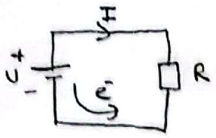
Elektrik, Bil Müh İçin

$Q = I.t = n.e$ $\quad e = 1{,}6.10^{-19}\ C$

Akım $= I = \frac{Q}{t}$



$U = \frac{W}{Q}$ $\quad V = \frac{kg.m^2}{A.s^3}$

$I = U.G$ (İletkenlik (mho ℧))

$R = \frac{1}{G}$

$R = \frac{l}{A.\rho}$

Bakır = 56 ρ $\quad$ Alüminyum = 35 ρ $\quad$ Gümüş = 62,5 ρ $\quad$ Altın = 44 ρ

ÖRN/1km uzunluğunda 16 mm² kesitinde olan bakır iletkenin ve bakır hattın direncini hesaplayınız

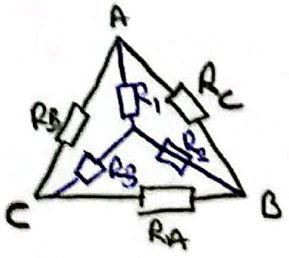
a) $l = 1km$ $\quad \rho = 56$ $\quad A = 16mm^2$

$R = \frac{l}{\rho.A} = \frac{1000}{56.16} = 1{,}116\ \Omega$

b) $l = 1km$ $\quad \rho = 56$ $\quad A = 16mm^2$ $\quad U_1$ $\quad U_2$ $\quad l = 1km$

$R = \frac{2l}{\rho.A} = \frac{2.1000}{56.16} = 2{,}232\ \Omega$

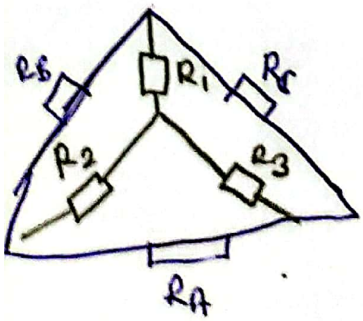
Yıldız λ Üçgen Δ dönüşümleri



$R_A = \frac{R_1.R_2 + R_1.R_3 + R_3.R_2}{R_1}$

$R_B = \frac{R_1.R_2 + R_1.R_B + R_2.R_3}{R_2}$

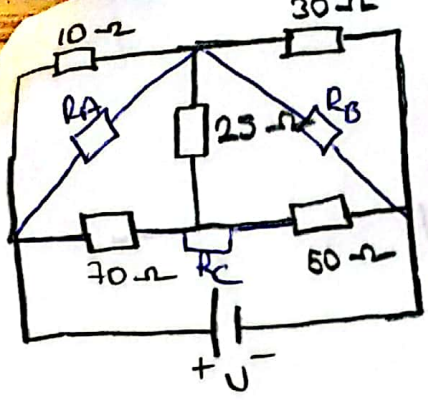
$R_C = \frac{R_1.R_2 + R_1.R_3 + R_B.R_2}{R_3}$



$R_1 = \frac{R_B.R_C}{R_A+R_B+R_C}$

$R_2 = \frac{R_B.R_A}{R_A+R_B+R_C}$

$R_3 = \frac{R_C.R_A}{R_A+R_B+R_C}$

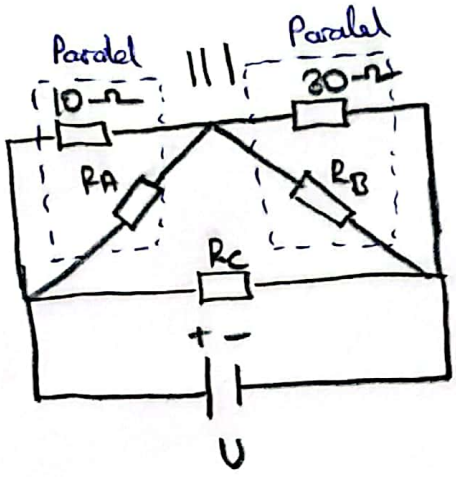


Eşdeğer Direnci Bulunuz

$R_A = \frac{25.70 + 25.50 + 50.70}{50} = 130\ \Omega$

$R_B = \frac{25.70 + 25.50 + 50.70}{70} = 92,85\ \Omega$

$R_C = \frac{25.70 + 25.50 + 70.50}{25} = 260\ \Omega$



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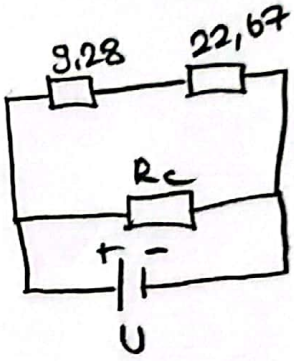


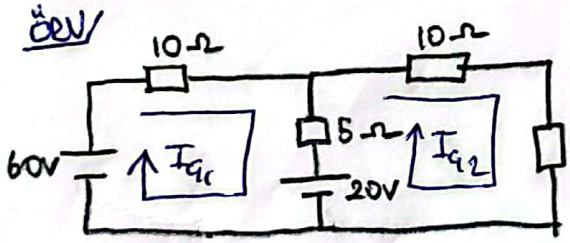
$R_{eş} = 28,46\ \Omega$

Kirchoff Yasaları

$I_2 + I_5 = I_1 + I_3 + I_4$

gelen akımlar giden akımlara eşittir

ÖRN/



① $10I_{q_1} + 5I_{q_1} + 20V - 5I_{q_2} = 60V$

② $10I_{q_2} + 5I_{q_2} - 20V + 5I_{q_2} - 5I_{q_1}$

① $15I_{q_1} - 5I_{q_2} = 40V$

② $20I_{q_2} - 5I_{q_1} = 20V$ 3/ →

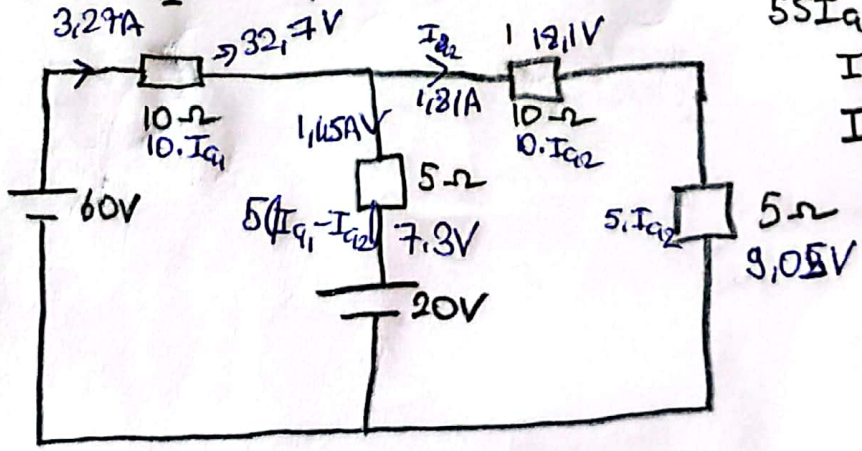
$15I_{q_1} - 5I_{q_2} = 40$

$60I_{q_2} - 15I_{q_1} = 60$

$55I_{q_2} = 100$

$I_{q_2} = 1,81$

$I_{q_1} = 3,27$

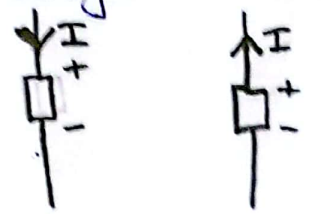


Elektriksel Enerji ve Güç

$E_e = U.Q = U.I.t$ W.s ≠ joule

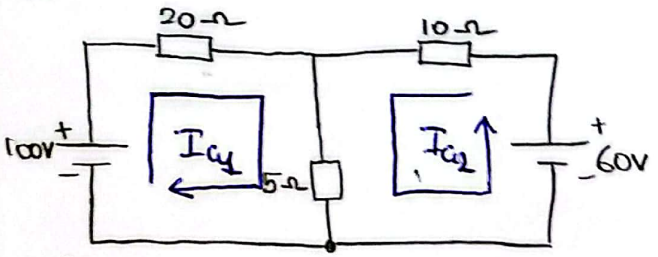
$P_e = \frac{E_e}{t} = U.I$

Tellegen Teoremi



$+P = U.I$ (Gelen güç) $\quad -P = U.I$ (Verilen güç)

ÖRN/



① $100 = 20I_{a1} + 5I_{a1} + 5I_{a2}$

② $10I_{a2} + 5I_{a2} + 5I_{a1} = 60$

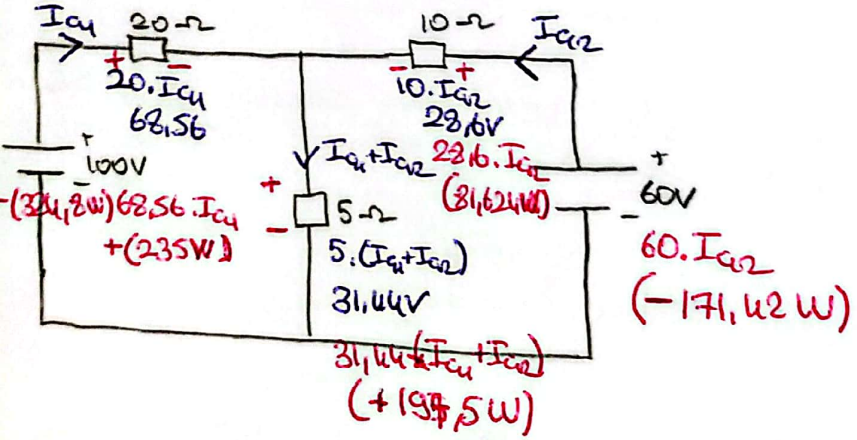
① $\cdot 3/$ $25I_{a1} + 5I_{a2} = 100$ ⟶ $-3\times$ ⟶ $-75I_{a1} + 15I_{a2} = -300$

② $15I_{a2} + 5I_{a1} = 60$ $\quad 15I_{a2} + 5I_{a1} = 60$

$-70I_{a1} = -240$

$I_{a1} = 3,428$

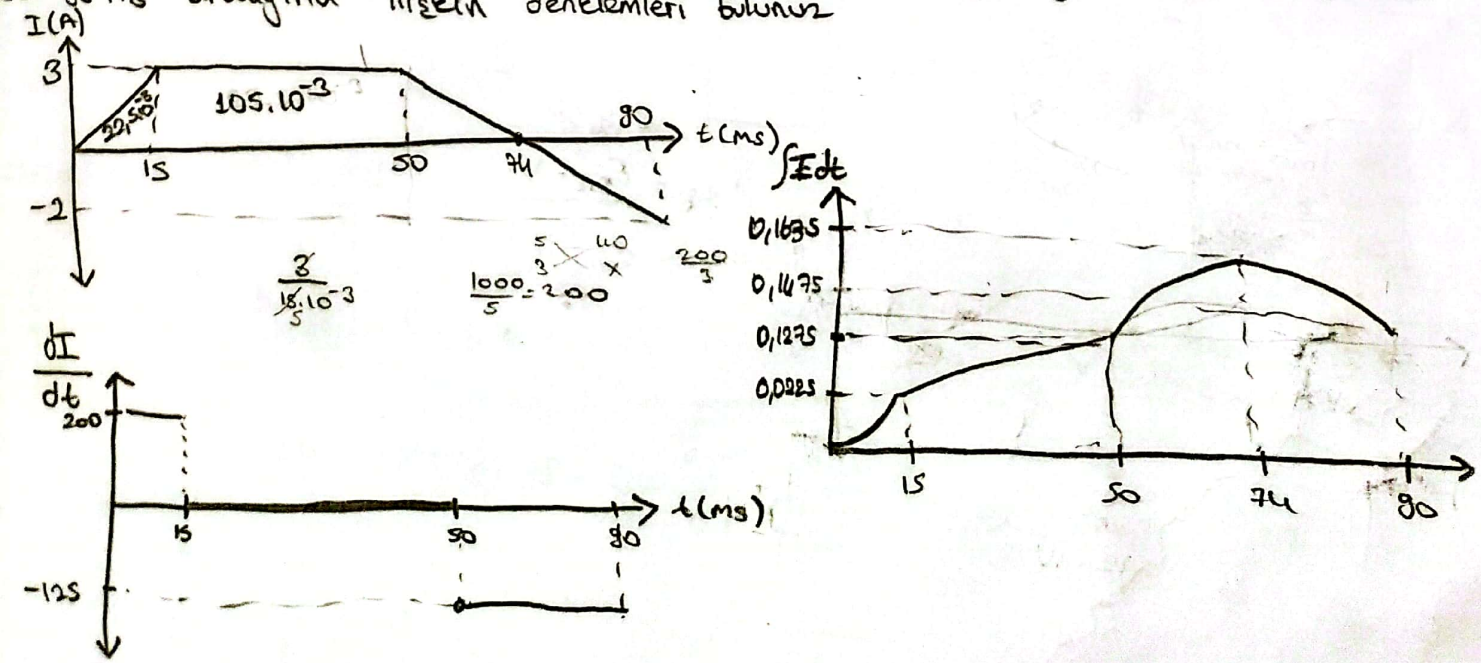
$I_{a2} = 2,86$



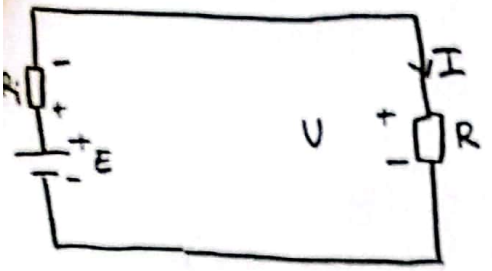
$P = U.I$

Türev – Integral

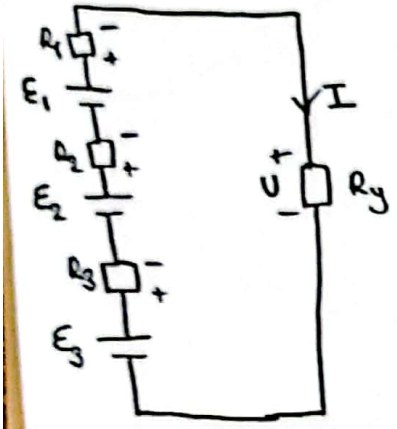
Verilen Akımın türevini ve Integralini zamana göre ölçekli çiziniz
50 - 80 ms aralığına ilişkin denklemleri bulunuz



...rilim Kaynağı



$U_i = R_i \cdot I$ $\quad U = E - \underbrace{R_i \cdot I}_{U_i}$ ← iç dirençte düşen gerilim



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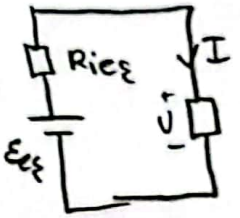


$U = \varepsilon_1 + \varepsilon_2 + \varepsilon_3 - I(R_1 + R_2 + R_3)$

$U = \varepsilon_{eş} - R_{eş} \cdot I$

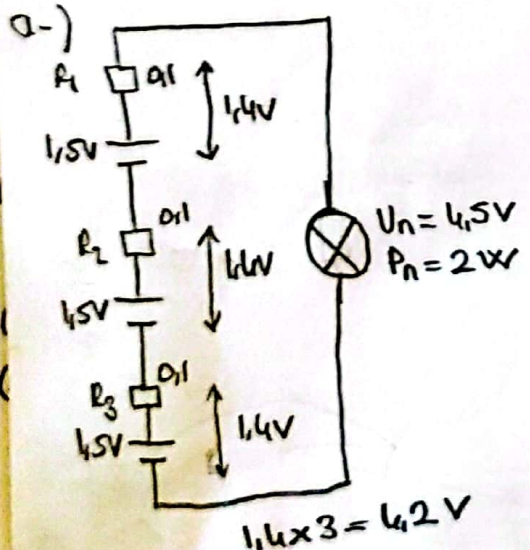
$R_{eş} = \dfrac{\varepsilon_{eş} - U}{I}$

4,5 V – 2 W nominal değerli lamba emk'sı 1,5V olan pillerle oluşturdan bir kaynaktan besleniyor her bir pilin uçlarındaki gerilim 1,4 V'a düş mektedir.

a) Eşdeğer iç Direnci bulunur

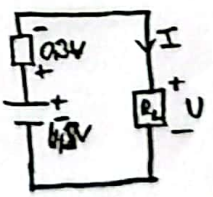
b) Lambaya ve kaynağa ait ilişkin güçleri hesaplayınız

a-)



1,4 x 3 = 4,2 V

≡



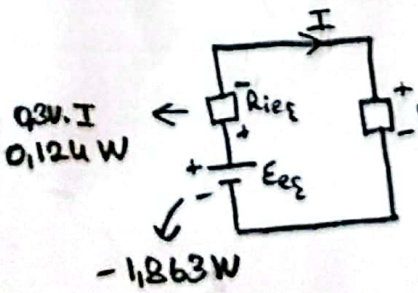
$P_N = \dfrac{U_N^2}{R_L}$ $\quad R_L = \dfrac{U_n^2}{P_N}$

$R_L = 10,125\ \Omega$

$I = \dfrac{U}{R_L}$ $\quad I = 0,414\ A$

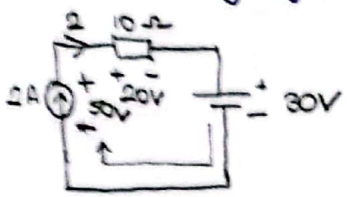
$R_{eş} = \dfrac{\varepsilon_{eş} - U}{I}$ $\quad \dfrac{4,5 - 4,2}{0,414} = 0,724\ \Omega$

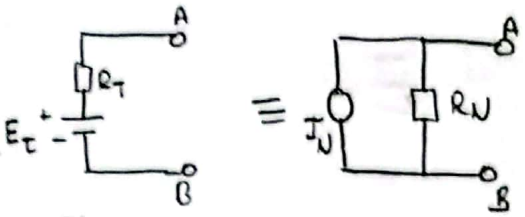
b-)



4,2 x I → 1,738 W

Akım Kaynağı

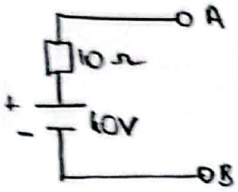




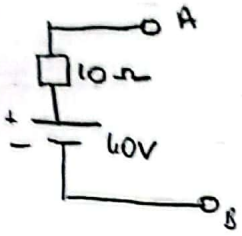
Thevenin Norton

a) Aşağıda verilen Thevenin Eşdeğerinin Norton Eşdeğerini bulunuz

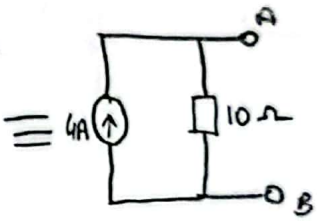
b) Her iki eşdeğer kaynağa 10Ω'luk direnç bağlayarak gerilimi ve akımı bulunuz



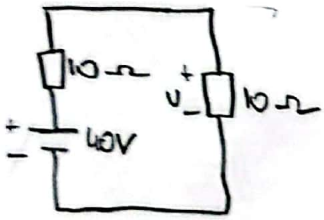
a-)



$\frac{40}{10} = 4A$

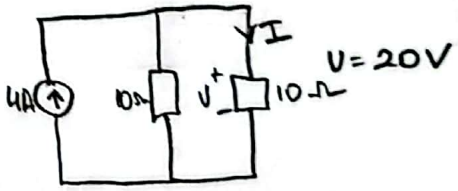


b)



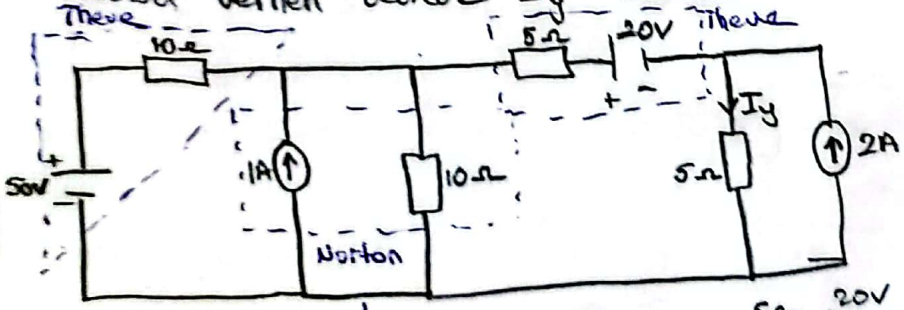
$\frac{40}{20} = 2A$

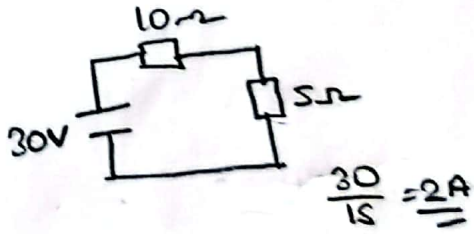
$U = 20V$



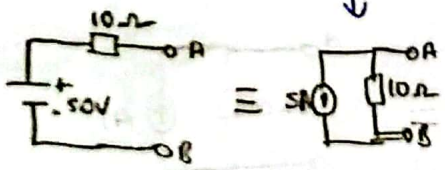
Kaynak Dönüşümü

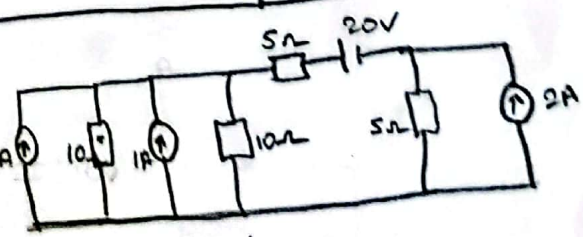
Yanda verilen devrede I_y akımını hesaplayınız

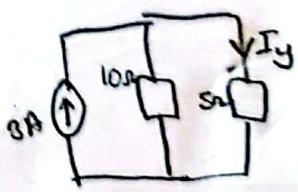




$\frac{30}{15} = 2A$

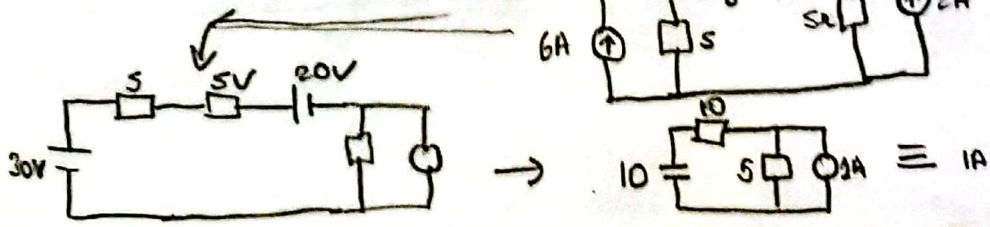




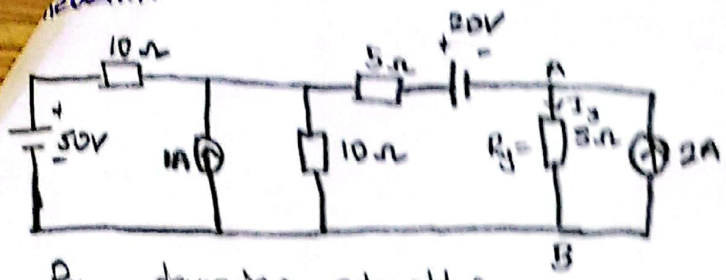


$I_y = \frac{R_n}{R_n + R_y} \cdot I_n$

$I_y = \frac{10}{15} \cdot 3 = 2A$



Thevenin Teoremi

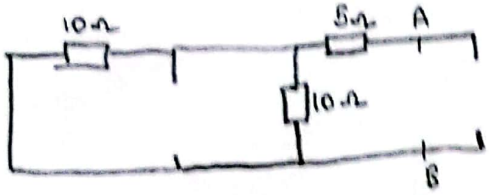


Thevenin Teoremiyle R_y nin akımını (I_y) hesaplayınız

R_y devreden çıkartılır

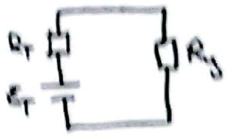
Kaynaklar devreden çıkartılıp kısa devre edilir

Akım kaynakları devreden çıkartılır yerleri açık bırakılır

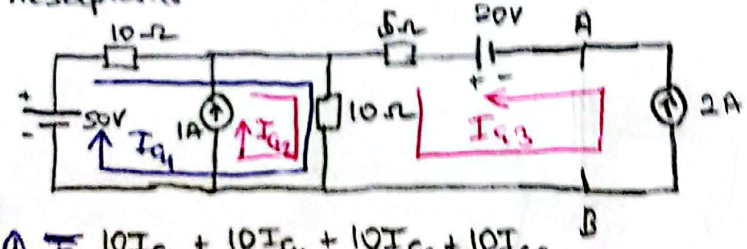


$R_{eş} = R_T$

$R_T = 10\Omega$



E_T hesabı için R_y devreden çıkartılır A-B arası gerilim hesaplanır



① $10I_{a_1} + 10I_{a_1} + 10I_{a_2} + 10I_{a_3}$

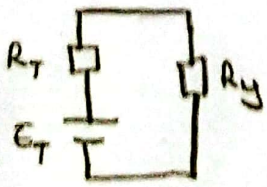
$20I_{a_1} + 10I_{a_2} + 10I_{a_3} = 50$

② $I_{a_2} = 1A$

③ $I_{a_3} = 2A$

$20I_{a_1} + \underbrace{10.1 + 10.3}_{30} = 50$ $\quad 20I_{a_1} = 20$ $\quad I_{a_1} = 1A$

$U_{AB} = E_T = 30V$



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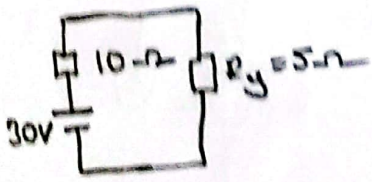
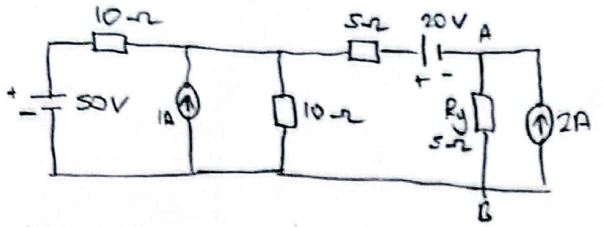


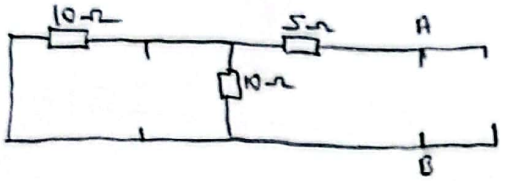
$\frac{30}{10+5} = 2A$ $\quad I_y = 2A$

Norton Teoremi



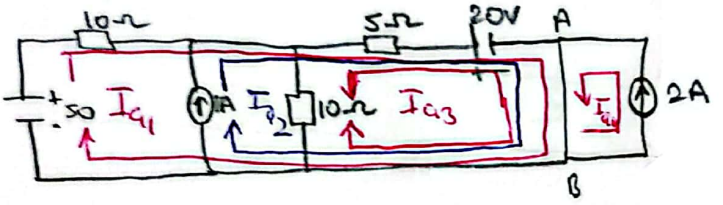
Ry devreden çıkartılır
Kaynaklar Devreden çıkartılıp Kısadevre edilir
Akım kaynakları devreden çıkarılır uçları boş bırakılır

a) $R_y = ?$



$R_y = 10\,\Omega$

b) $I_N = ?$

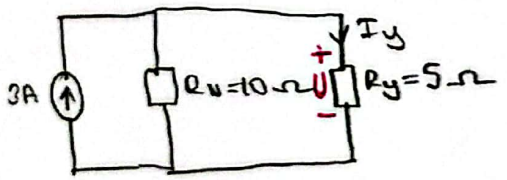


① $15I_{a1} + 5I_{a2} + 5I_{a3} + 20 - 50 = 0$
② $I_{a2} = 1A$
③ $15I_{a3} + 5I_{a1} + 5I_{a2} = -20$
④ $I_{a4} = 2A$

$I_{a1} = 2{,}5A \quad I_{a2} = 1A \quad I_{a3} = -2{,}5A$
$I_{a4} = 2A$

$I_N = I_{a1} + I_{a2} + I_{a3} + I_{a4}$

$I_N = 3A$



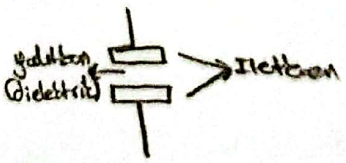
$$I_y = \frac{R_N}{R_N + R_y} \cdot I_N = \frac{10}{10+5} \cdot 3 = 2A$$

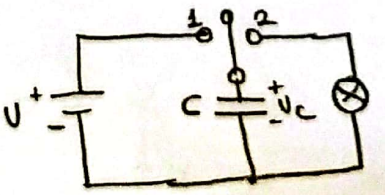
$$U = \frac{R_N \cdot R_y}{R_N + R_y} \cdot I_N \qquad I_y = \frac{U}{R_y}$$

Süperpozisyon Teoremi

Her seferinde Tek bir kaynak devrede bırakılarak çözüm yapılır, çözümlerin cebirsel toplamı Akımı verir

Kondansatör (Kapasitör)

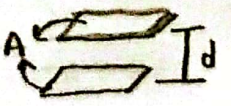




S = 0 → $V_C = 0$
S = 1 → $V_C = 0$ → Şarj → V
S = 0 → $V_C = V$
S = 2 → $V_C = V$ → Deşarj → 0
Işık çıkar

$Q = C \cdot U$ → Birimi Farad'dır $\quad F = \frac{S}{\Omega}$

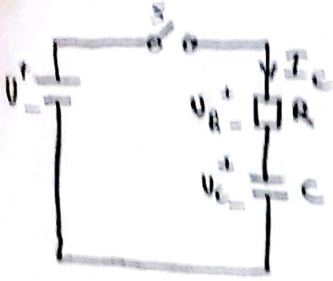
$$C = \varepsilon_0 \cdot \varepsilon_r \cdot \frac{A}{d}$$



ε_0 = boşluğun dielektrik sabiti
$\varepsilon_0 = 8{,}85 \cdot 10^{-12} \frac{F}{M}$
ε_r = Bağıl dielektrik sabiti
$\varepsilon_{r(Hava)} = 1$

Kondansatörde Biriken enerji (E_c)

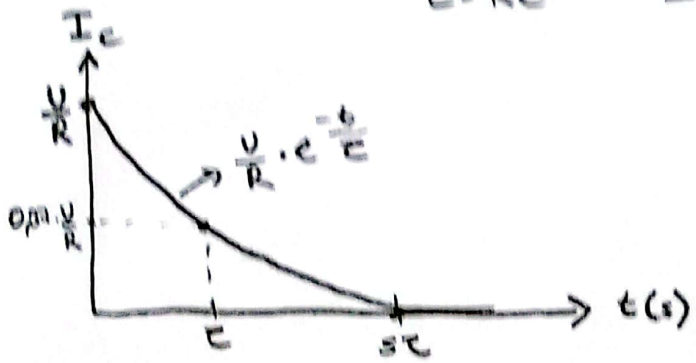
$E_c = \frac{1}{2} C \cdot U^2$

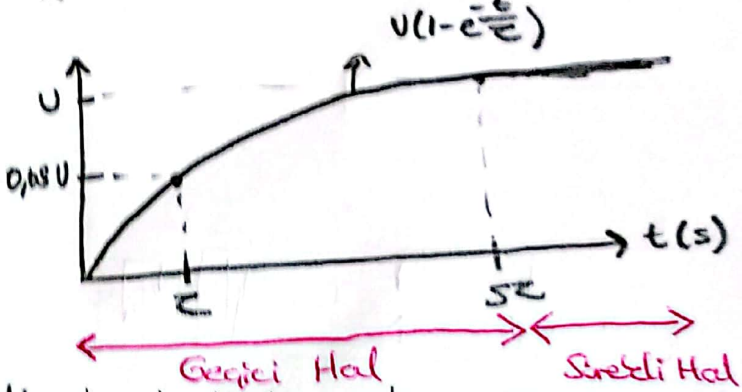


$U_R + U_c = U \rightarrow I_c \cdot R + \frac{1}{C}\int I_c dt = U$

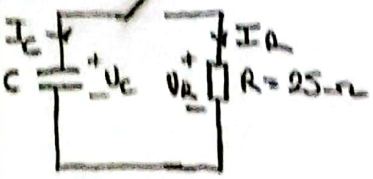
$I_c = \frac{U}{R} e^{-\frac{t}{RC}}$ $\quad U_c = U(1 - e^{-\frac{t}{RC}})$

$\tau = RC$ $\quad I_c = \frac{U}{R} e^{-\frac{t}{\tau}}$ $\quad U_c = U(1 - e^{-\frac{t}{\tau}})$





ÖRN 100 V'a doldurulmuş 1mF kapasiteli kondansatörün uçları arasına 25 Ω değerli direnç bağlanıyor Kondansatör gerilimini ve akımını zamana bağlı çiziniz



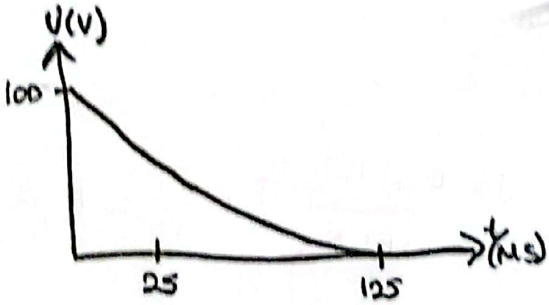
$\tau = R.C$

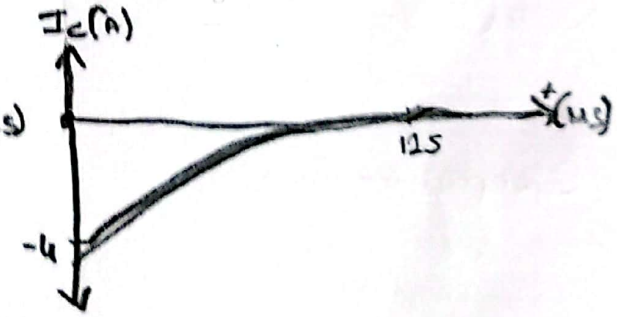
$\tau = 25 . 1 . 10^{-3} = 25 . 10^{-3} \rightarrow 25$ ms

$5\tau = 125$ ms

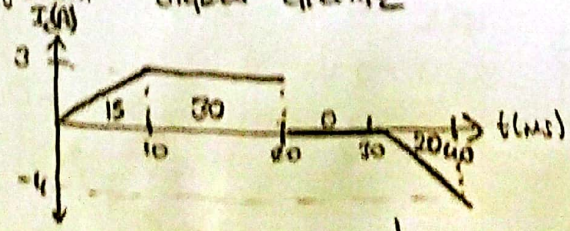
$I_c = -I_R$

$-\frac{100}{25} = -4$ A



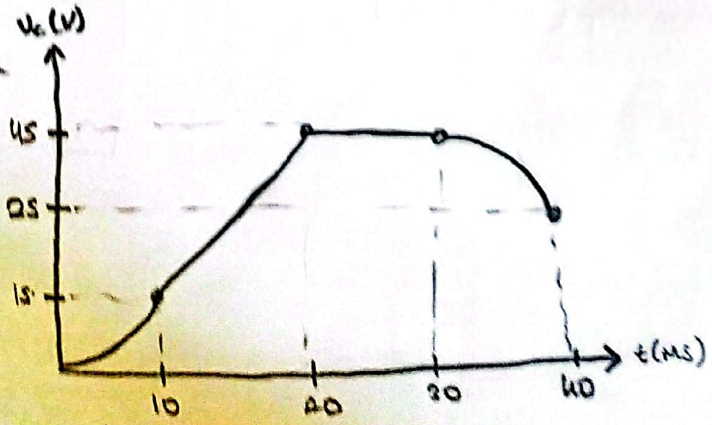


1mF değerindeki kondansatörden aşağıda verilen şekilde akım geçerse kondansatör gerilimini değişimini bağlı çiziniz



↳ integral →

Çözüm

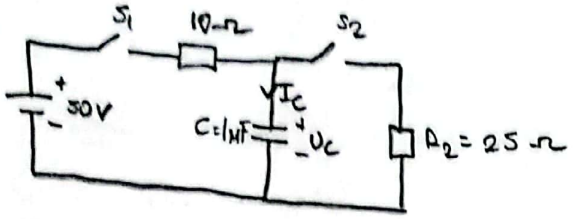


Aşağıdaki devrede $t=0$'da S_1 anahtarı kapatılıyor 60 ms sonra S_1 açılıp S_2 kapatılıyor

a) 200 ms süreçinde kondansatör gerilimini ve akımını çiziniz

b) U_c'nin 40V'dan geçtiği t değerlerini hesaplayınız

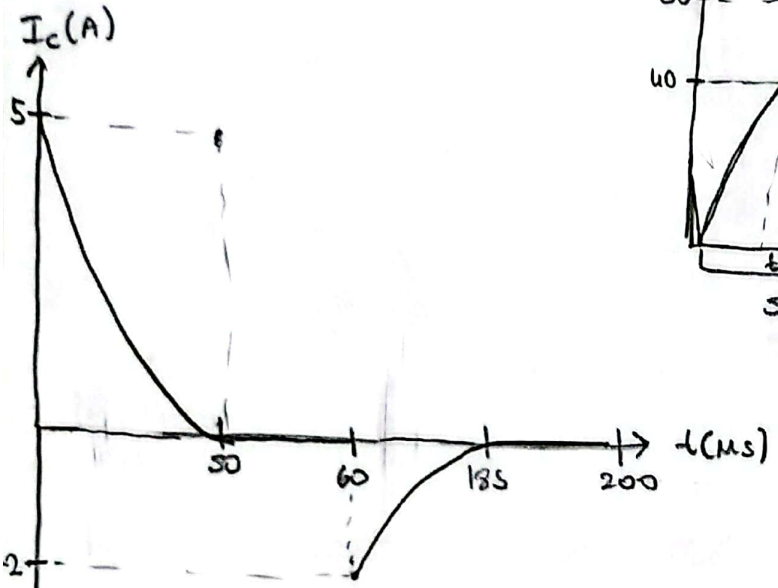
c) I_c'nin 10ms'deki ve 80 ms'deki değerlerini bulunuz

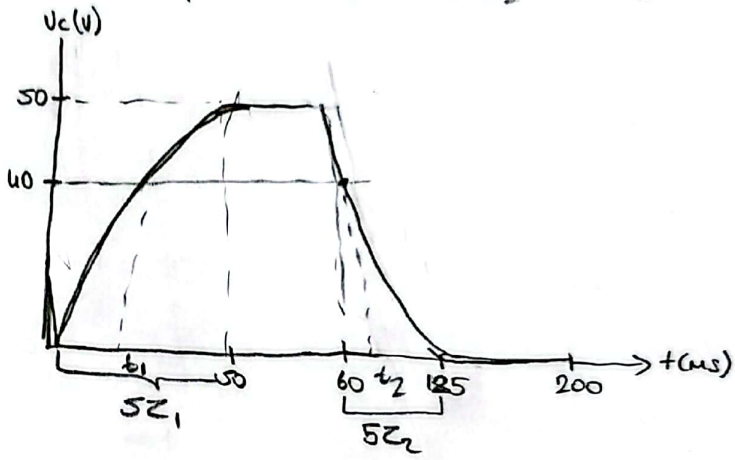


a-) $\tau_1 = R.C = 10.10^{-3} = 10ms$

$\tau_2 = R_2.C = 25ms$

$5\tau_1 = 50ms$ $5\tau_2 = 125ms$





b) $40 = U(1-e^{\frac{-t}{\tau}})$ = $40 = 50(1-e^{\frac{-t_1}{\tau}})$ = $\frac{40}{50} - 1 = (-e^{\frac{-t_1}{\tau}})$

$\frac{1}{5} = e^{\frac{-t_1}{\tau}}$ $\frac{1}{5} = e^{\frac{-t_1}{10}}$

$40 = 50\, e^{\frac{-t_2-60}{25}}$ $\ln\frac{40}{50} = \left(\frac{t_2-60}{25}\right)$ $t_2 = 65,57 sn$ $\ln\frac{1}{5} = \frac{-t_1}{10}$

$16,09 sn = t_1$

c) $5.e^{\frac{-t_1}{\tau}}$ $-2.e^{-\left(\frac{80-t_1}{25}-60\right)}$

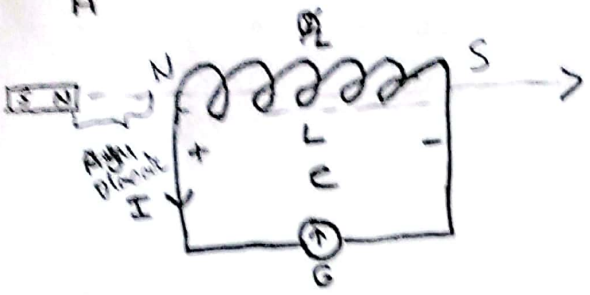
$5.e^{\frac{-10}{10}} = 1,839 A$

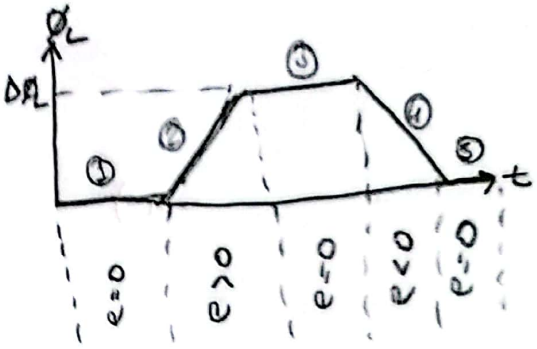
$-2.e^{\frac{-20}{25}} = -0,898 A$

Manyetik Alan

$B = \frac{\Phi}{A}$ = Tesla (T)

B → Manyetik Alan yoğunluğu



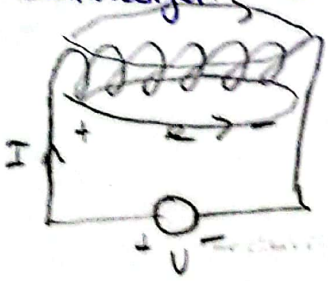


① Sabit Ucaklikta (Degisim yok)
② Mıknatıs sabit hızla bobinin içinden geçiyor
③ Mıknatıs bobin içinde sabit kalıyor
④ Sabit hızla içinden çıkıyor
⑤ Sabit uzaklıktan (Değişim yok)

İNDÜKSİYON BAĞLANTISI

$e = -N \frac{d\Phi}{dt}$ N → Sarım sayısı

Özindüksiyon ve Özindüktans



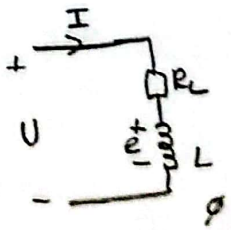
$e = -L \frac{dI}{dt}$

L = Özindüktans birimi Henry (H)

$H = \frac{V.s}{A}$

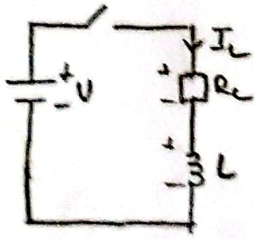
İndüktans Enerjisi

$E_M = \frac{1}{2} L . I^2$



Akı

$\Phi = k.I$

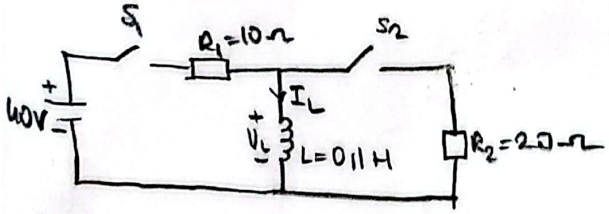


$U_R + U_L = U$

$I_L . R + L \frac{dI_L}{dt} = U$

$I_L = \frac{U}{R}(1 - e^{-\frac{t}{\tau}})$

$U_L = U . e^{-\frac{t}{\tau}}$



a) $t=0$ 'da S_1 kapatılıyor, $t=60$ ms'de S_2 kapatılıp S_1 açılıyor ilk 100ms için indüktansın akımını ve gerilimini zamana göre ölçekli çiziniz

b) $t=20$ ms'deki V_L değerini bulunuz

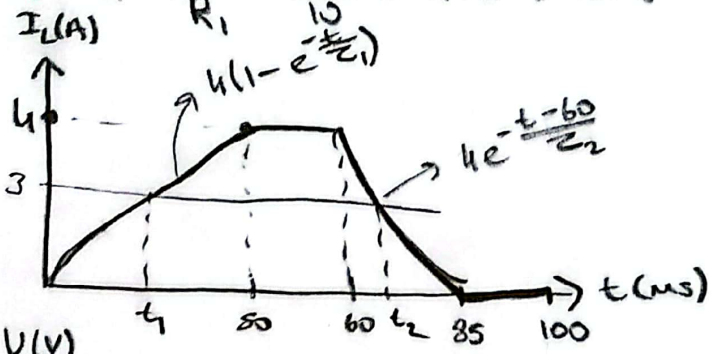
c) I_L'nin 3A'den geçtiği t değerini bulunuz

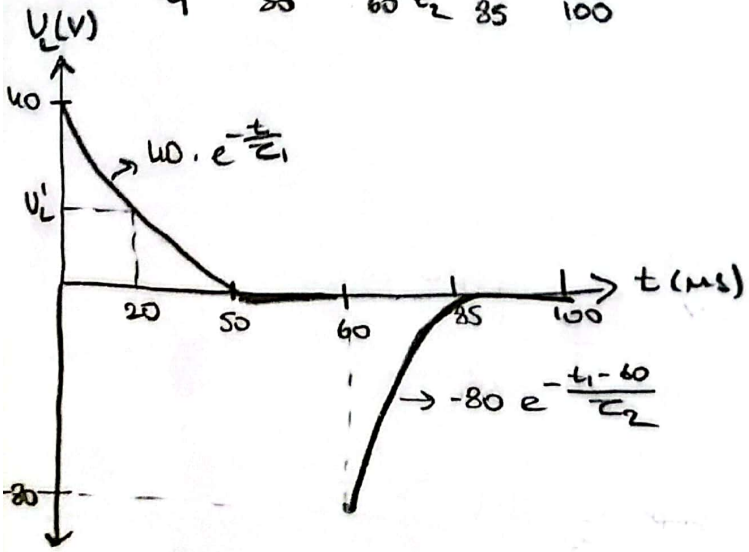
a-) $\tau_1 = \frac{L}{R_1} = \frac{0,1}{10} = 0,01 \rightarrow 10$ ms

$5\tau = 50$ ms

$\tau_2 = \frac{L}{R_2} = 0,005$ $\quad \tau_2 = 5$ ms

$5\tau_2 = 25$ ms





b-) $40 \cdot e^{-\frac{20}{10}} = 5,413$ V

c-) $3 = 4(1-e^{\frac{-t}{\tau}})$

$\frac{3}{4} - \frac{4}{4} \quad +\frac{1}{4} = e^{\frac{-t}{10}}$

$\ln\frac{1}{4} = -\frac{t}{10} \quad t = 13,86$ ms

$3 = 4e^{-\left(\frac{t_1-60}{\tau_2}\right)}$

$-\ln\frac{3}{4} = \frac{t_1+60}{5}$

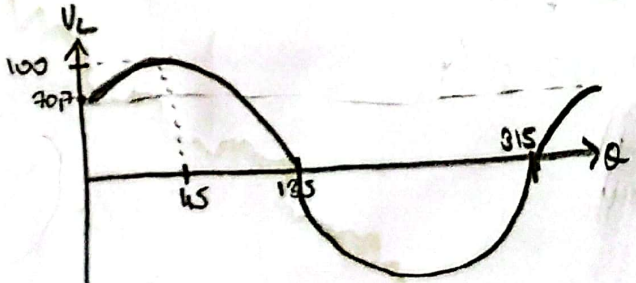
$t_2 = 61,43$ ms

$L = 1$H

$V_L = 100\sin(20t+45)$ V

V_L'yi ve I_L'yi ω'ya göre çizelim

$t=0 \quad 100\sin(45) = 70,7$ V

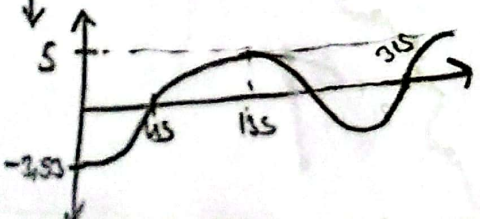


$X_L = \omega \cdot L$

$X_L = 20 \cdot 1 \Rightarrow X_L = 20\,\Omega$

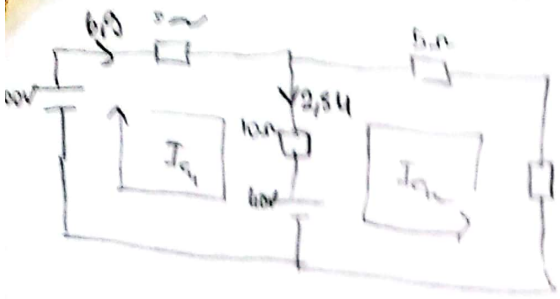
$I_{L_M} = \frac{V_M}{X_L} \quad \frac{100}{20} = 5$A

$I_L(t) = 5 \cdot \sin(\omega t - 45)$



$\omega = \frac{2\pi}{T}$ $\quad 20 = \frac{2 \cdot 3,14}{T}$

$T = 318$ (ms)



$2/\ 15I_{a_1} + 10I_{a_2} = 40$

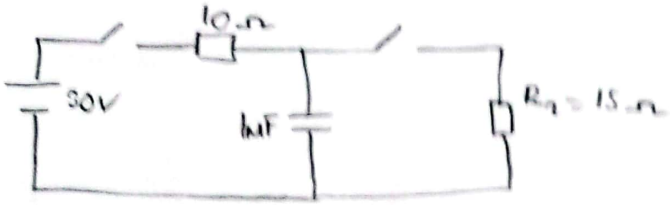
$-3/\ 25I_{a_2} + 10I_{a_1} = 40$

$30I_{a_1} + 20I_{a_2} = 120$

$-75I_{a_2} - 30I_{a_1} = 120$

$I_{a_2} = -4,36$

$I_{a_1} = 6,09$

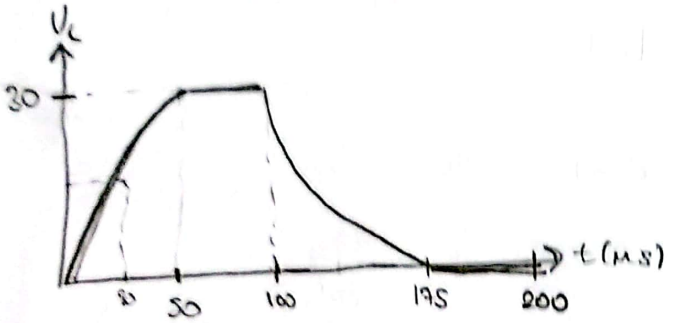


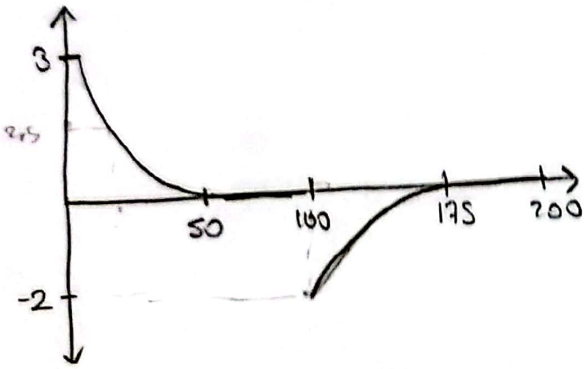
a) $\tau_1 = 10\,ms$ $\tau_2 = 15ms$

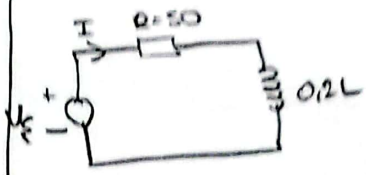
$5\tau_1 = 50\,ms$ $5\tau = 75ms$

$U_c = U(1 - e^{\frac{t}{\tau_1}})$

$I_c = I e^{-\frac{t}{\tau}}$







U_s = Şebeke gerilimi

a) Empedansı, güç katsayısını ve akımı hesaplayınız

$x_L = W \cdot L \rightarrow 0,2$ (314)

Empedans = $|z|$

$z = \sqrt{R^2 + x_L^2}$ $\sqrt{50^2 + 62,8^2}$ $z = 80,27\,\Omega$

$I = \frac{U \rightarrow 220}{|z| \rightarrow 80,27} = 2,74$

$\cos\varphi = \frac{R}{|z|} = \cos\theta = 0,62$ $\varphi = 51,63$

b) Aktif ve Reaktif Gücleri hesaplayınız

$P = U.I.\cos\varphi$ $220 \cdot 2,74 \cdot 0,62 = 373,96$

$Q = U.I.\sin\varphi$ $220 \cdot 2,74 \cdot 0,78 = 472,93$