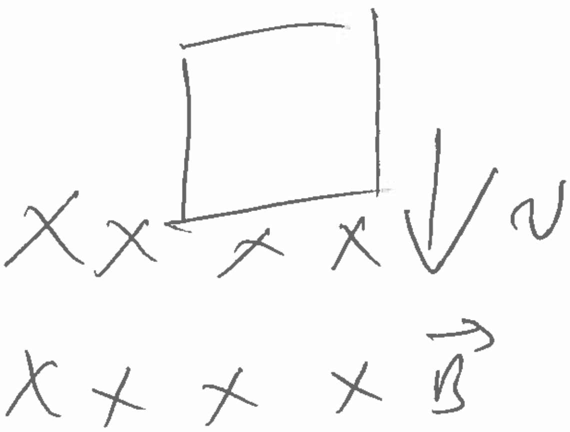
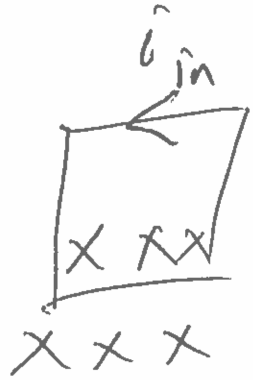



which way is $i_{ind}$.

magnetic flux $\Phi_B = \int \vec{B} \cdot d\vec{A}$

is increasing

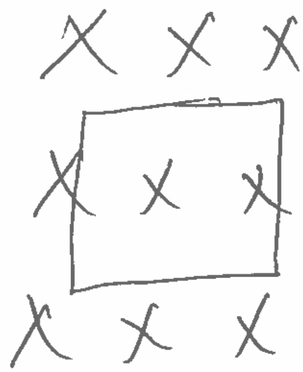
So induced Field wants to

oppose increase in $\Phi_B$ so

$B_{induced}$ Points out of Paper ⊙

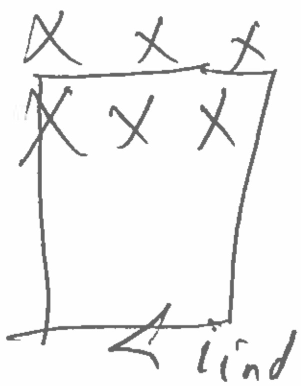
now $i_{ind}$ to create $B_{ind}$

must go Counterclockwise



What is the direction of current induced at this point?

There is no change in $\Phi_B$
So No induced E field or emf
and therefore No current induced.

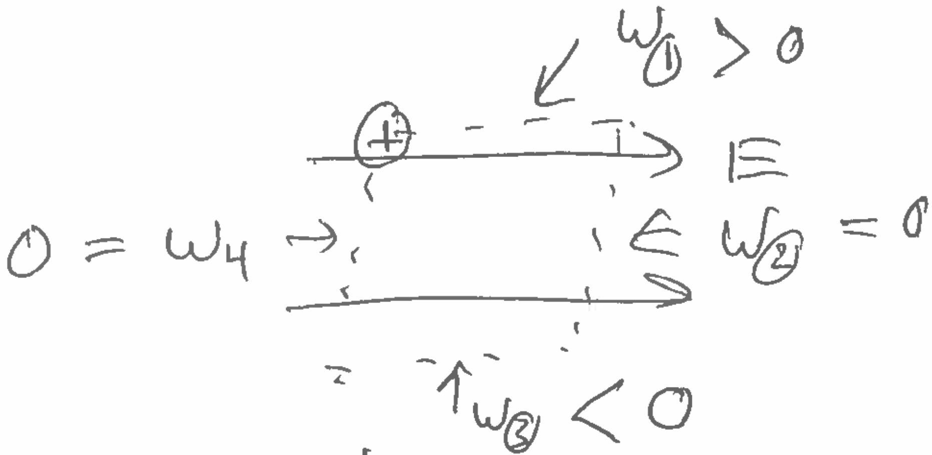



What is direction of induced current now?

$\Phi_B$ is decreasing induced B must add to existing B $\Rightarrow$ $i_{ind}$ clockwise

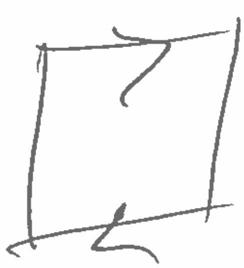
What is difference between induced $\vec{E}$ and static E fields?

induced $\vec{E}$ are not conservative!




$F = qE$

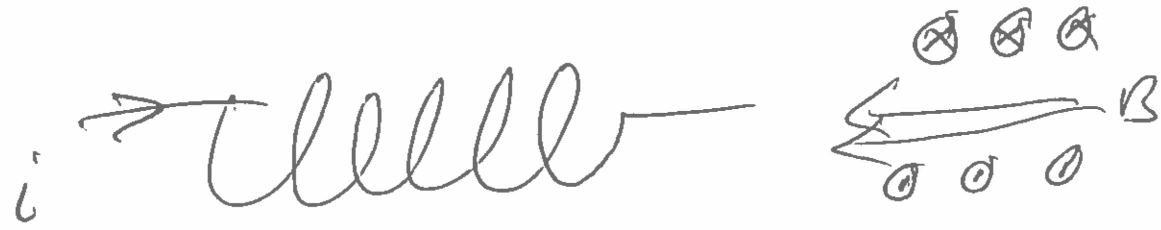
$W_{done} = 0$



$i_{ind}$

$E_{in}$

# Self-inductance




When $i$ first starts $\Delta\Phi_B$

$i_{induced}$ opposes $i_{wire}$

so $i_{induced}$ tries to prevent $i_{wire}$ from changing

After long time when is $\Delta\Phi_B = 0$

so $i_{ind} = 0$

coil acts like short circuit

if $i_{wire}$ drops $\Delta\Phi_B$ does change

it gets weaker so $i_{ind}$ goes

in same direction as $i_{wire}$

Inductors try to maintain constant

current in a circuit

similar to capacitors trying to maintain

constant voltage.

$$v_L = L\frac{di}{dt}$$

L is self-inductance (inductance)

it has units of Henrys (H)

Faraday tells us

$$\mathcal{E} = -N \frac{d\Phi_B}{dt}$$

$$V = \mathcal{E} = -N \frac{d}{dt}\left(\vec{B} \cdot \vec{A}\right)$$

for a solenoid $B = \mu_0 n i = \mu_0 \frac{N}{L^*} i$

$L^*$ – Length of Solenoid

drop – sign ⇒ polarity

$$V = N \frac{d}{dt}\left(\frac{\mu_0 N}{L^*} i\right) = \frac{\mu_0 N^2}{L^*} \frac{di}{dt}$$

L

$$V = \left(\frac{\mu_0 N^2}{L^*}\right) \frac{di}{dt}$$

$$c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$$

$\mu_0 = 4\pi \times 10^{-7} \frac{Tm}{A}$ – permeability of free space (vacuum

$$i_{cap} = C \frac{dv}{dt}$$ $v$ must be continuous

$$v_L = L \frac{di}{dt}$$ $i$ must be continuous

$$v_{cap}(t^+) = v_{cap}(t^-)$$

$$i_L(t^+) = i_L(t^-)$$

for inductor if $i$ is constant

inductor acts like short-circuit

for a capacitor if $V$ is constant

capacitor acts like an open circuit

for A.C.

$X_C$ - capacitive reactance $= \frac{-i}{WC}$ ← ($\sqrt{-1}$) measured in Ω ohms

$X_L$ - inductive reactance $= iWL$ ← ($\sqrt{-1}$) also measured in Ω

if $W \to 0$ D.C.

$X_C \to \infty$ (open circuit)

$X_L \to 0$ (short circuit)

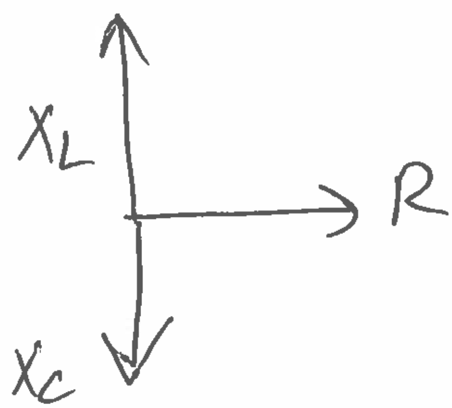
in a capacitor voltage lags behind current.

in a n inductor voltage leads current.

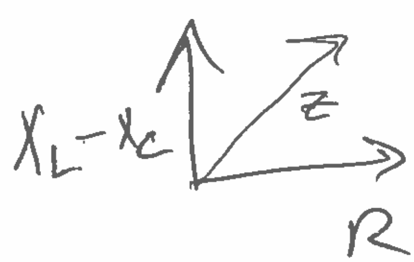
ELi the iCE man

what is Phese relationship between Voltase and current in a resistor?

They are in Phese




Phesor Diagram




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

Z is impedence

Z or impedence is The Total opposition To The flow current in an A.C circuit.

Phasors are Psuedo vectors.

A vector is an object that transforms as a vector under coordinate rotation.

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

min $Z \Rightarrow$ if $X_L - X_C = 0$

$$X_L = \omega L$$

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

$$X_L - X_C = \omega L - \frac{1}{\omega C}$$

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

$$\omega^2 = \frac{1}{LC}$$

$$\omega_0 = \sqrt{\frac{1}{LC}}$$

Resonance frequency is min Z

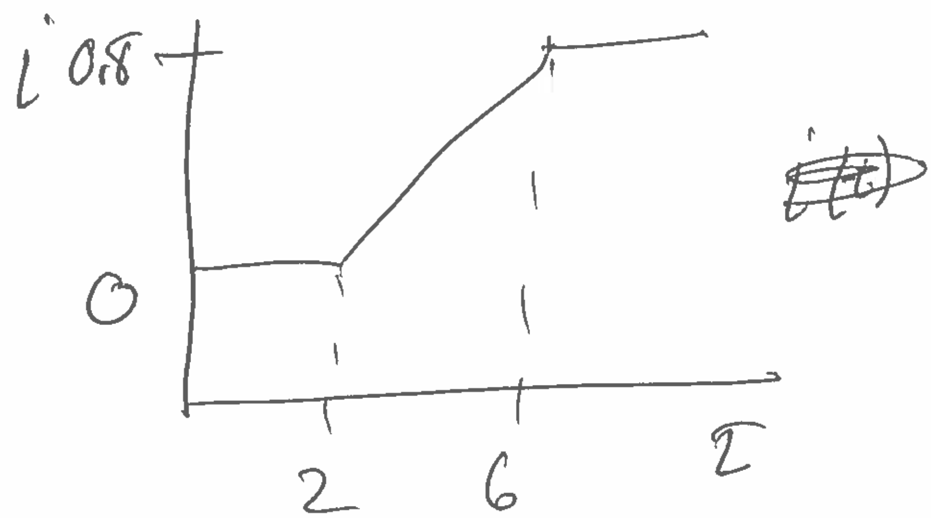
$$\omega_0 = \sqrt{\frac{1}{LC}}$$

$$v = L \frac{di}{dt}$$

$$di = \frac{v}{L} dt$$

$$i_{ind} = \frac{1}{L} \int_{t_0}^{t} v \, dt + i(t_0)$$

$$v_{cap} = \frac{1}{C} \int_{t_0}^{t} i \, dt + v(t_0)$$




$$i(t) = \begin{cases} 0 & 0 \le t \le 2s \\ 0.2t - 0.4 & 2s \le t \le 6s \\ 0.8 & t \ge 6s \end{cases}$$

$$L = 0.5\,H$$

$$v_L(t) = ?$$

$$\frac{di}{dt} = \begin{cases} 0 & 0 \le t \le 2s \\ 0.2t & 2s \le t \le 6s \\ 0 & t \geq 6s \end{cases}$$

$$v = L\frac{di}{dt} = \begin{cases} 0 & 0 \le t \le 2s \\ 0.1 & 2s \le t \le 6s \\ 0 & t \geq 6s \end{cases}$$

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what if insteid

$$v_L = \begin{cases} 0 & 0 \le t < 2s \\ 0.2t - 0.4 & 2s \le t < \\ 0.8 & \end{cases}$$

$$i(t) = \frac{1}{L}\int v\,d\tau + i(t_0)$$