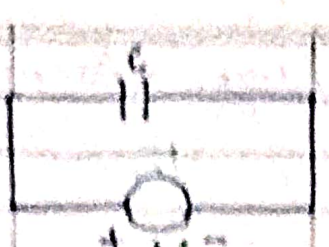
RC CIRCUIT

$v_c = \frac{1}{C}\int i\,dt$

$i = C\frac{dv_c}{dt}$

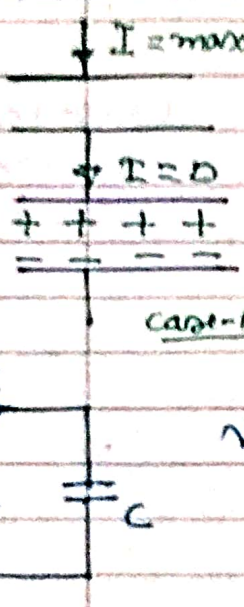


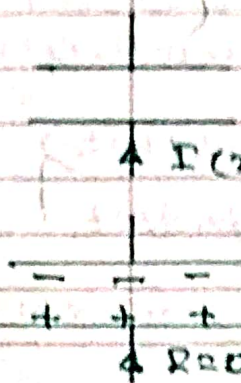
When AC applied to circuit, a back voltage exists it. Here current is opposed by the any change in the voltage at a rate which is equal to the rate of change of the electrical charge in the plates.

If cap fully charged. Flow of any more electrons onto its plates. as it becomes saturated.

AC Through capacitor.

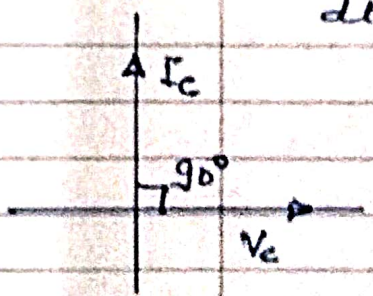
ac. circuit cap. constantly changing & discharging. This changes in saturation of voltage takes time to depend on rate of charges.





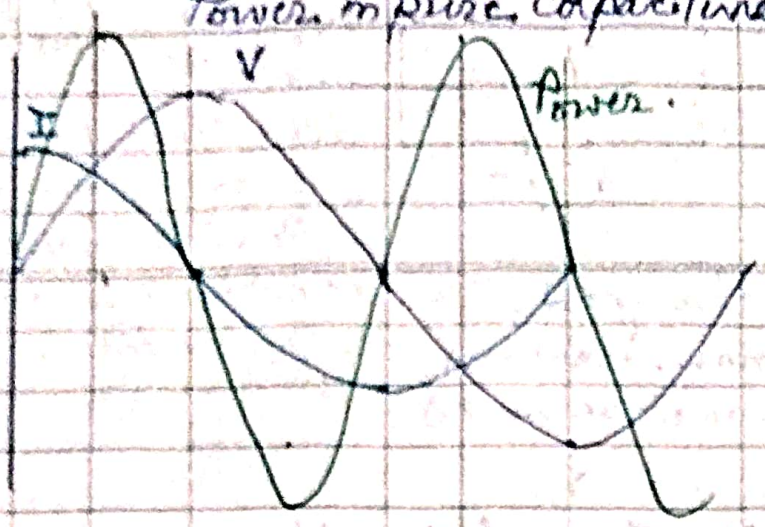
$v = V_m \sin \omega t$

$\because i_c = C\frac{dv_c}{dt}$ rate of change v_c across the plates is known at its max. i_c = also maximum. Hence Max. amount of electrons are moving from one plate to another.



I_c phase Lead V_c phase when plates saturated no current flows.

Power in pure capacitive circuit.



Instantaneous power (at any time).

$$p = V_m \sin \omega t \cdot I_m \sin(\omega t + 90^\circ)$$

$$= V_m I_m \cdot \sin \omega t \cdot \cos \omega t$$

$$= V_m I_m \cdot \frac{2}{2} \sin \omega t \cdot \cos \omega t$$

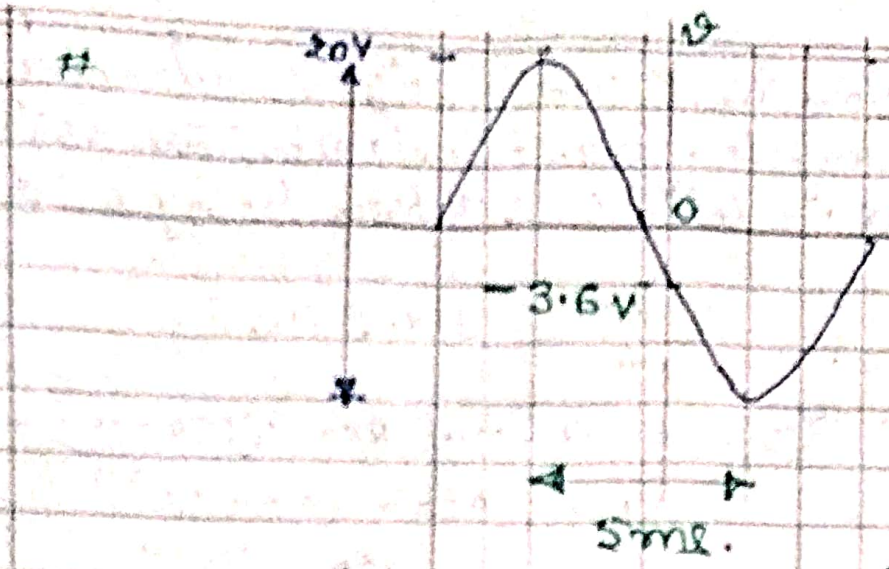
$$= \frac{V_m I_m}{2} \cdot \sin(2\omega t)$$

$$= \frac{V_m}{\sqrt{2}} \cdot \frac{I_m}{\sqrt{2}} \cdot \sin 2\omega t$$

$$= V_{rms} \cdot I_{rms} \sin(2\omega t)$$

Positive power energy stored
Negative power energy released.
average power in pure capacitor is zero.

AC FUNDAMENTAL



corresponding waveform.

a sinusoidal voltage is 20V P.P has a time bet. two cons. p. = 5ms.

5 ms. between consequitive Peak - Trough.

at t=0 ; voltage is (-3.6V)

Find the voltage and value of the voltage at t=12 ms.

$V_m = \frac{20}{2} = 10\ V.$

$T = 2 \times 5\ ms = 10\ ms.$ for one complete cycle.

$f = \frac{1}{T} = \frac{1}{10\ ms} = 10^{-3} \times (0.1) = 100\ Hz$

angular freq $= \omega = 2\pi f = 2\pi(100) = 200\pi$ rad.
$= 628.3$ rad/s.

sinusoidal voltage.

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

$= 10 \sin(628.3\,t + \phi)$

Let $\phi = ?$ Let from fig.

at $t=0$ $v = -3.6$ volt.

$-3.6 = 10 \sin\phi$

$\frac{-3.6}{10} = \sin\phi$

$\phi = \sin^{-1}(-0.36)$

$= -158.9^\circ$

eq.

$v(t) = 10 \sin(628.3\,t - 158.9^\circ)$

at 12 ms value of voltage.

$v(12ms) = 10 \sin(628.3(0.012) \cdot \frac{180^\circ}{\pi} - 158.9^\circ) = 10 \sin 273.1^\circ$

$= 10 \sin(432^\circ - 158.9^\circ)\ V$ $= -9.985\ V$

A.C. FUNDAMENTALS.

equation $v = 0.04 \sin(2000t + 60^\circ)$ V. determine the frequency, the angular freq. & instantaneous voltage when $t = 160\,\mu s$. what is time represented by 60° of angle.

Let $w = 2\pi f$

$$f = \frac{w}{2\pi} = \frac{2000}{2\pi} = 318.3\ Hz.$$

Inst. voltage $v(t) = 0.04 \sin(2000 \cdot (160 \times 10^{-6}) + 60^\circ)$

$= 0.04 \sin(0.32\ rad + 60^\circ)$

freq. $= 2000t$

$= wt$ rad.

$= (2\pi \times 160)/10^6 = 0.32$

Let 0.32 rad into degree.

π rad $= 180^\circ$

1 rad $= \frac{180}{\pi} = 180$

$0.32 \times \frac{180}{\pi} = 18.32^\circ$

$v = 0.04 \sin(18.32^\circ + 60^\circ)$ V

$= 0.04 \sin(78.32^\circ)$

$= 0.04 \times (0.98) = 0.0392$ volt.

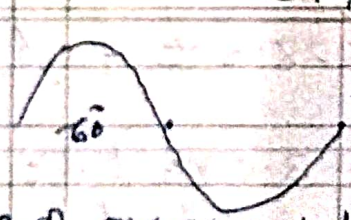
$= 39.2$ mV

time period $= t = \frac{1}{f} = \frac{1}{318.3}$

$= 3.14$ ms.

Let

time at 60°.



one cycle of 318.3 Hz takes.

$= 3.14$ ms!

$t = \frac{60^\circ}{360^\circ} \times 3.14\ ms$

$= 0.52$ ms.

2π rad $= \frac{360 \times}{114.6^\circ 2\pi}$

$= 360^\circ$

$\frac{7\pi}{4}$ rad $\rightarrow$ degree.

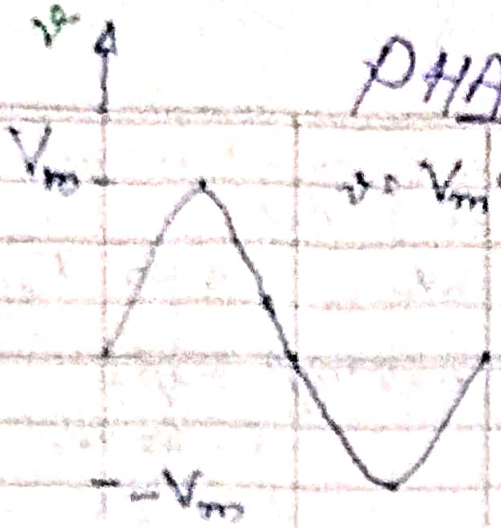
$\frac{7\pi}{4} \times \frac{180}{\pi} = 315^\circ$

$\frac{1}{3\pi}$ rad $\rightarrow$ degree

$\frac{1}{3\pi} \times \frac{180}{\pi} =$

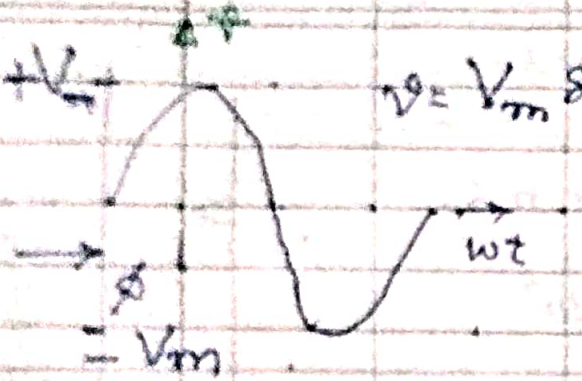
AC fundamental.

PHASE & PHASE DIFFERENCE

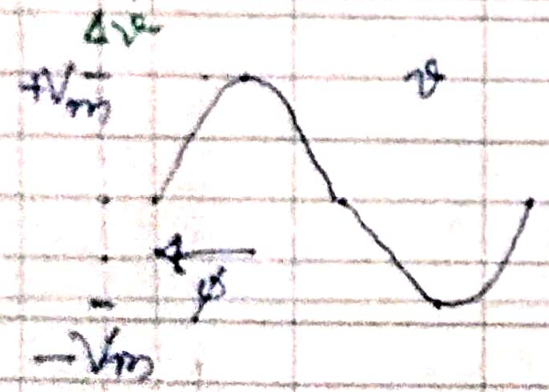


$v = V_m \sin \omega t$

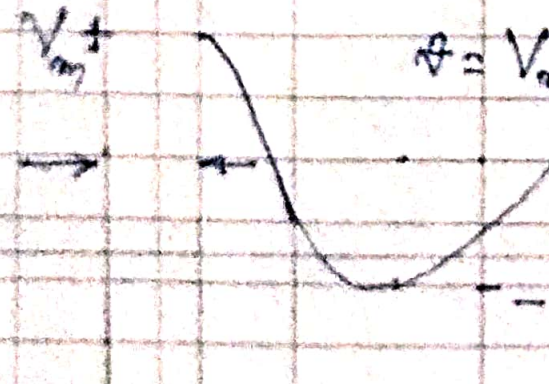
phase shift - $\phi = 0°$ Here.



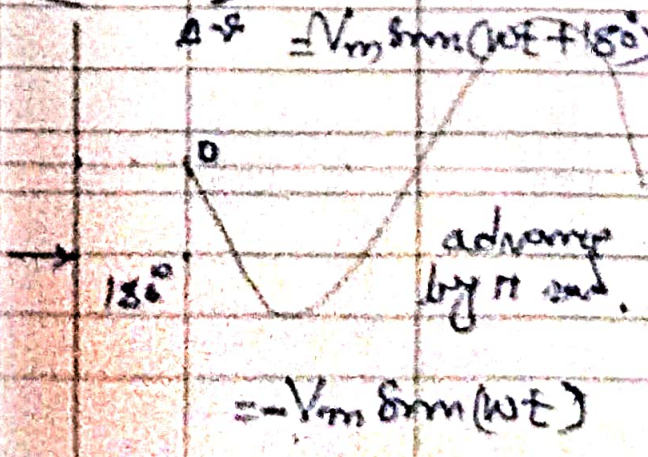
$v = V_m \sin(\omega t + \phi)$



$v = V_m \sin(\omega t - \phi)$ delayed



$v = V_m \sin(\omega t - 90°)$



$= V_m \sin(\omega t + 180°)$

$= -V_m \sin(\omega t)$

Determine the phase difference of the sinusoidal current $i_1 = 4\sin(100\pi t + 30^\circ)$ Amp with $i_2 = 6\sin(100\pi t)$ Amp. Draw the phasor diagram.

$i_1 = 4\sin(100\pi t + 30^\circ)$ $\quad \omega = 100\pi = 2\pi f$

$f = 50\,Hz$

$\frac{1}{f} = T = \frac{1}{50} = 0.02\,sec$

$= 20\,ms.$

Let

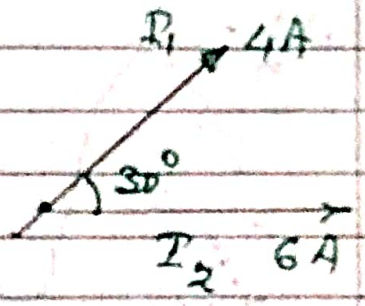
$i_2 = 6\sin(100\pi t)$

$100\pi = \omega = 2\pi f$

Hz, $50 = f = \frac{1}{T} = 20\,ms.$

Both are same time for full revolution.

$t = 20\,ms \cdot \frac{30^\circ}{360^\circ} = 1.67\,ms.$



Phasor i_1 lead phasor i_2 by 30°