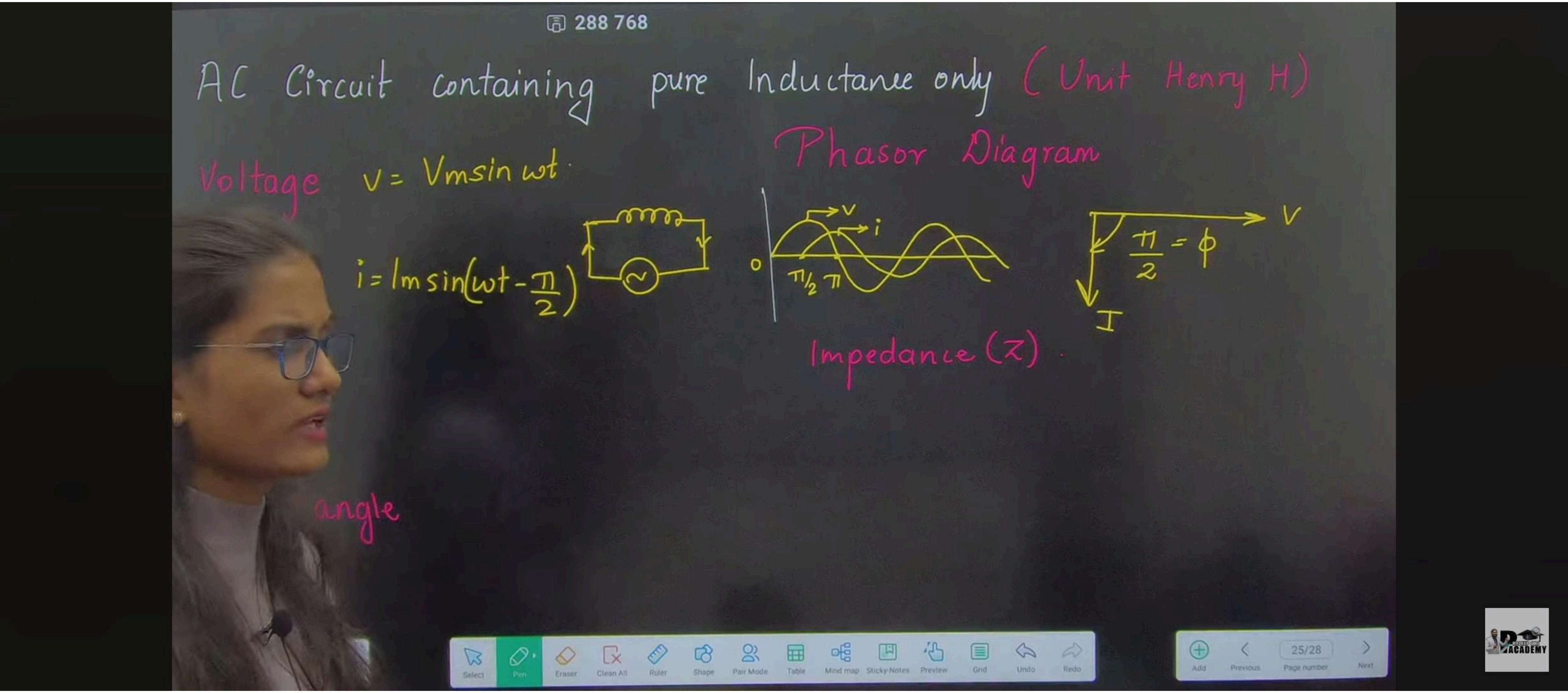
$$\boxed{Z = R}$$

Phase Angle

$\phi = 0$

Thus V & I are inphase.

$p.f = \cos\phi = \cos 0 = 1$ (Unity).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AC Circuit containing pure Inductance only (Unit Henry H)
Phasor Diagram
Voltage v = Vmsin ωt
i = Imsin(ωt - π/2)
v
i
0
π/2 π
V
π/2 = φ
I
Impedance (Z)
angle
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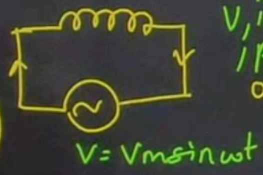
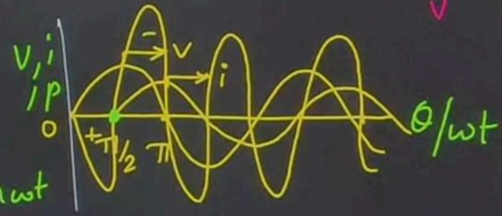
AC Circuit containing pure Inductance only (Unit Henry H)

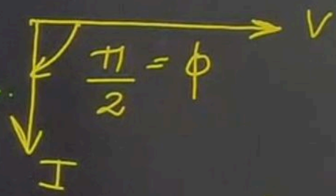
Voltage $v = V_m \sin \omega t$.

Current $i = I_m \sin\left(\omega t - \frac{\pi}{2}\right)$



Phasor Diagram





Power $P = 0$.

Impedance (Z) $= \frac{V}{I} = \omega L$

$Z = \omega L \ \Omega$.

$\boxed{X_L = \omega L \ \Omega}$

$\boxed{X_L = 2\pi f L \ \Omega}$

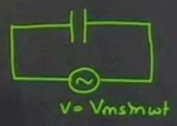
In Inductive circuit current lags Voltage by $\pi/2$.

Phase angle $\phi = -\frac{\pi}{2}$

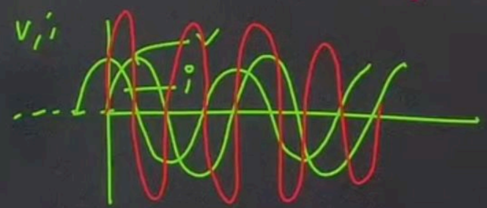
$p.f = \cos \phi = \cos \pi/2 = 0$.

AC Circuit containing pure Capacitance (Unit farad F)

Voltage $V = V_m \sin \omega t$.



Phasor diagram



Current $i = I_m \sin\left(\omega t + \frac{\pi}{2}\right)$

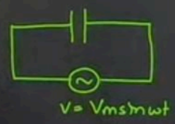
Impedance (z).

Power $P = 0$.

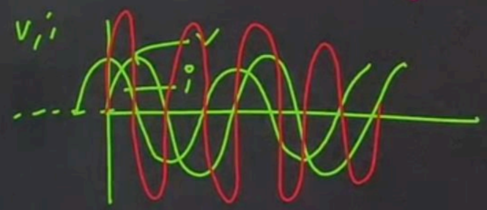
Phase angle

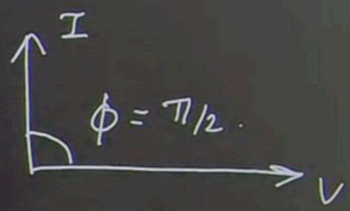
AC Circuit containing pure Capacitance (Unit farad F)

Voltage $V = V_m \sin \omega t$.



Phasor diagram





Current $i = I_m \sin\left(\omega t + \frac{\pi}{2}\right)$

Impedance (Z) $= \frac{V}{I} = \frac{1}{\omega C}$.

Power $P = 0$.

In capacitive circuit I leads V by $\pi/2$.

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

Phase angle $\phi = \pi/2$

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

$$Pf = \cos\phi = 0.$$

026 624

Q. A 318 μF capacitor is connected across a 230V, 50 Hz system.

(i) Determine capacitive reactance (ii) RMS value of current & equation of V & I.

$C = 318\,\mu F = 318 \times 10^{-6}\,F.$

$V = 230\,V$

$f = 50\,Hz.$

X_c

$I_m,\ V_m.$

$V =$

$i =$

(i) $X_c = \dfrac{1}{2\pi f \cdot C} = \dfrac{1}{2 \times \pi \times 50 \times 318 \times 10^{-6}}$

$= \underline{10\,\Omega}.$

(ii)

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$C = 318\ \mu F = 318 \times 10^{-6}\ F.$

V

f

(i) $X_c = \frac{1}{2\pi f \cdot C} = \frac{1}{2 \times \pi \times 50 \times 318 \times 10^{-6}}$

$= 10\ \Omega.$

(ii) $\frac{V}{I} = Z = \frac{1}{\omega C} = X_c$

$\frac{V}{I} = X_c$

27/28

288 768

Q. A 318 μF capacitor is connected across a 230V, 50 Hz system.
(i) Determine capacitive reactance (ii) RMS value of current & equation of V & I.

$C = 318\,\mu F = 318 \times 10^{-6}$ F.

$V = 230$ V

$f = 50$ Hz.

X_c

I_m, V_m.

$V =$

$i =$

(i) $X_c = \frac{1}{2\pi f \cdot C} = \frac{1}{2 \times \pi \times 50 \times 318 \times 10^{-6}}$

$= \underline{10\ \Omega}$.

$\omega = 2\pi f$
$= 2 \times \pi \times 50$
$= 314$ rad/s

(ii) $\frac{V}{I} = X_c$

$I = \frac{230}{10} = 23$ A.

$I_m = I \times \sqrt{2} = 32.53$ A.

$V_m = \sqrt{2} \times V$
$= \sqrt{2} \times 230$
$= 325.27$ V.

$V = V_m \sin \omega t$ $\qquad$ $i = I_m \sin \omega t + \frac{\pi}{2}$

$V = 325.27 \sin 314t$ $\qquad$ $i = 32.53 \sin 314t + \pi/2$.

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ACADEMY

550 912

A 10 mH inductor has a current of $i = 5\cos(2000)t$ A. Obtain the voltage V_L across it.

$L = 10\,mH = 10 \times 10^{-3}\,H$.

$i = 5\cos(2000t)$

$= 5\sin(2000t + \frac{\pi}{2})$.

$i = I_m \sin(\omega t + \frac{\pi}{2})$.

$\omega = 2000$

$I_m = 5$

$I = \frac{I_m}{\sqrt{2}} = \frac{5}{\sqrt{2}} = 3.54\,A$.

$\frac{V}{I} = X_L$.

$V = I \cdot X_L$

$= I \cdot \omega L$

$= 3.54 \times 2000 \times 10 \times 10^{-3}$.

$\boxed{V = 70.8\,V}$.

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ACADEMY

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$L = 10\,mH = 10 \times 10^{-3}\,H.$

$i = 5\cos(2000t)$

$= 5\sin\left(2000t + \frac{\pi}{2}\right).$

$i = I_m \sin\left(\omega t + \frac{\pi}{2}\right).$

$\omega = 2000$

$I_m = 5$

$I = \frac{I_m}{\sqrt{2}} = \frac{5}{\sqrt{2}} = 3.54\,A.$

$\frac{V}{I} = X_L.$

$V = I \cdot X_L$

$= I \cdot \omega L$

$= 3.54 \times 2000 \times 10 \times 10^{-3}.$

$\boxed{V = 70.8\,V.}$

$\boxed{t = 10\,sec}$

$V_m = V \times \sqrt{2}$

$= 70.8 \times \sqrt{2}.$

$V = 70.8 \times \sqrt{2} \cdot \sin(2000 \times 10$ ...

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