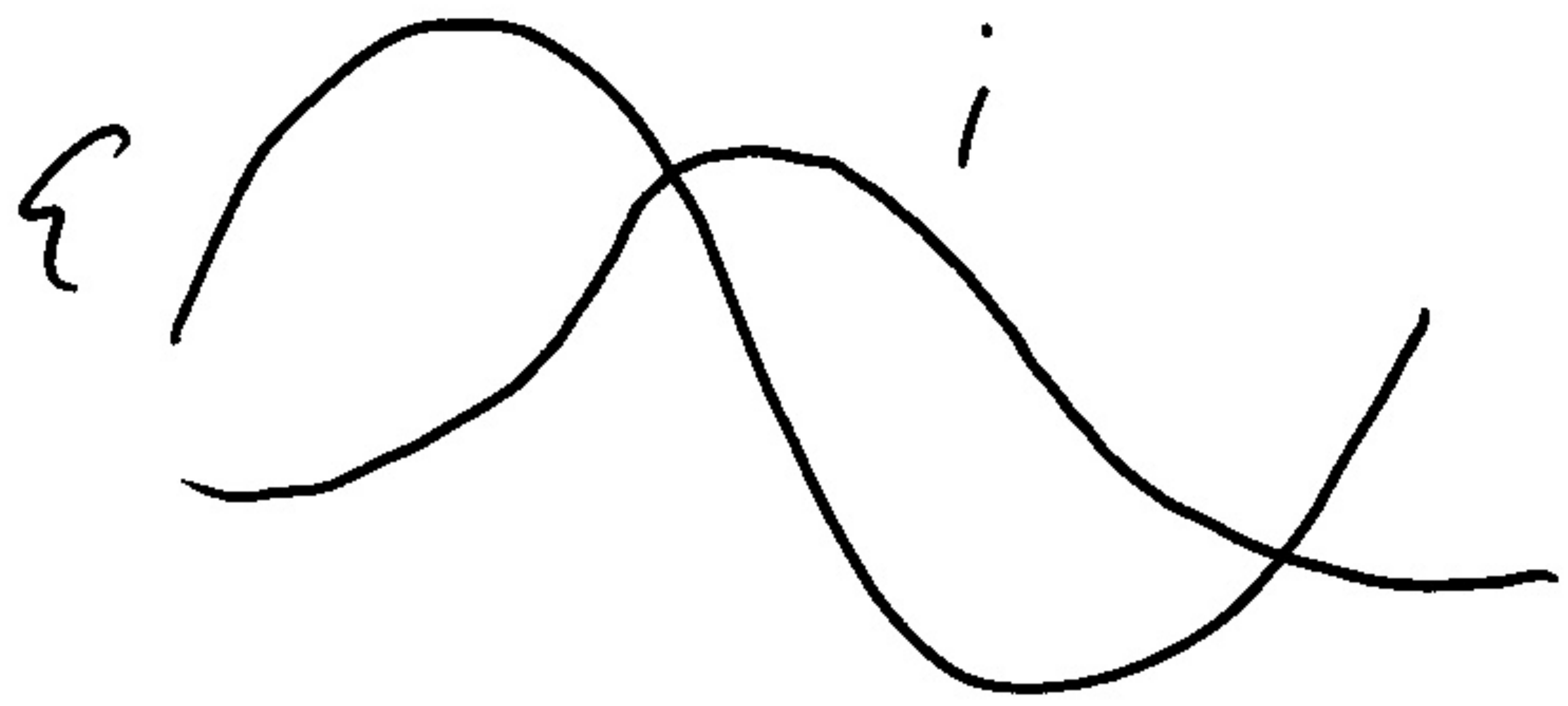
C1:

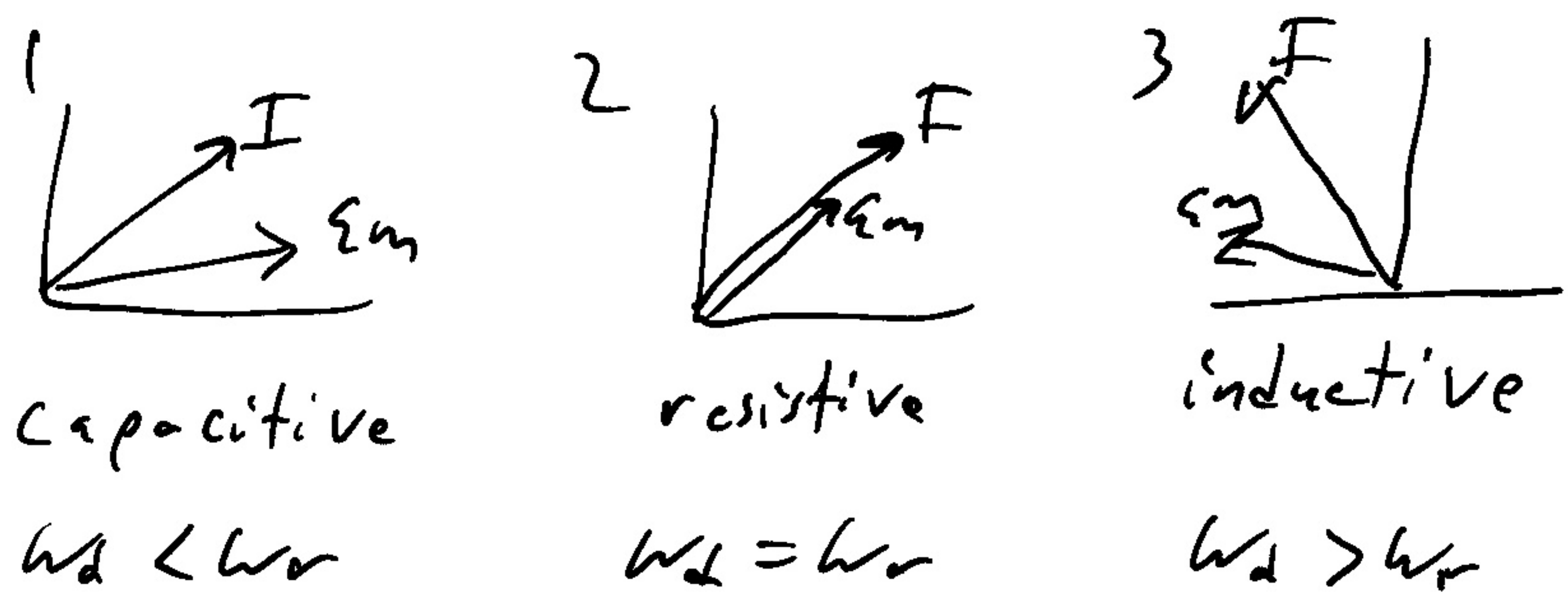


a. i lags ε
so if $\varepsilon = \varepsilon_m \sin \omega_d t$
$i = \varepsilon_m \sin(\omega_d t - \varphi)$
$\varphi > 0$

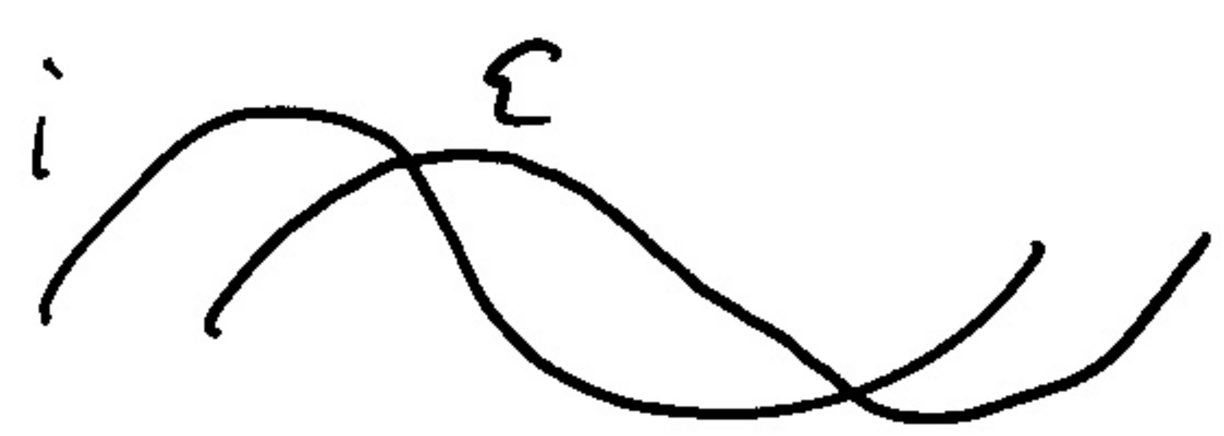
b. circuit is inductive, so want to decrease X_L & L

c. want to increase X_c, so decrease C

C2:



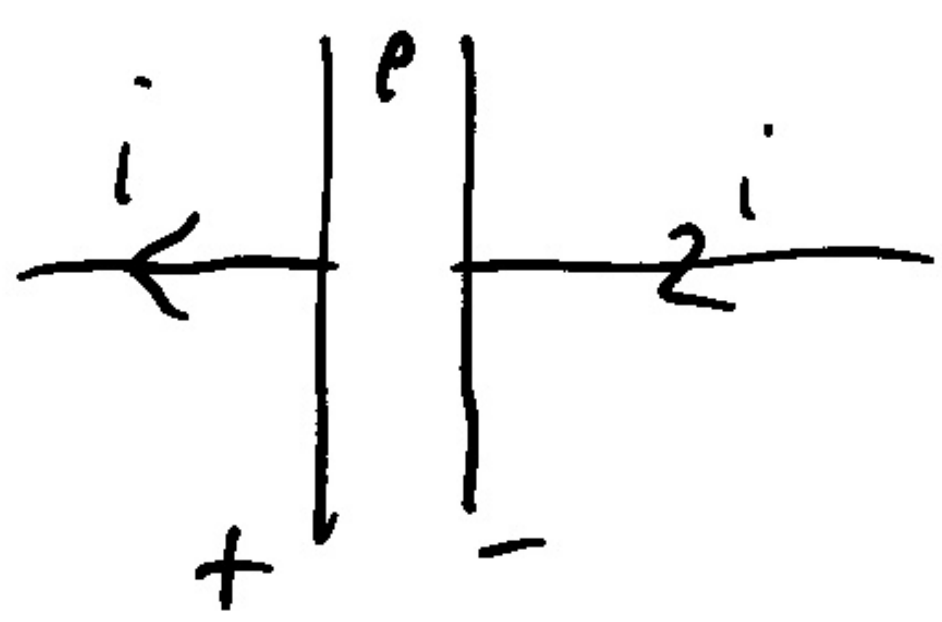
C3



capacitive

- increasing L, C, ω
- all make circuit more inductive
- shift i right & increase amplitude

C4:



capacitor discharging

E $\rightarrow$

i_d $\leftarrow$

B @ P $\otimes$

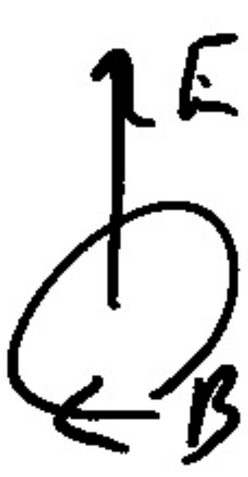
C5:

$$\oint \vec{B} \cdot d\vec{\ell} = \mu_0 \varepsilon_0 \, d\Phi_E/dt$$
$$= \mu_0 \varepsilon_0 A \, dE/dt$$

for fixed area

a. RHR gives dE/dt up, so $|\vec{E}|$ decreasing

b. dE/dt down, so $|\vec{E}|$ decreasing



M1: a. $X_C = 1/\omega C \quad \omega = 2\pi f$

b. $Z = \sqrt{R^2 + \sqrt{(\omega L - 1/\omega C)^2}}$

c. $I = \varepsilon_m / Z$

M2; a. $P_\sigma = \varepsilon i$

$= \varepsilon_m \sin(\omega_d t) \cdot \varepsilon_m/Z \sin(\omega_d t - \varphi_0)$

b. $P_C = V_C i$

$= q/C \cdot i$

$= -1/\omega_d C\, I \cos(\omega_d t - \varphi_0) \cdot I \sin(\omega_d t - \varphi_0)$

$= -\varepsilon_m^2/Z^2 \cdot X_C \cdot \cos(\omega_d t - \varphi_0) \sin(\omega_d t - \varphi_0)$

c. $P_L = V_L i$

$= i L\, di/dt$

$= I \sin(\omega_d t - \varphi_0) \cdot L \cdot \omega_d \cdot I \cos(\omega_d t - \varphi_0)$

$= \varepsilon_m^2/Z^2 \cdot X_L \cdot \sin(\omega_d t - \varphi_0) \cos(\omega_d t - \varphi_0)$

d. $P_R = i^2 R$

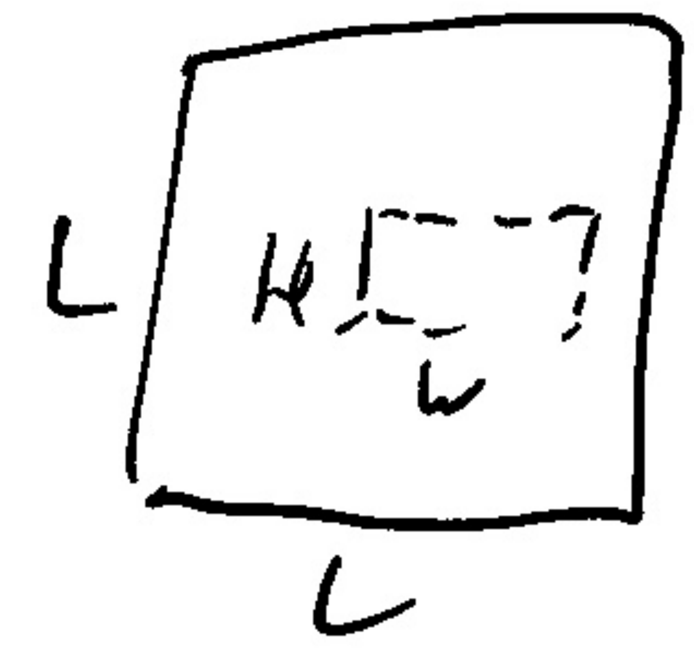
$= \varepsilon_m^2/Z^2 \cdot R \cdot \sin^2(\omega_d t - \varphi_0)$

$P_\sigma = P_C + P_L + P_R$

M3: $\oint \vec{B} \cdot d\vec{s} = \mu_0 \varepsilon_0 \, d\varphi_E / dt$

$= \mu_0 i_{denc}$

$i_{denc} = i \cdot H \cdot W / L^2$



M4: $\oint \vec{B} \cdot d\vec{s} = B \cdot 2\pi r$

$= \mu_0 i_{denc}$

$= \mu_0 i \cdot \pi r^2 / \pi R^2$

$\Rightarrow B = \frac{\mu_0 i r}{2\pi R^2}$

$i = \mathcal{E}/R \, e^{-t/RC}$ w/ $C = \varepsilon_0 A/d$

M5: $V = V_0 e^{-t/\tau}$

$E = V/d$

$\varphi_E = EA = E \cdot \pi r^2 = \frac{V_0}{d} \cdot \pi r^2 e^{-t/\tau}$

$|d\varphi_E/dt| = \frac{\pi r^2 V_0}{\tau d} e^{-t/\tau}$

$|\vec{B}| = \mu_0 \varepsilon_0 |d\varphi_E/dt| \cdot 1/2\pi r$

$= \frac{\mu_0 \varepsilon_0 r V_0}{2 \tau d} e^{-t/\tau}$

Parallel Eqs.

$$\oint \vec{B} \cdot d\vec{l} = \mu_0 \epsilon_0 \, d\Phi_E/dt$$

$$\oint \vec{E} \cdot d\vec{l} = - d\Phi_B/dt$$

- why difference in sign?
  - (−) in Faraday's Law

    ⇒ changing B produces EMF that drives current that opposes change in B

  - (+) in Ampere's Law

    ⇒ changing E produces an effective current that "completes the circuit" and reinforces the change

- If both were (+) or both (−) light waves would not oscillate