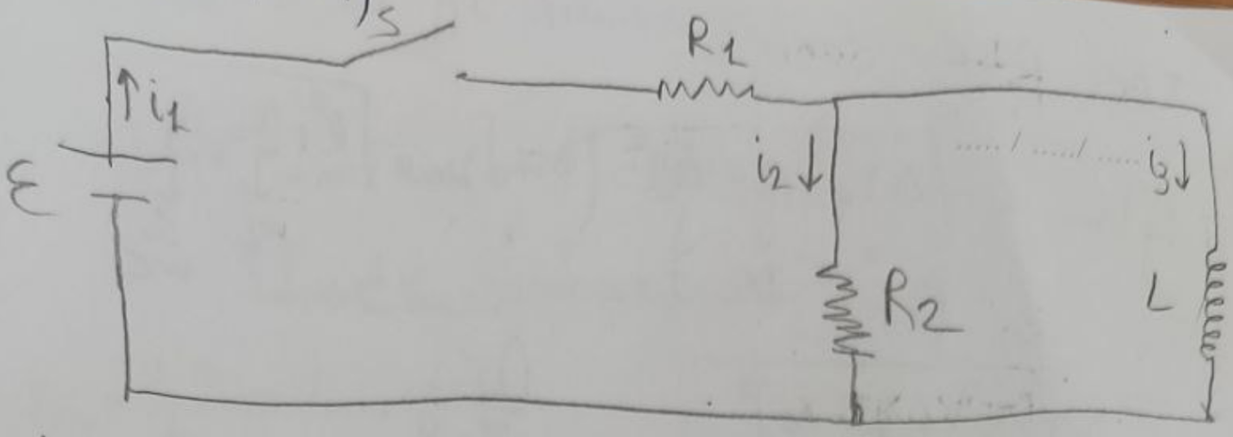
İndüktans Aday Soru

Question (final)



An inductor with inductance L=0.200H and negligible resistance is connected to a battery, a switch S and two resistors, $R_1 = 8.00\Omega$ and $R_2 = 6.00\Omega$. The battery has emf 48.0V and negligible internal resistance.

S is closed at t=0

(a) what are the current i_1, i_2 and i_3 just after S is closed

(b) what are i_1, i_2 and i_3 after S has been closed a long time

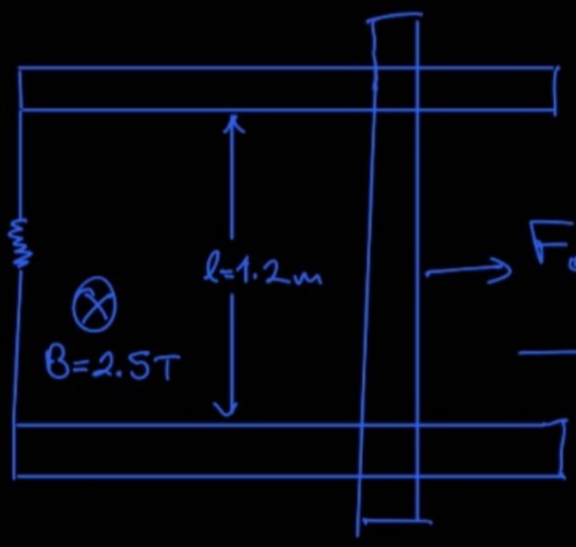
Solution

(a) L'nin davranışı C'nin tam tersidir
anahtar kapanır kapanmaz L'den akım geçmez
o yüzden $i_1 = i_2 = \frac{\mathcal{E}}{R_1+R_2} = \frac{48V}{14\Omega} = 3,--A$

b) anahtar kapanır kapanmaz L'nin direnci 0 olur
tüm akım ordan geçer R_2 iptal olur

$$i_1 = i_3 = \frac{48V}{8\Omega} = 6A$$

Hareketli EMK
Aday Soru



#SS
#FSS

→ olması için F_{app} kaç olmalı

$$|\vec{F_B}| = I\,|\vec{\ell}\times\vec{B}| = I\ell B$$

$$\mathcal{E} = B\ell v$$

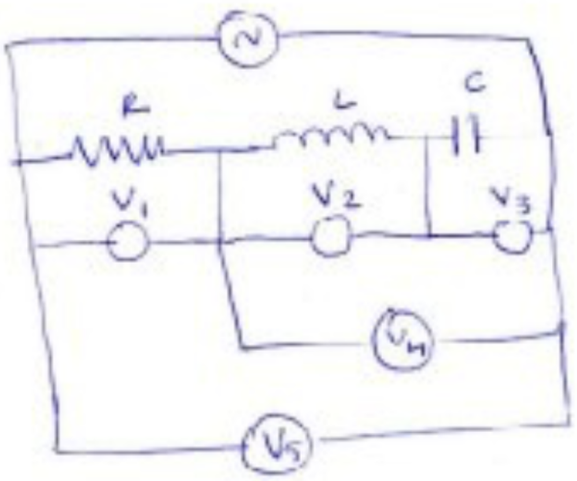
$$I = \frac{\mathcal{E}}{R}$$

$$F = \frac{B\ell v}{R}\cdot \ell B = \frac{B^2\ell^2 v}{R}$$

$$F_{app} = 3N$$

AC devresinde RLC

Problem 31.40



$R = 200\ \Omega$

$L = 0{,}4\ H$

$C = 6.00\ \mu F$

$V = 30.0\ V$

a) $\omega = 200\ \frac{rad}{s}$

(b) $\omega = 1000\ \frac{rad}{s}$

kaln voltmetreler ne gösterir

1) X_L, X_C ve R'yi bul.

2) $\frac{V_{rms}}{Z} = I_{rms}$

3) $I_{rms} \cdot R$
$I_{rms} \cdot X_L$
$I_{rms} \cdot X_C$

(a) $X_L = \omega L = 200 \cdot 0{,}4 = 80\ \Omega$

$X_C = \frac{1}{\omega C} = \frac{1}{200 \cdot 6 \cdot 10^{-6}} = 833\ \Omega$

$Z = \sqrt{R^2 + (X_L - X_C)^2} = 779\ \Omega$

$V_{kok} = \frac{V}{\sqrt{2}} = \frac{30}{\sqrt{2}} = 21.2$ volt

$I_{kok} = \frac{V_{kok}}{Z} = \frac{21.2}{779} = 0{,}0272\ A$

$V_1 = (V_R)_{kok} = I_{kok} \cdot R = 0{,}0272 \cdot 200 = 5.44\ V$

$V_2 = (V_L)_{kok} = X_L I_{kok} = 0{,}0272 \cdot 80 = 2.18\ V$

$V_3 = (V_C)_{kok} = X_C I_{kok} = 0{,}0272 \cdot 833 = 22.7\ V$

$V_4 = |(V_L)_{kok} - (V_C)_{kok}| = 20.5\ V$

$V_5 = V_{kok} = 21.2\ V$

(b) aynı şeyler $\omega = 1000\ \frac{rad}{s}$ için tekrar!

Elektromanyetik Aday Sorular

An e^- moves through a uniform elektric field $\vec{E} = (2.50\hat{i} + 5.00\hat{j})$ V/m and a uniform magnetic field $\vec{B} = (0.400\hat{k})$ T. Determine the acceleration of the e^- when it has a velocity $v = 10.0\hat{i}$ m/s

$$F = qE$$

$$F = ma \qquad \vec{a} = \frac{\vec{F}}{m}$$

$$\vec{a} = \frac{\vec{F}}{m} = \frac{q\vec{E} + q\vec{v} \times \vec{B}}{m}$$

$$a = (-4.39 \times 10^{11}\,\hat{i} - 1.76 \times 10^{11}\,\hat{j})\ m/s^2$$

In a region of free space, the electric field at an instant of time is $\vec{E} = (80.0\hat{i} + 32.0\hat{j} - 64.0\hat{k})$ N/C and the magnetic field is $\vec{B} = (0.200\hat{i} + 0.080\hat{j} + 0.290\hat{k})\,\mu T$.

(a) Show that the two fields are perpendicular to each other

(b) Determine the Poynting vector for these fields.

$$\vec{S} = \frac{1}{\mu_0}\vec{E} \times \vec{B} \qquad \left(\mu_0 = 4\pi \times 10^{-7}\ T\ m/A\right)$$

$$b)\ \vec{S} = (11.5\hat{i} - 28.6\hat{j})\ \frac{W}{m^2}$$

$$S = \frac{1}{\mu_0}(\vec{E} \times B) = \frac{[(80\hat{i} + 32\hat{j} - 64\hat{k})\ N/C] \times [(0.2\hat{i} + 0.08\hat{j} + 0.29\hat{k})\,\mu T]}{4\pi \times 10^{-7}\ T\ m/A}$$

$\frac{2\pi}{\lambda}$ B_{max} k

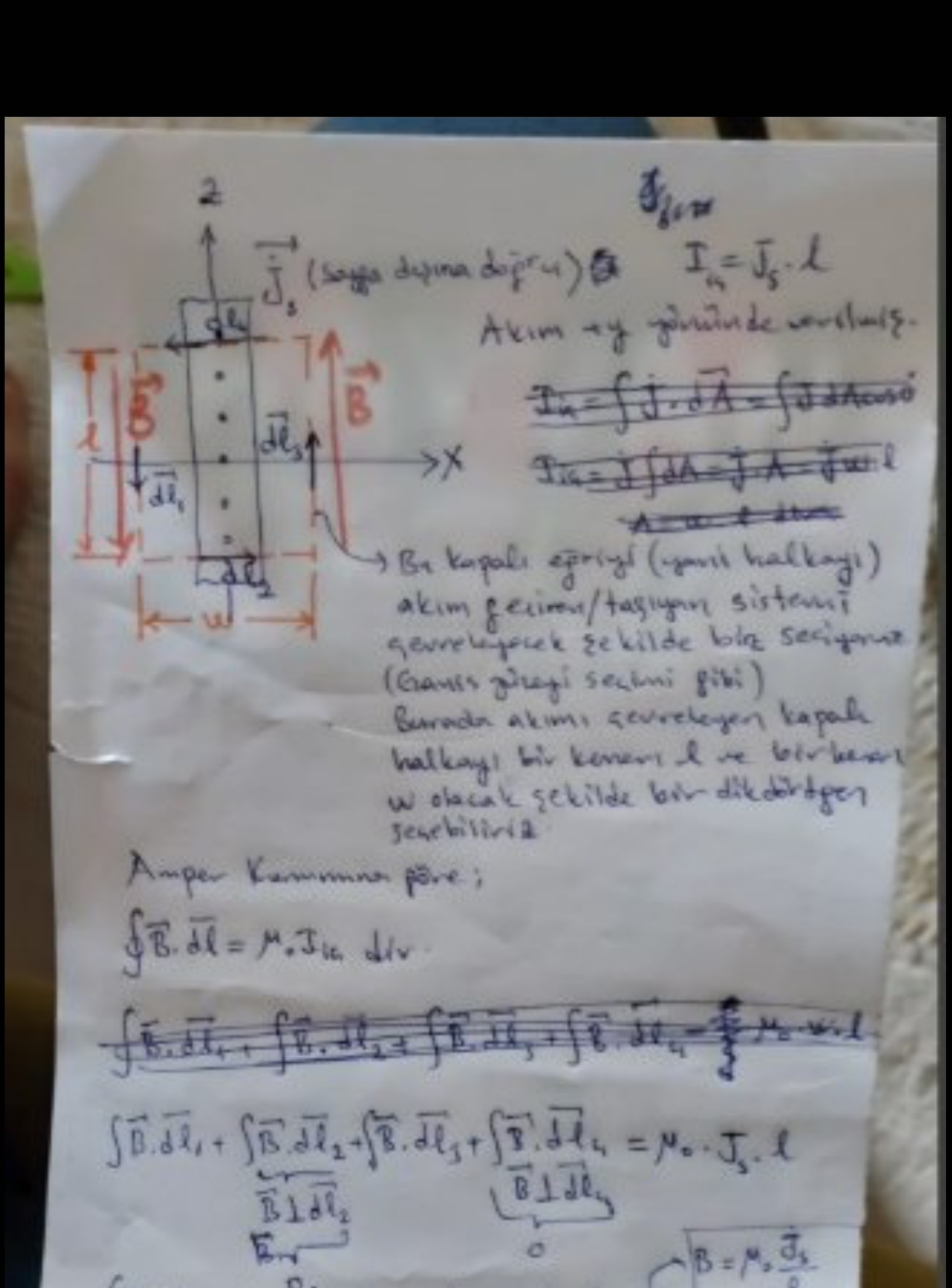
Ex 7

A sinusoidal electromagnetic wave of frequency 40 MHz travels in free space in the x-direction

(A) Determine the wavelength and period of the wave

$$\lambda = \frac{c}{f} = \frac{3\times10^8 m/s}{40\times10^6 1/s} = 7.5m$$

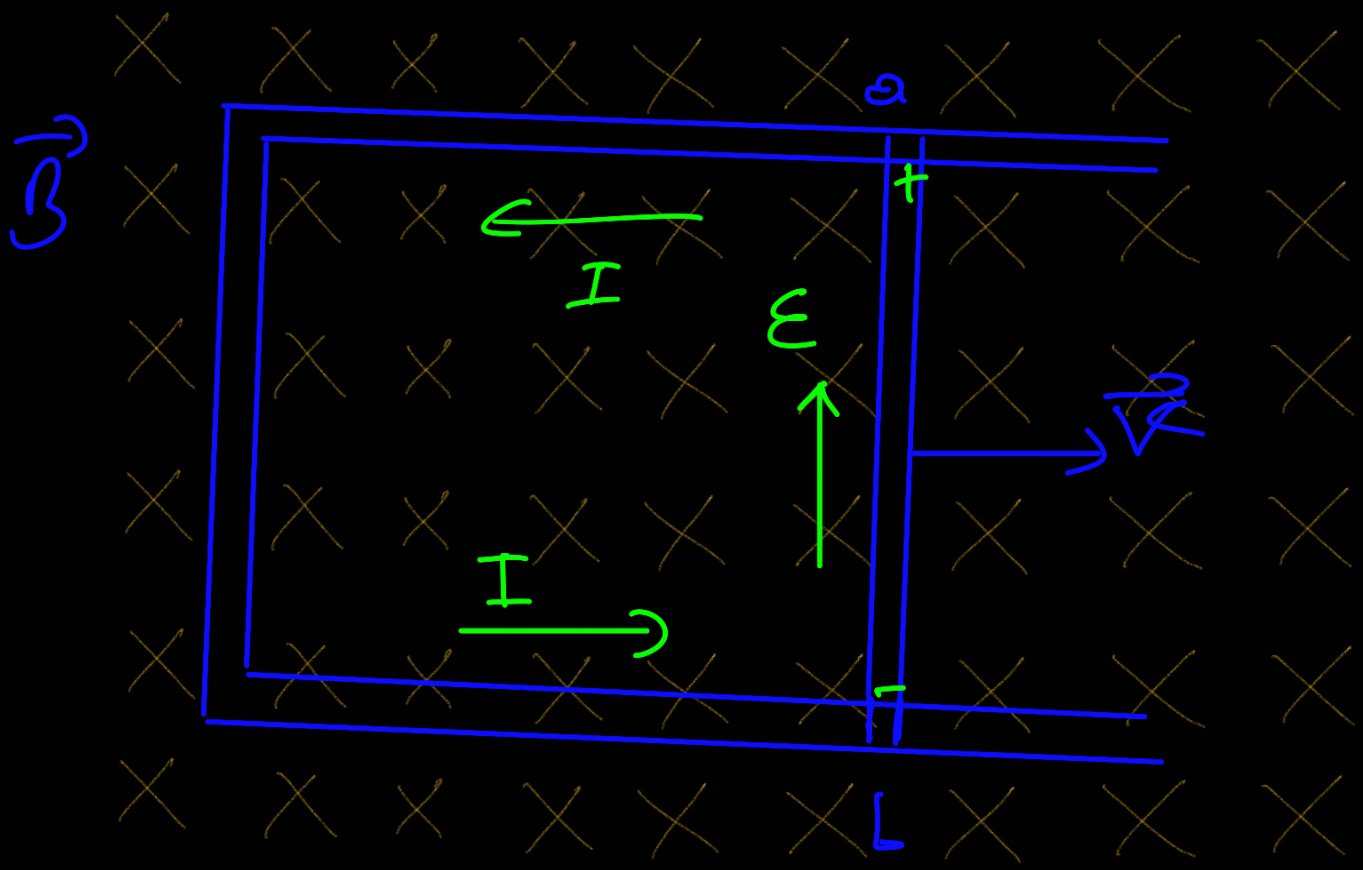
$$T = \frac{1}{f} = \frac{1}{40\times10^6 1/s} = 2.9\times10^{-8} s$$



Sonsuz bir akım levhası

Hareketli EMK

$F_{dış}$ nedeniyle $\vec{v}$ hızıyla kızak çekilir.
Because of that Manyetik Akı değişir.
$d\Phi$'yi azaltacak yönde EMK indüklenir.
İletken telden akım geçer.
Sonra bu akım taşıyan iletken tele
$F_{dış}$'ın zıddı yönde $\vec{F}_B = (I\vec{L}\times\vec{B})$ etki eder.
$F_B = F_d$ olunca kızak durur.



$|\Delta\Phi| = |q|\varepsilon$

$\varepsilon = vB$

$\varepsilon = EL$

$\boxed{\varepsilon = BvL}$

$I = \frac{\varepsilon}{R} \Rightarrow \frac{BvL}{R}$

$F = BIL$

↳ Akım taşıyan iletken tele etki eden manyetik kuvvet

I

$F = \left(\frac{BvL}{R}\right) \cdot B \cdot L = \frac{B^2 v L^2}{R}$

$\left(\frac{R}{}\right)$ $= \frac{B^2 v L^2}{R} = F$

Sabit v için $F_{dış} = F = \frac{B^2 v L^2}{R}$

Elektriksel güç (P) $= I^2 . R = \left(\frac{BvL}{R}\right)^2 . R = \frac{(B^2 v^2 L^2) R}{R^2}$

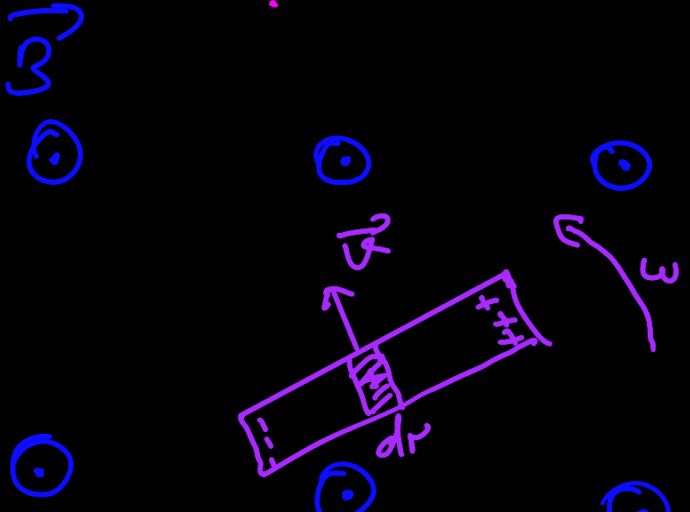
Mekanik güç $= F . v = \frac{B^2 v L^2}{R} . v = \frac{B^2 v^2 L^2}{R}$

! verilen mekanik güç ($F_{dış}$) → elektriksel güç ($F = ILB$)

! Manyetik alanda hareket eden iletken, mekanik enerjiyi elektriksel enerjiye çevirmiş olur.

α

$\varepsilon = ?$

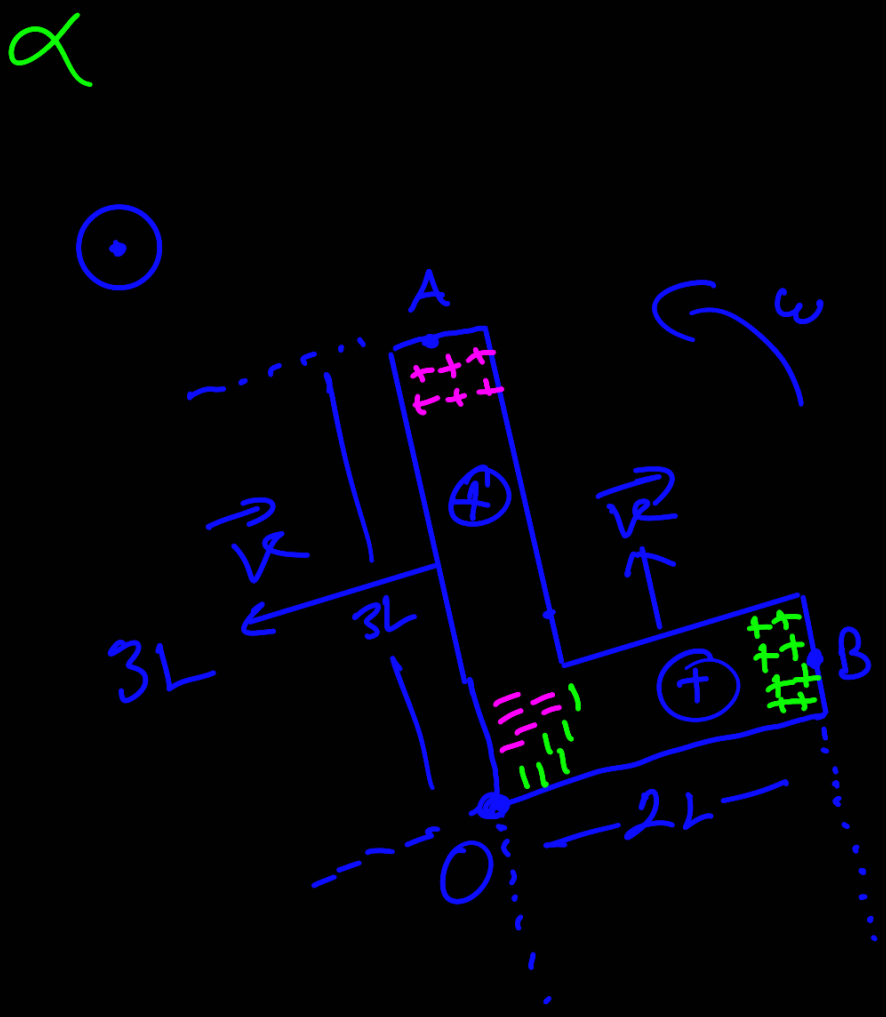


$\varepsilon = BVL$

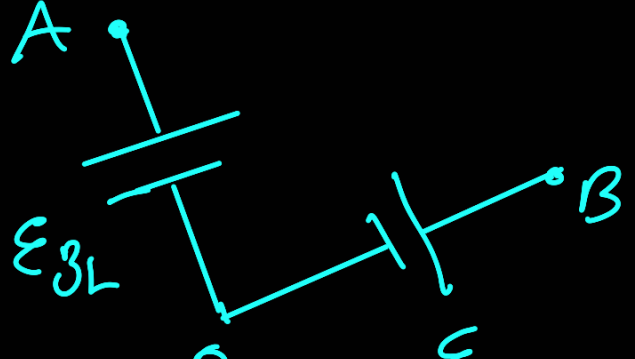
$d\varepsilon = B\omega r\, dr$

$$\mathcal{E} = \int_0 B\omega r\, dr = \frac{r^2}{2}\Big|_0^L$$

$$\mathcal{E} = B\omega \frac{L^2}{2}$$



A ile B arası Potansiyel nedir?



$$\mathcal{E}_{3L} = \frac{1}{2} B\omega (3L)^2 = \frac{9B\omega L^2}{2}$$

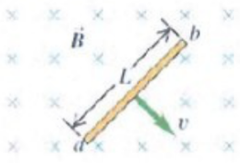
$$\mathcal{E}_{2L} = \frac{1}{2} B\omega (2L)^2 = \frac{4B\omega L^2}{2}$$

$$V_A - V_B = \mathcal{E}_{3L} - \mathcal{E}_{2L} = \frac{5wBL^2}{2}$$

A ucu daha yüksek potansiyelde.

Problem 29.25

Figure E29.25

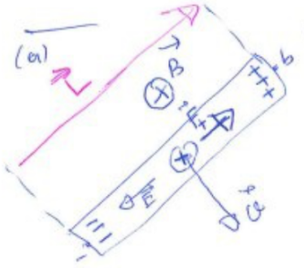


$B = 0{,}45\,T$, $L = 30\,cm = 0{,}3\,m$, $v = 5{,}00\,\frac{m}{s}$

(a) a ile b arası potansiyel farkı nedir. Hangisi yüksek potansiyelddedir. $\vec{E} = ?$

(b) $\vec{v}$, ab'ye paralel olsa ne olur

(c) $\vec{v}$ bize doğru olsa ne olur



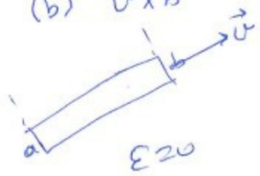
+ yükler b ucunda b ucu yüksek potansiyle

$$\mathcal{E} = (\vec{v} \times \vec{B}) \cdot \vec{L} = vBL = 5 \cdot 0{,}45 \cdot 0{,}3 = 0{,}675 \text{ volt}$$

($\vec{L}$ yönünde elektrik alan)

$$E = \frac{\mathcal{E}}{L} = \frac{0{,}675}{0{,}3} = 2{,}25\,\frac{V}{m}$$ b'de a'ya doğru

(b) $\vec{v} \times \vec{B}$



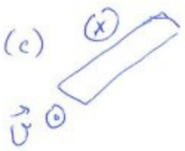
$\mathcal{E} = 0$

$\vec{v} \times \vec{B} \perp \vec{L}$

$(\vec{v} \times \vec{B}) \cdot \vec{L} = 0$

dik ise ska

(c)



$\vec{v}$ ile $\vec{B}$ arası 180°

$\vec{v} \times \vec{B} = 0$

$\mathcal{E} = 0$

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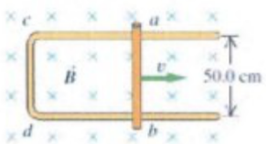
Problem 29.29

Figure E29.29



$L = 0{,}5\,m$

$B = 0{,}8\,T$,

(a) $v = 7{,}50\,\frac{m}{s}$ iken $\mathcal{E} = ?$, akım yönü nedir.

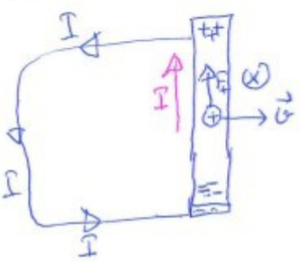
(b) $R = 1{,}50\,\Omega$ ise $I = ?$

(c) Sabit v için $\vec{F}_{dış} = ?$

(d) Mekanik güç nedir.

(e) Elektrikse l güç nedir

(a)



Çubuk içinde yukarı yönde

$\mathcal{E} = BvL = 0{,}8 \cdot 7{,}5 \cdot 0{,}5\,m$

$= 3$ volt

(b) $I = \frac{\mathcal{E}}{R} = \frac{3}{1{,}5} = 2A$

(c) $|\vec{F}_{dış}| = |\vec{F}_B|$

$f_{dış} = BIL$

$f_{dış} = 0{,}8 \cdot 2 \cdot 0{,}5$

$f_{dış} = 0{,}8\,N$

(d) $P_{mek} = Fv = 0{,}8 \cdot 7{,}5$

$= 6$ watt

(e) $P_{elk} = I^2R = (2)^2 \cdot 1{,}5$

$= 6$ watt

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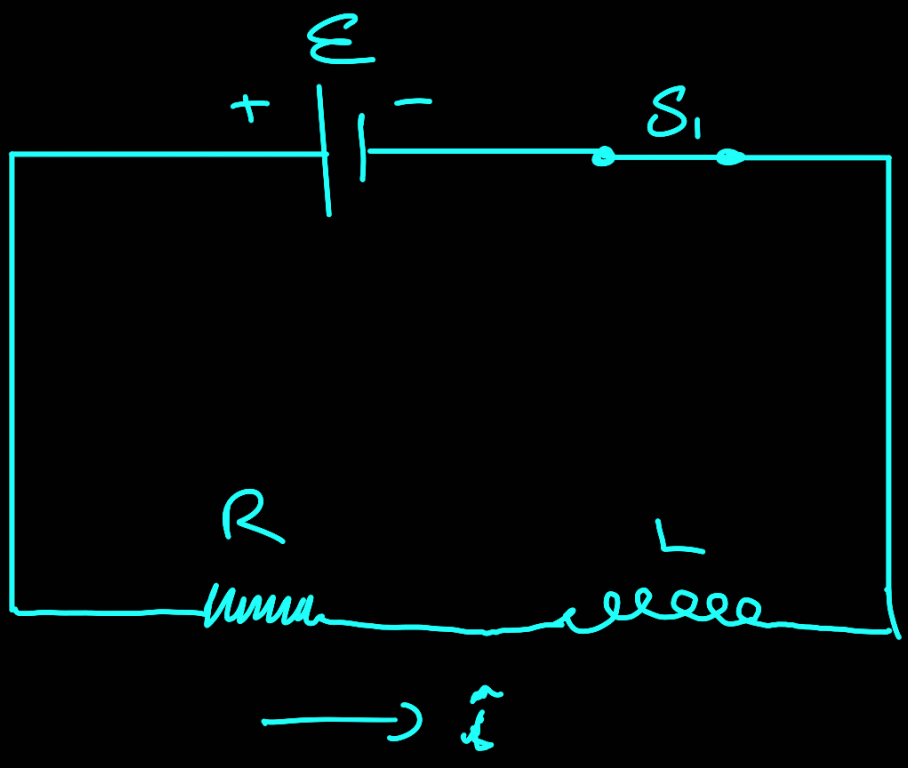
İndüktans

: RL devresi : $t=0$ anında S anahtarı kapatılsın

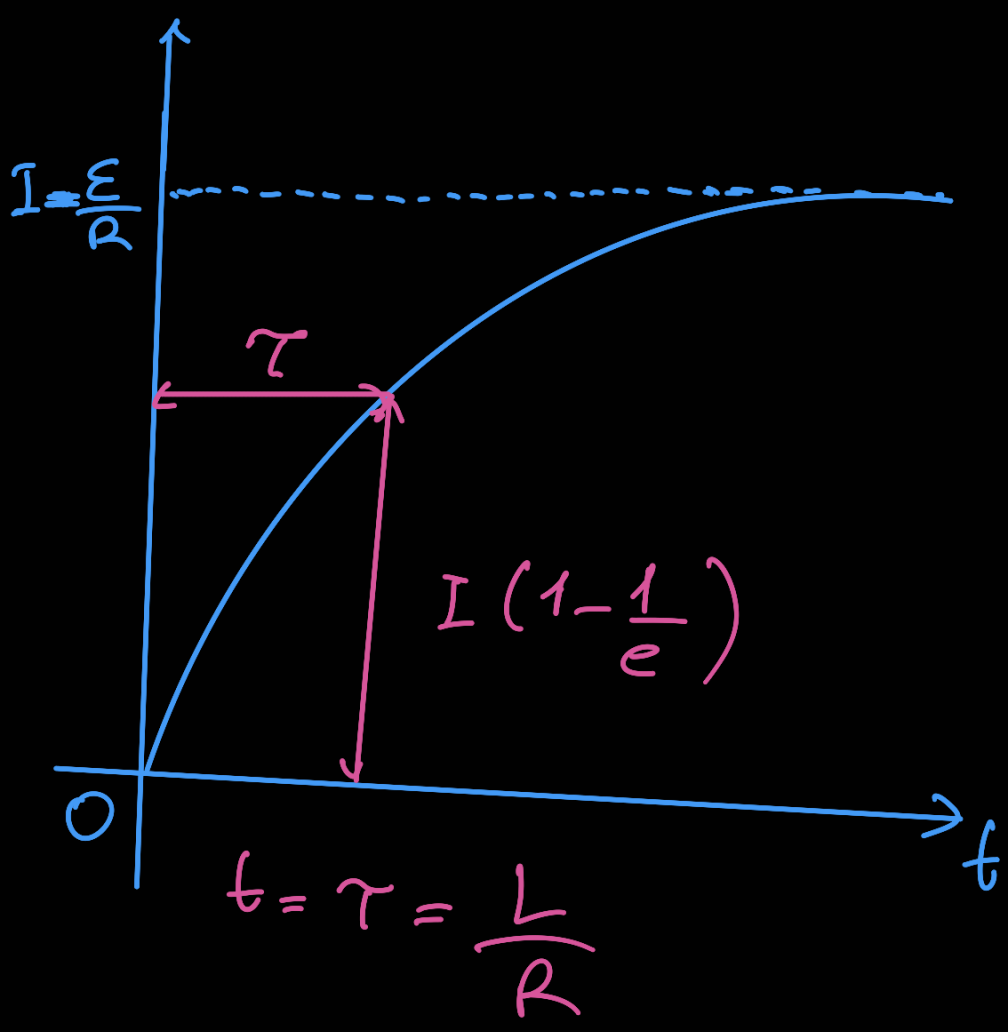


- Anahtar kapatılır kapatılmaz ($i=0$)

  Selonoid akım geçmesine engel olur.

- Yeterince beklenirse

  Sanki selonoid yokmuş gibi (kısa devre)



- Bu iki limit arasında eksponansiyel artar.

$$\hat{i} = I_{son}\left(1 - e^{-\frac{Rt}{L}}\right) = \frac{\mathcal{E}}{R}\left(1 - e^{-\frac{Rt}{L}}\right)$$

$$\tau = \frac{L}{R} \quad ; \quad \hat{i} = \frac{\mathcal{E}}{R}\left(1 - e^{-\frac{t}{\tau}}\right)$$

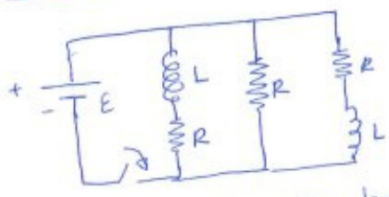
RL devresinde güç

$$i/ \quad \mathcal{E} = iR + L\frac{di}{dt}$$

$$i\mathcal{E} = i^2R + Li\frac{di}{dt}$$

- $i\mathcal{E}$: bataryanın verdiği güç
- i^2R: dirençte harcanan güç
- $Li\frac{di}{dt}$: selenoidde depolanan güç

Örnek:



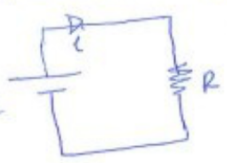
$\mathcal{E} = 18$ volt
$R = 9{,}0\ \Omega$
$L = 2{,}0$ mH

(a) Anahtar kapatılır kapatılmaz devreden geçen akım nedir.

(b) Yeterince beklenirse akım hangi değere ulaşır.

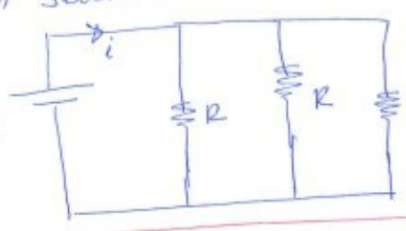
Zıt emk önce akım geçmesine izin vermez, akım durulduktça zıt emk sıfırlanır ve düz tel gibi davranır.

(a) Selenoid akım geçmesine izin vermez



$$i = \frac{\mathcal{E}}{R} = \frac{18}{9} = 2A$$

(b) Selenoid düz tel gibi davranır



$$R_{eq} = \frac{R}{3} = 3\Omega$$

$$i = \frac{\mathcal{E}}{R_{eq}} = \frac{18}{3} = 6A$$

Örnek: 53 mH selenoid $r = 0{,}37\ \Omega$ iç dirence sahiptir. Bir bataryaya bağlanırsa denge akımın yarısına ne zaman ulaşır.

$$i = I_{son}\left(1 - e^{-\frac{Rt}{L}}\right) = \frac{I_{son}}{2}$$

$$\ln/ \quad e^{-\frac{Rt}{L}} = \frac{1}{2}$$

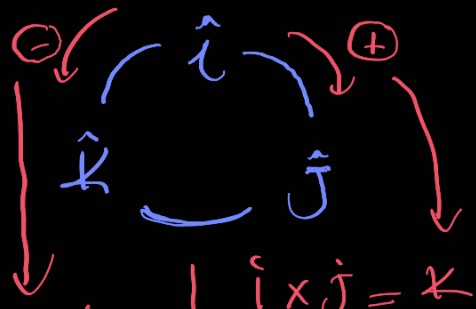
$$-\frac{Rt}{L} = \ln\left(\frac{1}{2}\right)$$

$$t = -\frac{L}{R}\ln\left(\frac{1}{2}\right) = \frac{L}{R}\ln(2) = \frac{53\times10^{-3}}{0{,}37}\ln(2)$$

$$t = 0{,}10s$$

EM Dalgalar

Vektörler quickSamuhder



$i \times k = -j$

$k \times j = -i$

$j \times i = -k$

$i \times j = k$

$j \times k = i$

$k \times i = j$

EM 'de enerji

$S = c\varepsilon_0 E^2$ $\Rightarrow$ Birim zamanda birim yüzeyden geçen enerji akısı.

$$S = \frac{EB}{\mu_0}$$

$$\vec{S} = \frac{1}{\mu_0}(\vec{E} \times \vec{B})$$ Poynting Vektörü: birim zamanda birim yüzeyden geçen enerji.

Sinusoidal EM dalgaları için

$$S = \frac{E_0 B_0}{\mu_0}\cos^2(kx - \omega t)$$

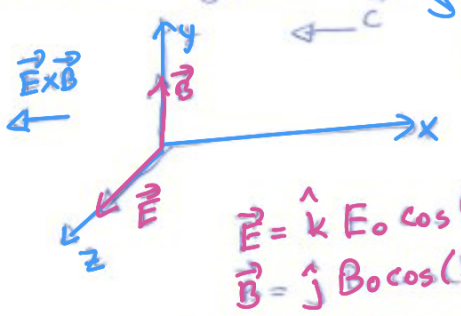
$$I = S_{\text{intensity}} = \frac{1}{2}\varepsilon_0 c E_0^2$$

Örnek: Karbondioksit lazerinden çıkan dalgalar $-x$ yönünde $10.6\,\mu m$ dalga boyuyla yayılmaktadırlar. $\vec{E}$ z ekseni yönünde ve genliği $1.5 \frac{MV}{m}$ ise $\vec{E}$ ve $\vec{B}$ vektörlerini yazınız

E_0

$\vec{c}$

$E_0 = 1.5 \frac{MV}{m}$



$\vec{E} = \hat{k} E_0 \cos(kx + \omega t)$

$\vec{B} = \hat{j} B_0 \cos(kx + \omega t)$

$B_0 = \frac{E_0}{c} = \frac{1.5 \times 10^6}{3.10^8} = 5 \times 10^{-3} T$

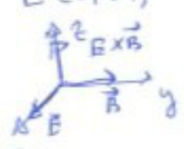
$k = \frac{2\pi}{\lambda} = \frac{2\pi}{10,6 \times 10^{-6}} = 5,93 \times 10^5 \frac{rad}{m}$

$c = \frac{\omega}{k}$, $\omega = ck = 3.10^8 . 5,93.10^5 = 1.78 \times 10^{14} \frac{rad}{s}$

$\vec{E} = \hat{k}\,(1.5 \times 10^6 \frac{V}{m}) \cos(5,93 \times 10^5 x + 1.78 \times 10^{14} t)$

$\vec{B} = \hat{j}\,(5 \times 10^{-3} T) \cos(5,93 \times 10^5 x + 1.78 \times 10^{14} t)$

Örnek: z-yönünde ilerleyen dalga için $f = 6,10 \times 10^{14}$ Hz, $B_0 = 5.8 \times 10^{-4} T$ ise $\vec{E}(z,t)$, $\vec{B}(z,t)$ nedir. $\vec{E}$ x-yönündedir.



$\vec{E} = \hat{i} E_0 \cos(kz - \omega t)$

$\vec{B} = \hat{j} B_0 \cos(kz - \omega t)$

$E_0 = cB_0 = 1,74 \times 10^5 \frac{V}{m}$

$\omega = 2\pi f = 3,83 \times 10^{15} \frac{rad}{s}$

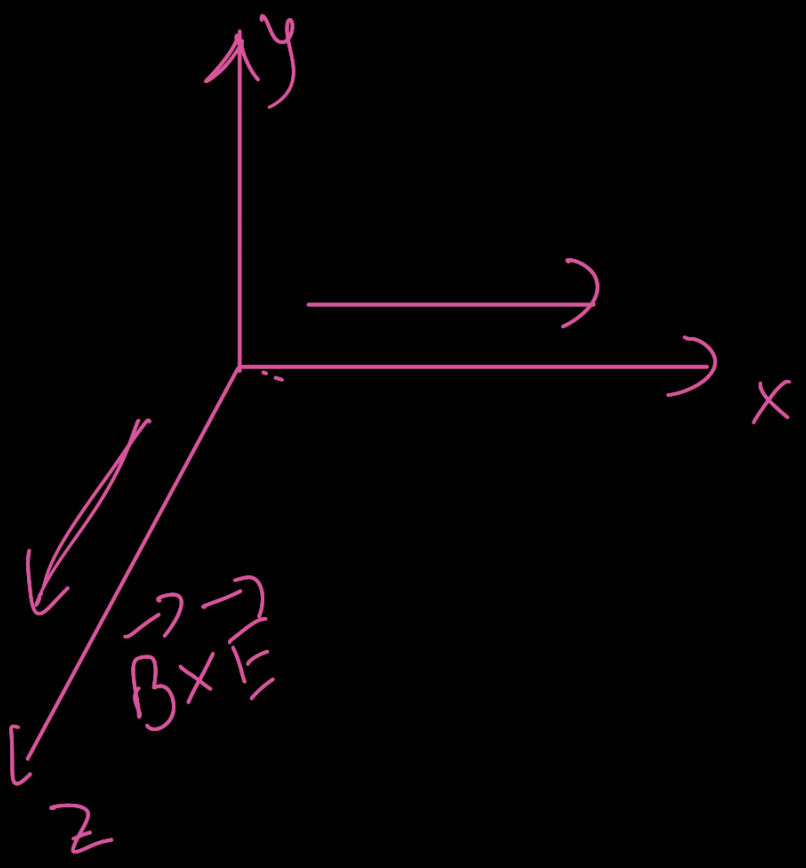
$c = \frac{\omega}{k} \Rightarrow k = \frac{\omega}{c} = 1,28 \times 10^7 \frac{rad}{m}$

$\vec{E} = \hat{i}\,(1,74 \times 10^5 \frac{V}{m}) \cos(kz - \omega t)$

$\vec{B} = \hat{j}\,(5,8 \times 10^{-4} T) \cos(kz - \omega t)$

$\Rightarrow \vec{E} = \hat{i}\,(1,74 \times 10^5 \frac{V}{m}) \cos(1,28 \times 10^7 z - 3,83 \times 10^{15} t)$

$\vec{B} = \hat{j}\,(5,8 \times 10^{-4} T) \cos(1,28 \times 10^7 z - 3,83 \times 10^{15} t)$


y
x
z
$\vec{B} \times \vec{E}$