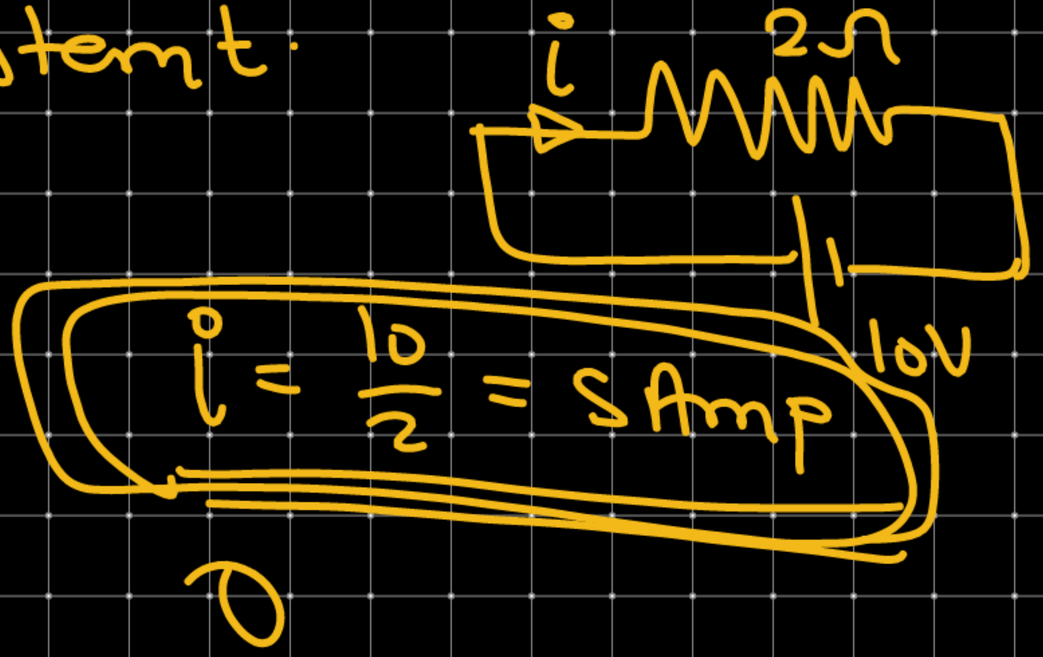
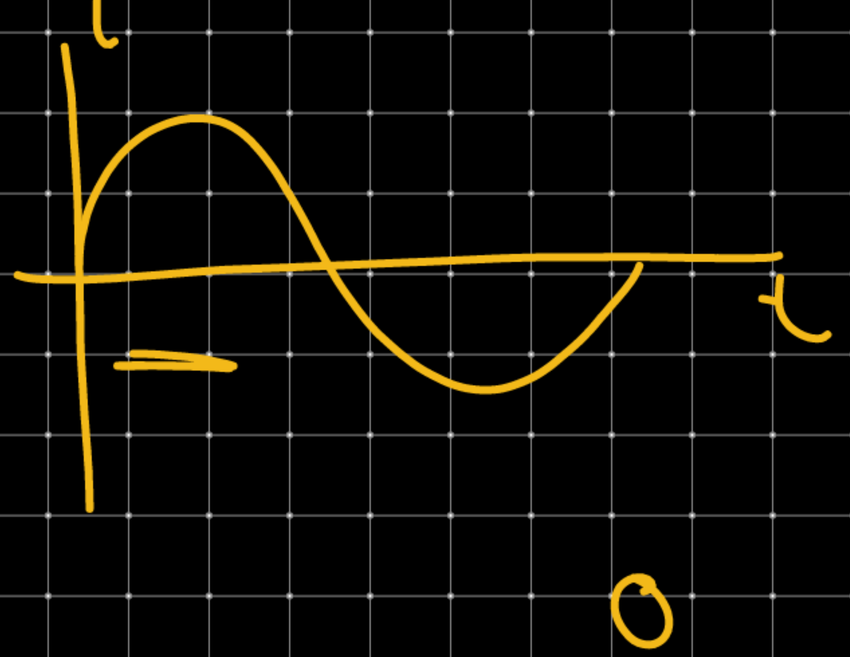
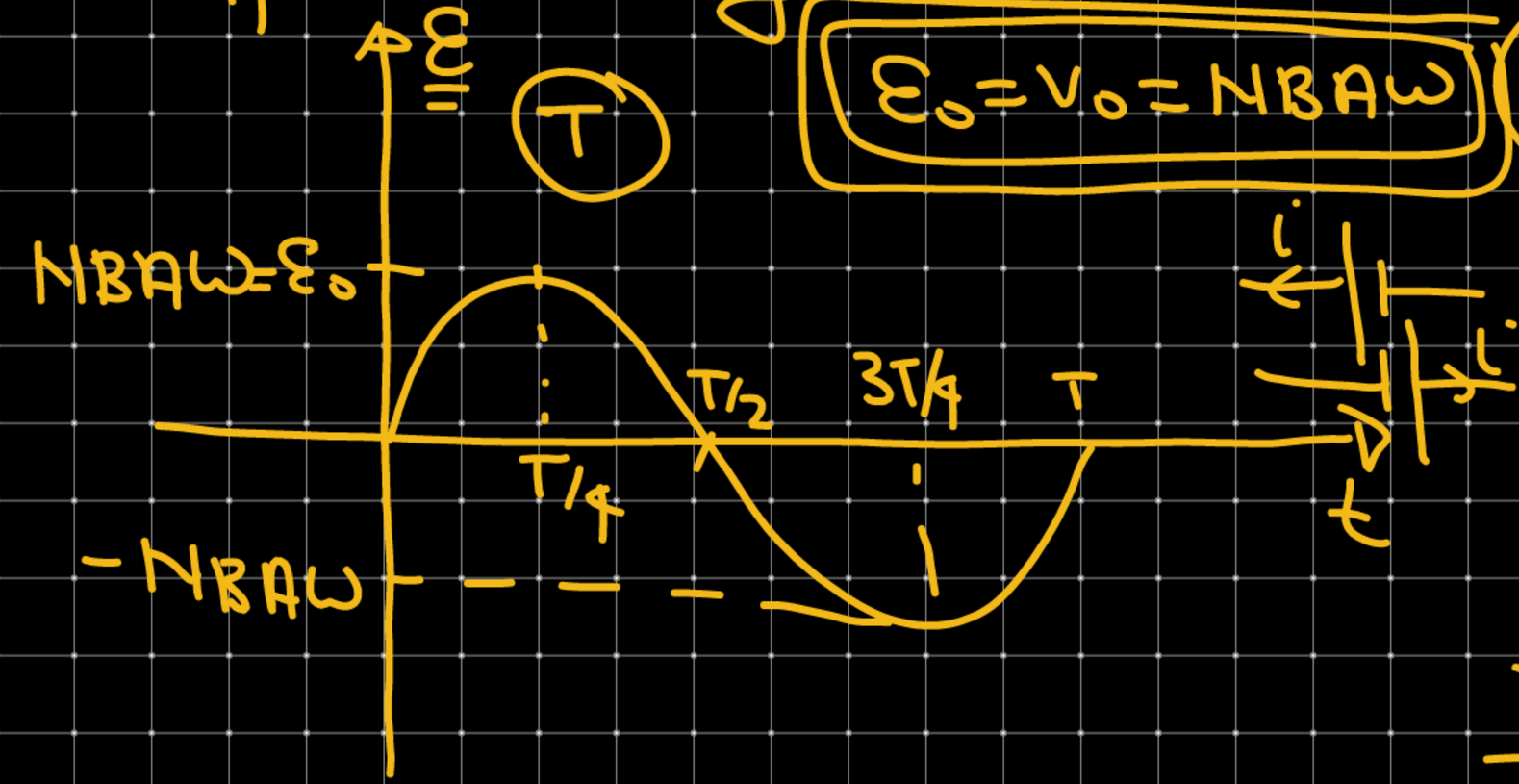
[Alternating Current (AC)]

DC:- Dirn & magnitude both remains constant.





AC :- Magnitude & dirn of current changes periodically.



$\varepsilon_0 = V_0 = NBA\omega$

DC

AC

$\varepsilon = NBA\omega \sin\omega t$

$\varepsilon = \varepsilon_0 \sin\omega t$

$V = V_0 \sin\omega t$

#1 Emf of AC

$$\mathcal{E} = \mathcal{E}_0 \sin\omega t$$

$$\boxed{\mathcal{E} = NBA\omega \sin\omega t}$$

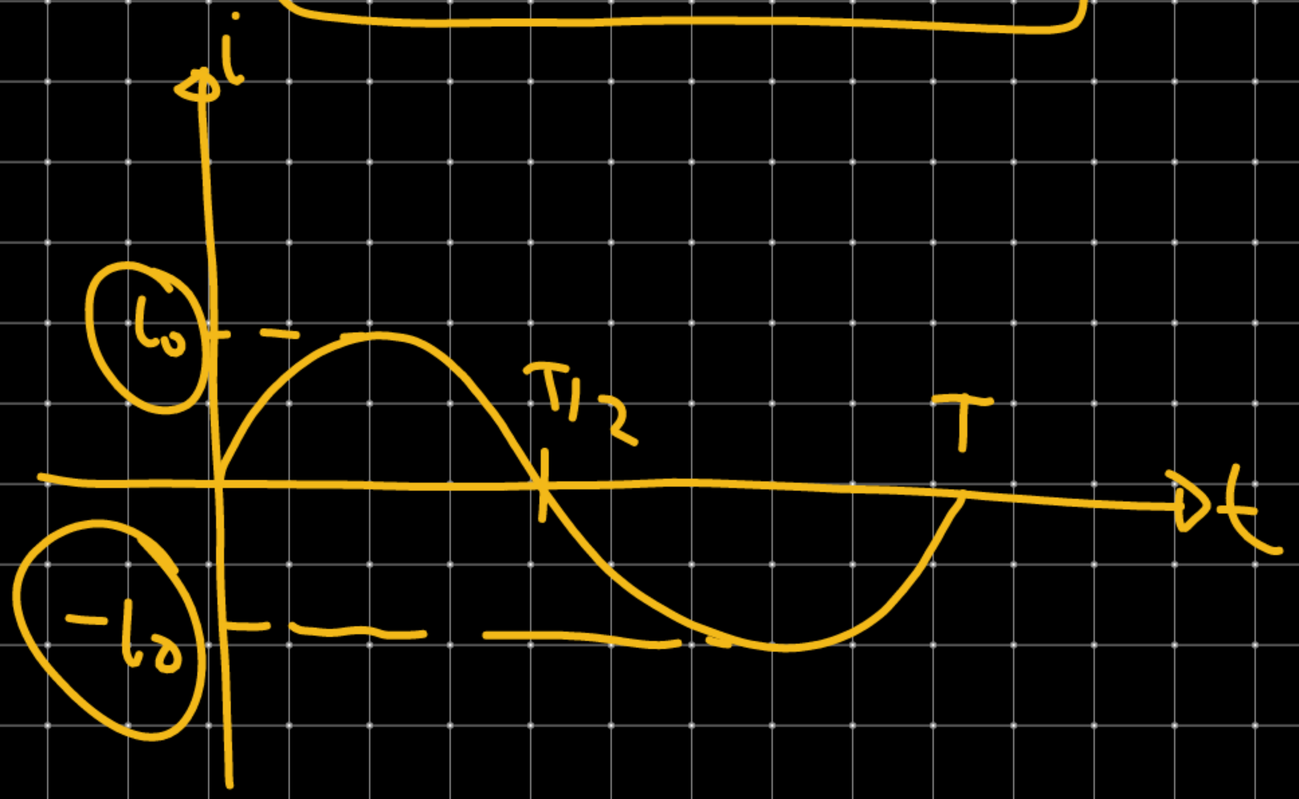
$\Rightarrow$ ω = Angular frequency.

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

Exp of AC :-

$$i = \frac{\mathcal{E}}{R} = \left(\frac{NBA\omega}{R}\right) \sin \omega t$$

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



Exp of AC:- $I = I_0 \sin \omega t = I_0 \sin 2\pi f t$

ω = angular frequency.

I_0 → Peak Value of current.

$T = \frac{2\pi}{\omega}$ Frequency $f = \frac{1}{T}$

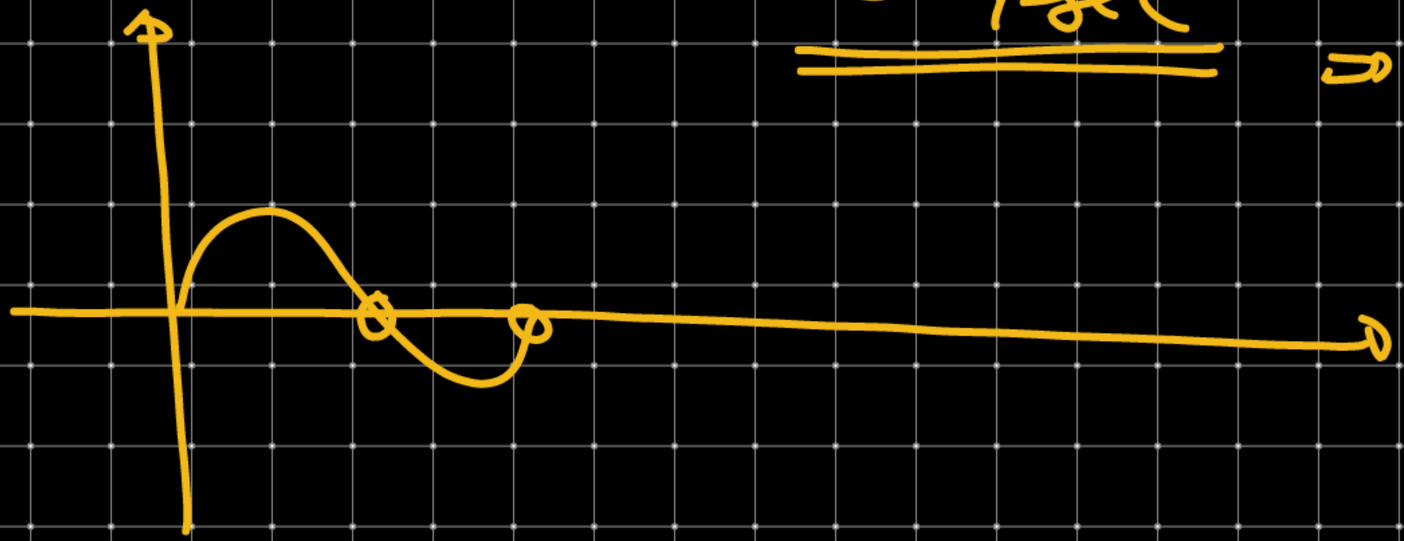
$f = \frac{1}{2\pi/\omega}$

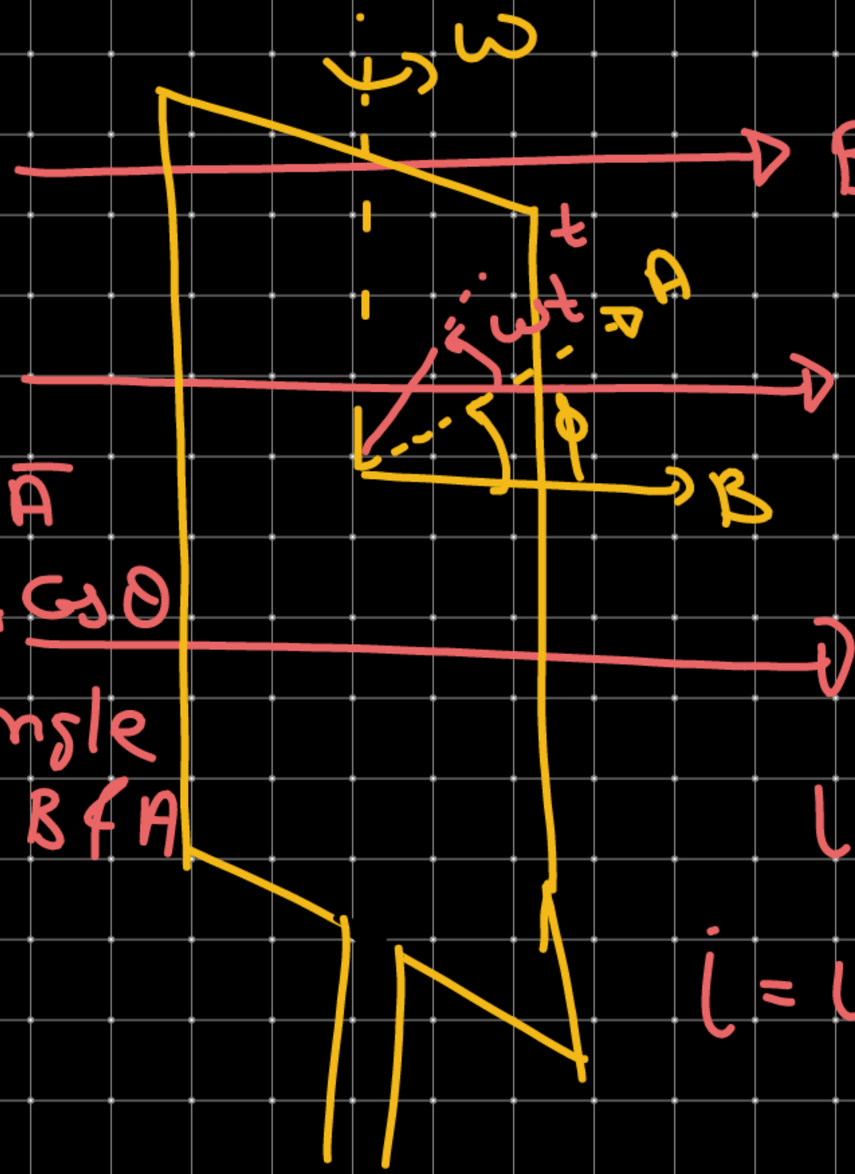
$f = \frac{\omega}{2\pi} \Rightarrow \omega = 2\pi f$

⇒ In India :

AC Source :- 220 Volt , 50 Hz

50 / sec ⇒





$\phi = \bar{B} \cdot \bar{A}$

$= BA\cos\theta$

θ – Angle b/w B & A

$t = 0$

$\phi = NBA\cos\phi$

$t = \theta = \omega t$

$\phi = NBA\cos(\omega t + \phi)$

$\varepsilon_{ind} = NBA\omega \sin(\omega t + \phi)$

$i = \dfrac{NBA\omega \sin(\omega t + \phi)}{R}$

$i = i_0 \sin(\omega t + \phi)$

$i = i_0 \sin \omega t$ [Initial B ⊥ A Parallel]

$i = i_0 \sin(\omega t + \phi)$

ϕ = Initial phase.

ω = Angular frequency

i_0 = Peak value of Current

$$i_0 = \frac{NBA\omega}{R}$$

$\mathcal{E} = \mathcal{E}_0 \sin(\omega t + \phi)$

$$\mathcal{E}_0 = NBA\omega$$

Q1) The eqn of current in AC ckt is $I = 4\sin\left[100\pi t + \frac{\pi}{3}\right]$ A Calculate

(a) Peak = 4 Amp

(b) $\omega = 100\pi$ rad/sec

(c) T = ?

(d) Initial phase.

$I = 4\sin\left[100\pi t + \frac{\pi}{3}\right]$

$I = I_0 \sin(\omega t + \phi)$

$I_0 = 4$ = Peak value of current.

$\omega = 100\pi$

ϕ = initial phase = $\frac{\pi}{3}$

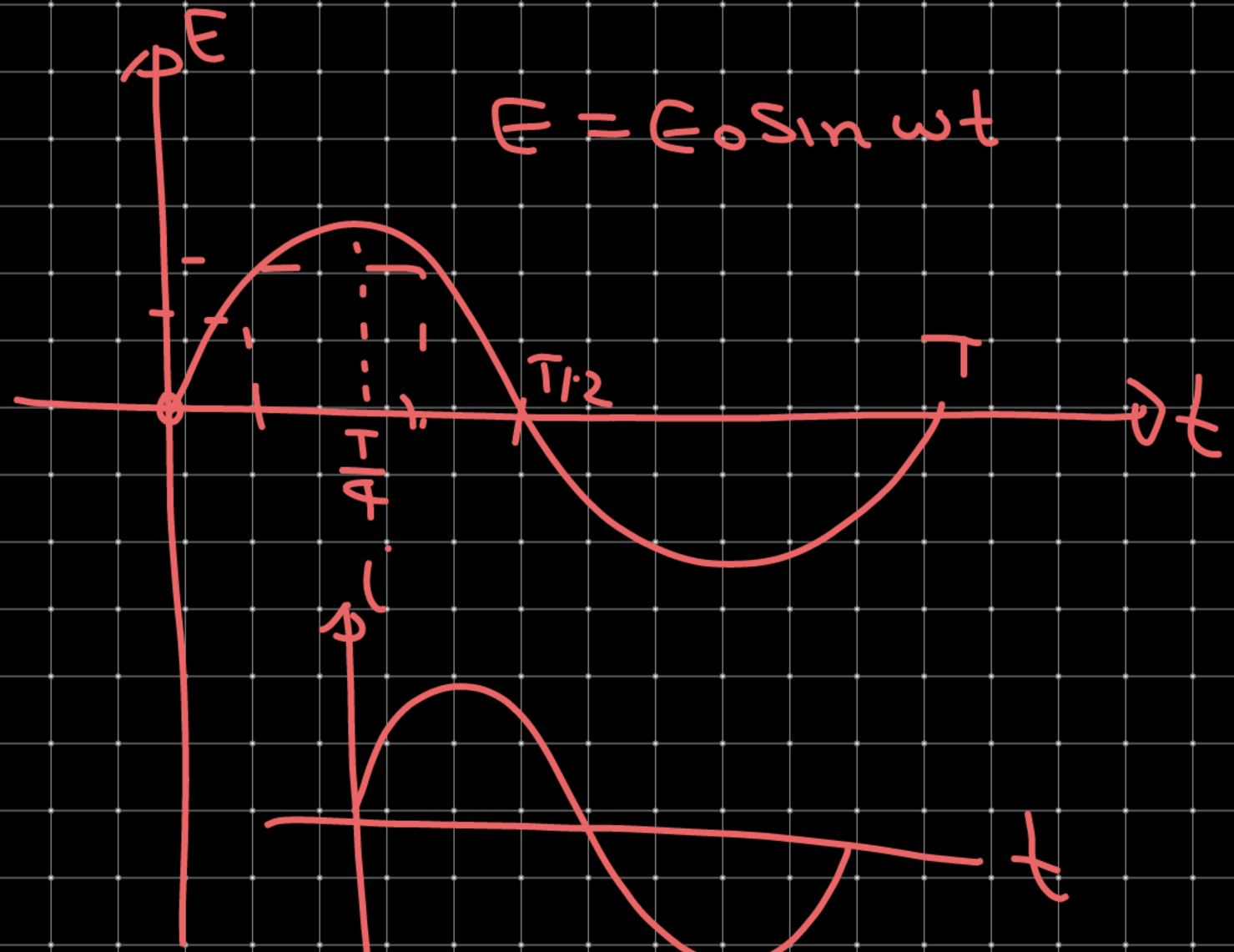
$T = \frac{2\pi}{\omega} = \frac{2\pi}{100\pi} = \frac{1}{50}$ second

$f = ?$

$f = 50$ Hz

$= 50$/sec

$E = E_0 \sin \omega t$



Q3) $i = 2\sin\omega t$

find i at $t = \frac{\pi}{2\omega}$.

Solve) $i = 2\sin\left(\omega \times \frac{\pi}{2\omega}\right)$

$= 2\sin\frac{\pi}{2}$

$i = 2$ Amp

$\frac{\pi}{6} = \frac{180^\circ}{6} = 30^\circ$

$\pi^c = 180^\circ$

ABLES KOTA

Q.34) The peak value of Alt Emf which is given by $E=(E_0 \cos \omega t)$ V is 10 volt & frequency is 50Hz, at time $t=\frac{1}{600}$ sec The value of Emf The value of instantaneous Emf.

Sol) $E = E_0 \cos \omega t$

$E_0 = 10$ Volt

$E = 10 \cos \omega t$

$E = 10 \cos\left(100\pi \times \frac{1}{600}\right)$

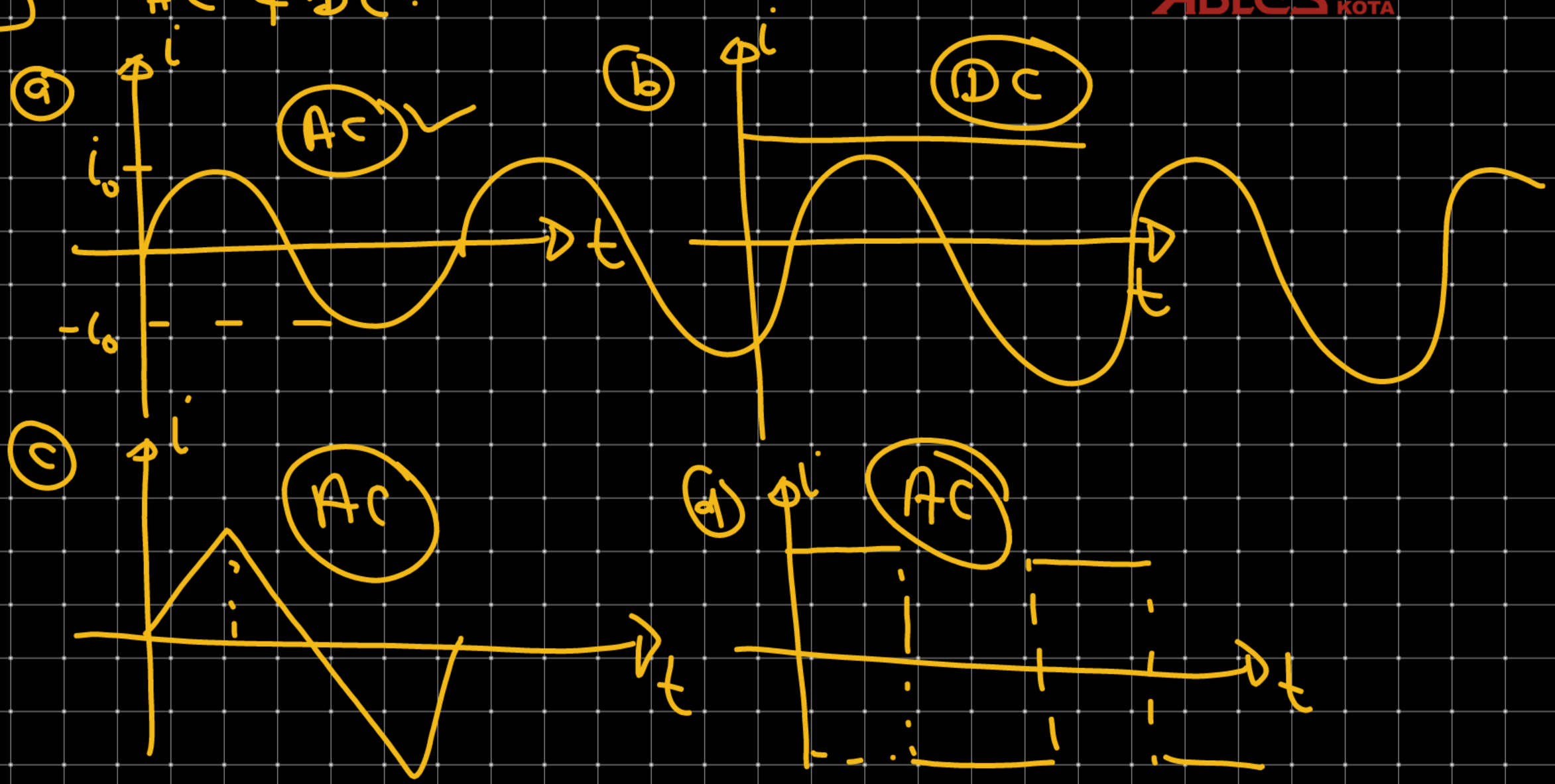
$= 10 \cos \pi/6 = \frac{10\sqrt{3}}{2} = 5\sqrt{3}$ Volt

$f = 50$ Hz

$\omega = 2\pi f$

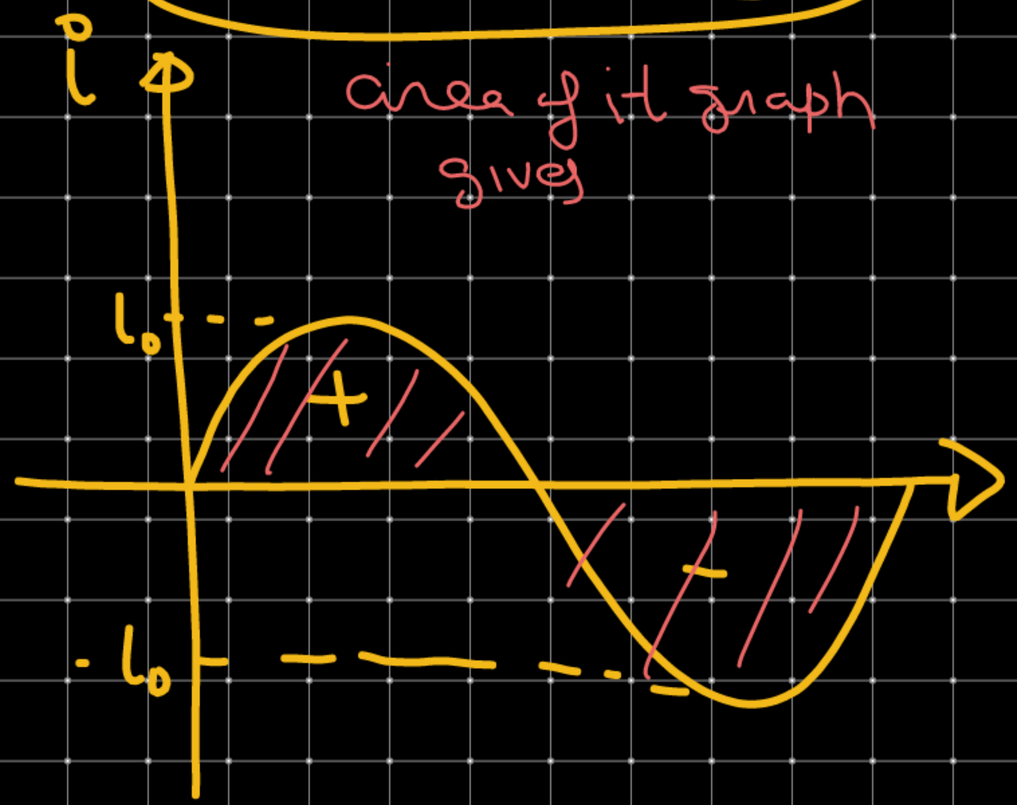
$\omega = 2\pi \times 50 = 100\pi$

Q) AC & DC.



(#) $i = I_0 \sin(\omega t + \phi)$

$I = I_0 \sin \omega t$



area of i-t graph gives

Average value of i in one time period = 0

How to find Average value by maths:

$$I_{av} = \frac{\int_0^T i\,dt}{\int_0^T dt}$$

$i = i_0 \sin\omega t$ [$i_{av} = 0$ for one Time period]

ABLES KOTA

$$i_{av} = \frac{\int i\,dt}{\int dt} = \frac{q_{total}}{\text{Total time}} = \frac{\int dq}{\int dt} = \frac{\int i\,dt}{\int dt}$$

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

$$i_{av} = \frac{\int_0^T i_0 \sin\omega t\,dt}{\int_0^T dt} = \frac{\int_0^T i_0 \frac{\cos\omega t}{\omega}}{[t]_0^T}$$

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

$\int \sin\theta\,d\theta = -\cos\theta$

$$= \frac{-i_0}{\omega}\left[\cos\omega t\right]_0^T = \frac{-i_0}{\omega T}\left(\cos\omega T - \cos 0\right)$$

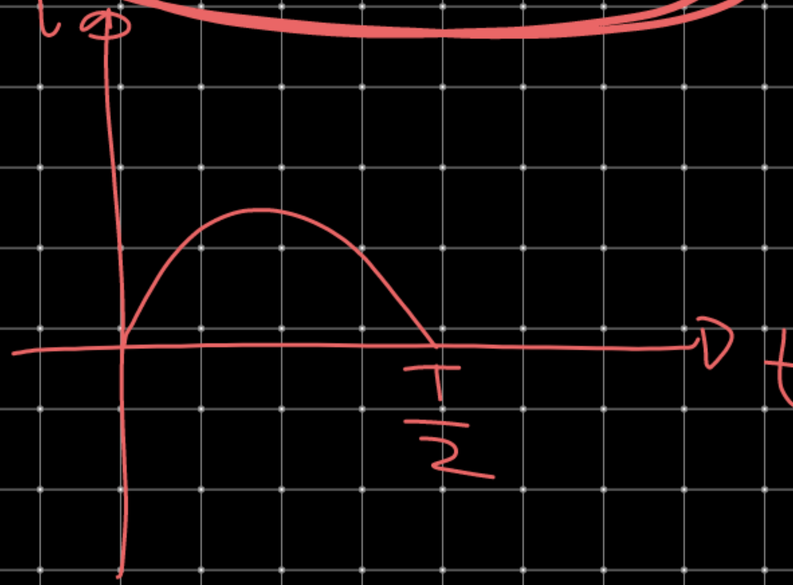
$$= \frac{-i_0}{\omega T}\left(\cos 2\pi - \cos 0\right)$$

$$= \frac{i_0}{\omega T}(1-1) = 0$$

#1

i_{av} in half time period

$i = i_0 \sin \omega t$



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

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

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

$i = 4\sin\omega t$

$i = i_0 \sin\omega t$

Find $\langle i \rangle$ [$\langle i \rangle$ → Average current]

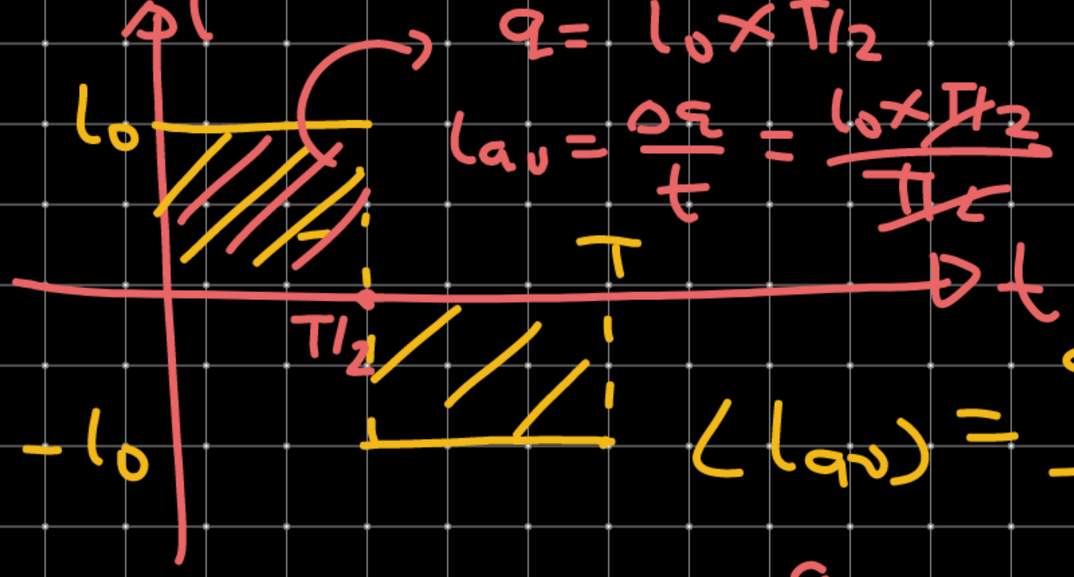
for (T) & (T/2)

$\frac{2i_0}{\pi}$

Sol) $\langle i \rangle_{0-T} = 0$

$\langle i \rangle_{0-T/2} = \frac{2i_0}{\pi} = \frac{2\times 4}{\pi} = \frac{8}{\pi}$ Amp

Q2) Find i_{av} for (0 – T)



$q = I_0 \times T/2$

$i_{av} = \frac{\Delta q}{t} = \frac{I_0 \times T/2}{T/2} = I_0$

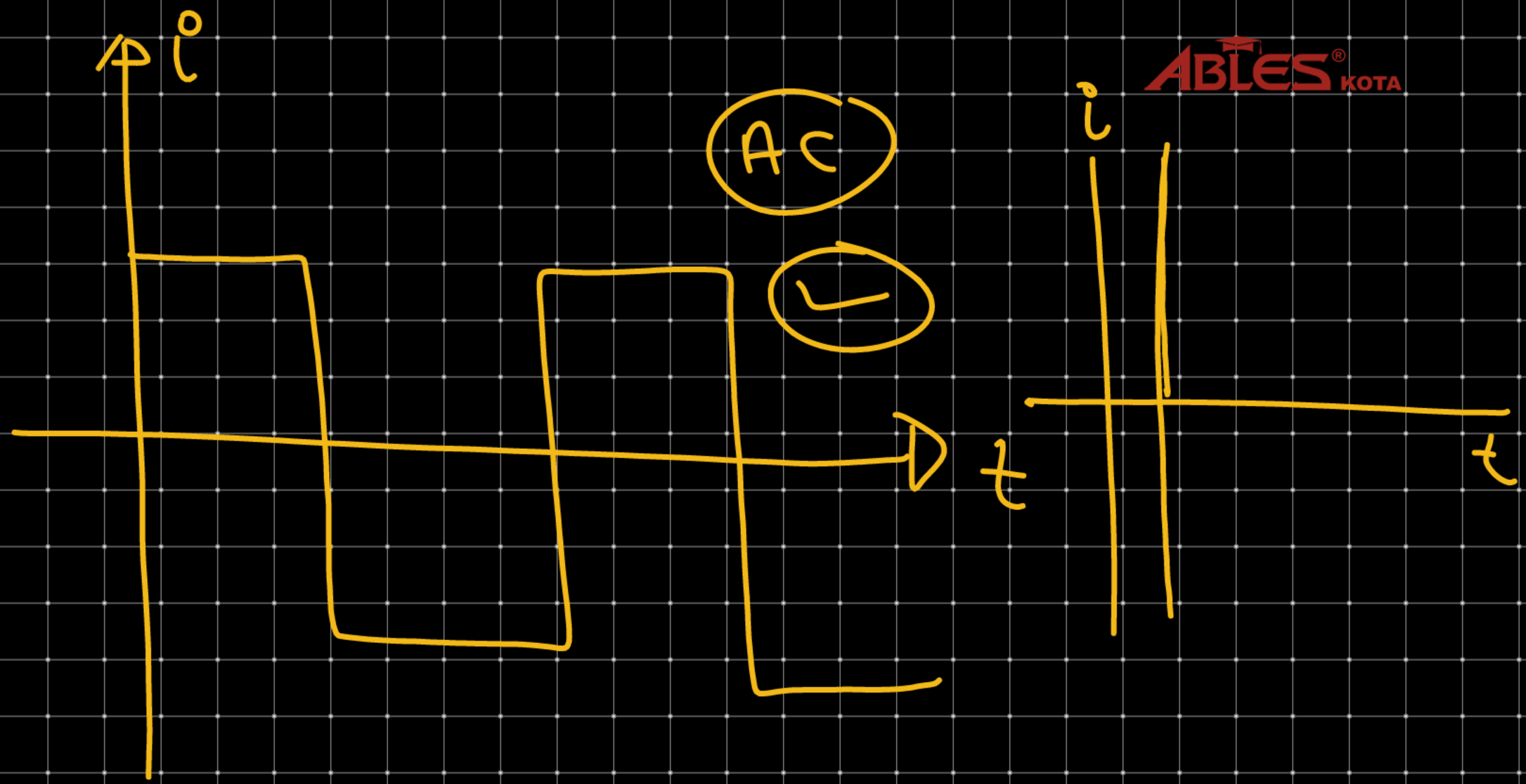
$(i_{av})_{0-T} = ?$

$\langle i_{av} \rangle = \frac{q_{total}}{\text{Time Interval}} = \frac{0}{T} = 0$

$\langle i \rangle_{0-T/2} = ?$

$i_{av} = \frac{q}{t}$

$= \frac{I_0 \times T/2}{T/2} = I_0$


i
AC
t
i
t

Q2) If $E = 20\sin(100\pi t)$ V. then Calculate value of E at $t = \frac{1}{600}$ sec.

Sol) $E = 20\sin(100\pi t)$

$E = 20\sin(\omega t + \phi)$ $\phi = 0$

$\theta = \omega t$

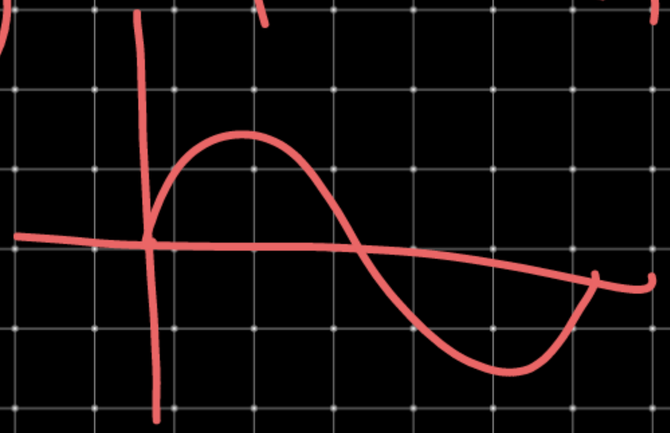
$E = 20\sin\left(100\pi \times \frac{1}{600}\right)$

$= 20\sin\left(\frac{\pi}{6}\right)$

$= 20 \times \sin 30^\circ$

$= 20 \times \frac{1}{2} = 10$ Volt

T = Time period



$\mathcal{E}$ ~

$\mathcal{E} = \mathcal{E}_0 \sin\omega t$

$\mathcal{E} = NBA\omega \sin\omega t$

$i_0 = \frac{\mathcal{E}_0}{R} \quad i = \frac{\mathcal{E}}{R} = \frac{\mathcal{E}_0 \sin\omega t}{R}$

$i = \frac{\mathcal{E}_0}{R} \sin\omega t$

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

i_0 = Peak Value of Current.

→ Ex of AC:- $I = I_0 \sin(\omega t + \phi)$

I_0 → maximum value of current
Peak value

ω = Angular frequency.

ϕ = initial Phase.