Tugas Modul=2 Tanggal: 9-03-2024
Kelompok = 8

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1. Berapakah beda potensial berapakah sehuah elektron mulai diri diam perlu dipercepat agar mencapai nilai kecepatan 40,0% dari kecepatan cahaya? Kec. cahaya adalah $c = 3,00 \times 10^8$ m/s.

Dik: $V_i = 0 \rightarrow$ Kinetik = 0

$V_f = 0,4 \times 3 \times 10^8$ m/s

Dit: ΔV!

$W_{eksternal} = \Delta E_m + W_{gesek} + W_{interaksi}$ (=0 gas)

$0 = \Delta E_m + 0 + 0$

$\Delta E_m = 0 \rightarrow E_{Mf} - E_{Mi} = 0$

$(U_f + K_f) - (U_i + K_i) = 0$ ($U_i = 0$)

$\Delta U + K_f = 0$

$\Delta U = -K_f$ (=0 W internal: perubahan energi dalam)

#Kf: energi kinetik final

q: elektron

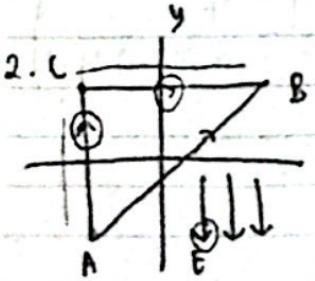
$q \cdot \Delta V = -K_f$

$\Delta V = \frac{+\frac{1}{2}mv^2}{+e}$

$= \frac{1}{2} \frac{(9,1 \times 10^{-31}\,kg)(0,4 \times 3 \times 10^8\,m/s)^2}{1,60 \times 10^{-19}\,C}$

$\Delta V = 4,0950 \times 10^4$ Volt

2. C



Medan listrik

kekuatan : 325 V/m

koor A (-0,200 ; -0,300) m (dot: silver)

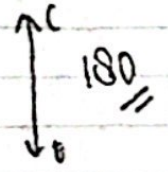
B (0, 400 ; 0, 500) m

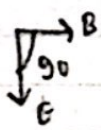
$V_B - V_A$?

$\Delta V = -\int \vec{E} \cdot d\vec{s}$

$\Delta V = -\int E \cos\theta \, ds$

$V_B - V_A = -\int_A^B \vec{E} \cdot d\vec{s}$





$= -\int_A^C E \cdot ds \cdot \cos\theta - \int_C^B E \cdot ds \cdot \cos\theta$

$= -\int_A^C E \cdot dy \cos(180°) - \int_C^B E \cdot dx \cdot \cos(90°)\, dx$

$V_B - V_A = -\int_{0,3}^{0,5} E\,dy \cdot (-1)$

$V_B - V_A = \int_{0,3}^{0,5} E\,dy$

$= 325 \int_{0,3}^{0,5} dy = 325\,(0,5 + 0,3) \Big|_{0,3}^{0,5} = 260$ V

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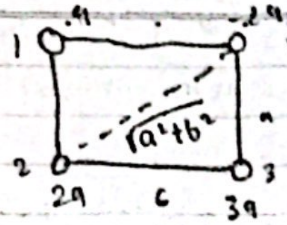
3.) 

Diket : a = 0,200 m
b = 0,400 m
q = 6,00 C
Dit = energi potensial listrik!

E. Potensial : U → banyaknya sistem

$$U = \frac{\sum k.q_1.q_2}{r}$$

(1+7)

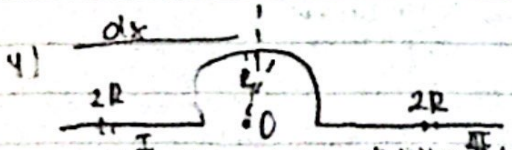
$U = U_{12} + U_{23} + U_{14} + U_{24} + U_{34}$

$= k\left(\frac{q(2q)}{a} + \frac{q(3q)}{\sqrt{a^2+b^2}} + \frac{q(-2q)}{b} + \frac{2q(3q)}{b} + \frac{2q(-2q)}{\sqrt{a^2+b^2}} + \frac{3q(-2q)}{a}\right)$

$= kq^2\left(\frac{2}{0,2} + \frac{3}{\sqrt{(0,2)^2+(0,4)^2}} + \frac{(-2)}{0,4} + \frac{6}{0,4} + \frac{(-4)}{\sqrt{(0,2)^2+(0,4)^2}} + \frac{(-6)}{0,2}\right)$

$= 8,9\times10^9\,(6)^2\left(\frac{4}{0,4} - \frac{4}{0,2} - \frac{1}{0,447}\right)$

$= -392078$

4) 

panjang berhingga

Potensial listrik di titik O!

a)	Kerapatan	1D → $\lambda = \frac{q}{L}$	→ garis
		2D → $\sigma = \frac{q}{A}$	→ garis
		3D → $\rho = \frac{q}{V}$	

$q = \lambda . L$

$dq = \lambda dL$

Potensial di titik O :

$$V = k\int_{\text{seluruh muatan}} \frac{dq}{r}$$

$V_o = V_{\text{batang kiri}} + V_{\text{½ lingkaran}} + V_{\text{batang kanan}}$

$= V_1 + V_2 + V_3$

$= k\int_{-3}^{-R} \frac{\lambda\, dx}{-x} + k\int_{0}^{\pi} \frac{\lambda\, dl}{R} + k\int_{R}^{3R} \frac{\lambda\, dx}{x}$

$= -k\lambda \ln|-x|\Big|_{-3R}^{-R} + \frac{k\lambda}{R}\int_0^{\pi} R\,d\theta + k.\lambda \ln x\Big|_{R}^{3R}$

$= k\lambda \ln\frac{3R}{R} + k\lambda.\pi + k\lambda \ln\frac{3R}{R} = 2k\lambda \ln 3 + k\lambda\pi$

$= k\lambda(\pi + 2\ln 3)$

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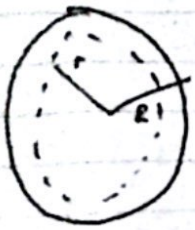
5. Dik konduktor r = 14,0 cm
q = 26,0 nC

Dit : kuat medan listrik & potensial (a) r = 10 cm
(b) r = 20,0 cm
(c) r = 14,0

V(r=0) = 0

a) di r = 10 cm



E = 0 → konduktor

$\oint E\,dA = \frac{q_{enc}}{\varepsilon_0}$

$E \cdot 4\pi r^2 = \frac{0}{\varepsilon_0}$

E = 0

•) potensial listrik

$\Delta V = -\int E\,dr$

$V(r) - V(\infty) = -\int_{\infty}^{r} E\,dr$

$V(r) - 0 = -\int_{\infty}^{R} E\,dr - \int_{R}^{r} E\,dr$ (→ 0)

r > R

$\oint E\,dA = \frac{q_{enc}}{\varepsilon_0}$

$E \cdot 4\pi r^2 = \frac{q}{\varepsilon_0}$

$E = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q}{r^2}$]

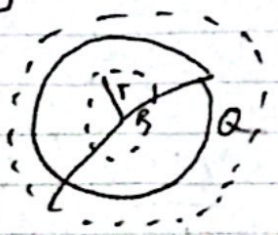
$V(r) = -\int_{\infty}^{r} k \cdot \frac{q}{r^2}\,dr$

$V(r) = -k \cdot q \int_{\infty}^{R} \frac{dr}{r^2}$

$= -kq \left(-\frac{1}{r}\right)\Big|_{\infty}^{R}$

$V = \frac{kq}{R} = \frac{8,9 \times 10^9 (26 \times 10^{-6})}{0,14} = 1,67 \times 10^6$ Volt

b) Medan listrik di r = 20 cm



$\oint E\,dA = \frac{q_{enc}}{\varepsilon_0}$

$E 4\pi r^2 = \frac{q}{\varepsilon_0}$

$E = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q}{r^2}$

$= \frac{8,9 \times 10^9 (26 \times 10^{-6})}{(0,20)^2} = 5,04 \times 10^6$ N/C

E → menjauh secara radial dari pusat bola

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Potensial listrik

$$\Delta V = -\int_{\infty}^{r} E\, dr$$

$$V(r) - V(\infty) = -\int_{\infty}^{r} E\, dr$$

$$V(r) = -\int_{\infty}^{r} \frac{kq}{r^2} dr$$

$$= -kq \left[\frac{-1}{r}\right]_{\infty}^{r}$$

$$V_{(20\,cm)} = \frac{kq}{r} = \frac{(9 \times 10^9)(26 \times 10^{-6})}{(0{,}20)}$$

$$V_{(20\,cm)} = 1{,}17 \times 10^6\ V$$

c) r = 14 cm → medan listrik :

$$\oint E = \frac{q}{\varepsilon_0}$$

E searah Radial (pusat bola)

$$E\, 4\pi r^2 = \frac{q}{\varepsilon_0}$$

$$E = \frac{q}{4\pi\varepsilon_0 R^2}$$

$$= \frac{9 \times 10^9 (26 \times 10^{-6})}{(0{,}14)^2}$$

$$E = 11{,}9 \times 10^6\ N/C$$

Potensial listrik

$$\Delta V = -\int_{\infty}^{r} dr$$

$$= -k.q \int_{\infty}^{r} \frac{dr}{r^2} = \frac{kq}{R}$$

$$V_0 = \frac{kq}{R}$$

$$V = \frac{kq}{R} = \frac{9 . 10^9 (2{,}6 \times 10^{-6})}{0{,}14}$$

$$= 1{,}67 \times 10^6\ V$$

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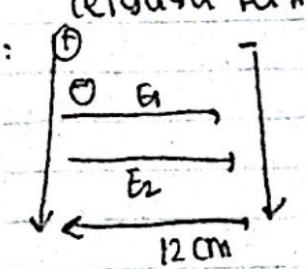
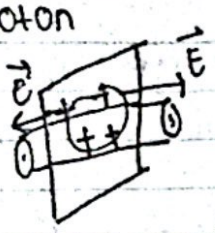
6. Dua buah plat sejar yg sama besar tetapi berlawanan tanda, dipisahkan sejauh 12,0 cm. Setiap pelat ✓kerapatan ~~kerapatan~~ muatan permukaan 36,0 nC/m
Sebuah proton dari keadaan diam di pelat positif.
Tentukkan (a) beda potensial antar plat
(b) energi proton saat mencapai pelat negatif
(c) kecepatan proton sesaat sebelum menumbuk pelat negatif
(d) percepatan proton
(e) gaya pd proton

jawab:





$\Phi_{total} = \Phi_{alas} + \Phi_{selimut} + \Phi_{tutup}$

$\Phi = \vec{E} \cdot A\hat{n}$ A normal

#proton akan ketarik bergerak ke lempeng positif

$\Phi_1 = -E\hat{i} \cdot A(-\hat{i}) = EA$

$\Phi_2 = -E\hat{i} \cdot A(\hat{n}) = 0$ ✓selimut

$\Phi_3 = EA$

$\Phi_{total} = EA + 0 + EA + 2EA$

$\Phi_{total} = \frac{q_{enc}}{\varepsilon_0}$

$2EA = \frac{\sigma A}{\varepsilon_0} \rightarrow \boxed{|E| = \frac{\sigma}{2\varepsilon_0}}$

$|E| = \frac{36 \times 10^{-9}\ C/m^2}{2(8{,}85 \times 10^{-12}\ C^2/Nm^2)}$

$= 2{,}03 \times 10^3\ N/C$

E total (diantara 2 plat) $\rightarrow E = E_+ + E_-$

$= \frac{\sigma}{2\varepsilon_0} + \frac{\sigma}{2\varepsilon_0}$

$= 2{,}03 \times 10^3 + 2{,}03 \times 10^3$

$|E| = 4{,}06 \times 10^3\ N/C$

a) $\Delta V = -\int E\,dx$

Misalkan V=0 pada plat (-)

potensial pada plat positif adalah:

$V - 0 = -\int_0^{12cm} [-4{,}07 \times 10^3]\,dx$

$= 4{,}07 \times 10^3 \times \Big|_0^{12cm}$

$= 4{,}07 \times 10^3 (0{,}12) = 488\ V$

JOYKO 35 Lines 8 mm

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b) tidak ada hambatan, tidak ada gaya luar
maka berlaku $\Sigma EM = 0$

$EM_F - EM_i = 0$

$EM_i = EM_F$

$(K+U)_i = (K+U)_F$

$(0 + qV)_i = (\frac{1}{2}mv^2 + 0)_F$

$(qV) = \frac{1}{2}mv^2$

$U = qV = 1,6\times10^{-19}\,C\,(400\,V)$

$= 7,8\times10^{-17}\,J$

↓

energi proton
saat mencapai plat negatif

c) kita tahu

$qV = \frac{1}{2}mv^2$

$v = \sqrt{\frac{2qV}{m}}$

$= \sqrt{\frac{2(7,8\times10^{-17})}{1,67\times10^{-27}}}$

$v = 3,06\times10^5\ m/s$

d) $v_f^2 = v_i^2 + 2a(x_f - x_i)$ ($v_i = 0$)

$(3,06\times10^5)^2 = 2a(0,12) \rightarrow a = 3,9\times10^{11}\ m/s^2$

e) $F = m.a$

$= 1,6\times10^{-27}\,(3,9\times10^{11})$

$= 6,51\times10^{-16}\,N$ //

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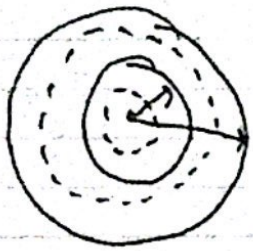
7.) $r_1 = 15{,}0$ cm
$q_1 = 10{,}0$ nC
$r_2 = 30{,}0$ cm
$q_2 = 15{,}0$ nC
Ditanya) Muatan listrik E
b) Potensial listrik V di A, B & C
$V = 0$
$r = \infty$



a) (i) daerah A

$$\oint EdA = \frac{q_{enc}}{\varepsilon_0} \rightarrow E4\pi r^2 = \frac{0}{\varepsilon_0} \rightarrow E = 0$$

(ii) daerah B

$$\oint EdA = \frac{q_{enc}}{\varepsilon_0}$$

$$E4\pi r^2 = \frac{q_{enc}}{\varepsilon_0}$$

$$E = k \cdot \frac{\varepsilon_0}{r^2}$$

$$E = \frac{8{,}9 \times 10^9 \cdot 10 \cdot 10^{-19}}{r^2}$$

$$E_B = \frac{89{,}9}{r^2} \ V/m$$

(iii) daerah C

$$\oint EdA = \frac{q_{enc}}{\varepsilon_0}$$

$$E4\pi r^2 = \frac{q_1 + q_2}{\varepsilon_0}$$

$$E = k\frac{(q_1 + q_2)}{r^2}$$

$$= 8{,}9 \times 10^9 (10 \times 10^{-9} + 15 \times 10^{-9})/r^2$$

$$E_C = \frac{224{,}75}{r^2} \ V/m$$

b) Potensial listrik

(i) daerah C

$$\Delta V = -\int_{\infty}^{r} E\,dr \rightarrow V - 0 = -\int_{\infty}^{r} \frac{224{,}15}{r^2}\,dr$$

$$= -224{,}15 \int_{\infty}^{r} \frac{dr}{r^2} = -224{,}15 \left[-\frac{1}{r}\right]_{\infty}^{r}$$

$$V = \frac{224{,}75}{r}$$

$r_2 = 30\ cm$

$V = \frac{224,75}{0,3} = 749\ volt$

(ii) untuk daerah B

$\Delta V = -\int_{\infty}^{r} E\,dr$

$V_{B-0} = -\int_{\infty}^{r_2} E\,dr - \int_{r_2}^{r} E\,dr$

$= (749) - \int_{r_2}^{r} \frac{899,9}{r^2}\,dr$

$= 749 + 899 \left(\frac{1}{r} - \frac{1}{0,3}\right)$

$= \left(1048 + \frac{899,9}{r}\right) V$

(iii) untuk daerah A

$\Delta V = -\int_{\infty}^{r} E\,dr$

$V_{A-0} = -\int_{\infty}^{r_1} E\,dr - \int_{r_2}^{r_1} E\,dr - \int_{r_1}^{r} E\,dr \hookrightarrow 0$

$V_A = 749 \left[1048 + \frac{899,9}{0,15}\right] - 0$

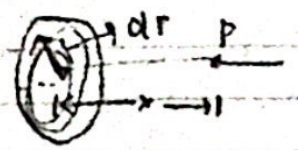
$\boxed{V_A = 2396,3\ V}$

8) Sebuah piringan tipis jari-jari R punya kerapatan muatan permukaan tidak seragam $\sigma = Cr$.

C = konstanta

r = pusat piringan

Tentukanlah (integrasi langsung) potensial di P



Jawab: $\sigma = \frac{q}{A}$

$q = \sigma . A$

$dq = \sigma\, dA \Rightarrow dq = \sigma(2\pi r\,dr)$

$A = \pi r^2$

$dA = 2\pi r\,dr$

$dV = K \cdot \frac{dq}{r}$

$= K \frac{\sigma(2\pi r\,dr)}{\sqrt{a^2 + r^2}}$

Potensial di P $V = \int K \frac{dq}{\sqrt{x^2+r^2}}$

$= K \int \frac{\sigma (2\pi r dr)}{\sqrt{x^2+r^2}}$

$V_P = KC \int \frac{2\pi r^2 dr}{\sqrt{x^2+r^2}}$

$= 2\pi K C \int \frac{r^2 dr}{\sqrt{x^2+r^2}}$

$V_P = 2\pi \rho C \left[R\sqrt{R^2+x^2} + x^2 \ln\left(\frac{x}{R+\sqrt{R^2+x^2}} \right) \right]$

9.) Dik : I = 30A

Dit = Berapa banyak elektron yang menumbuk layar tabung selama 40s?

$I = \frac{\Delta Q}{\Delta t}$

$\Delta Q = I \cdot \Delta t$

$= 30 \cdot 40 = 1200$ C

$N = \frac{\Delta Q}{e} = \frac{1200}{1,6 \times 10^{-19} C}$

$= 7,5 \times 10^{17}$ elektron

10.) Dik = $A = 2\ cm^2 = 2 \times 10^{-4}\ m^2$

$q = 4t^3 + 5t + 6$

Dit = a. Arus sesaat yang melalui permukaan $t = 1s$

$I = \frac{dq}{dt} = \frac{d}{dt}(4t^3 + 5t + 6)$

$= 12t^2 + 5$

$I(1) = 12 \cdot 1 + 5$

$= 17$ A

B. Rapat arus?

$J = \frac{I}{A} = \frac{17}{2 \times 10^{-4}\ m^2}$

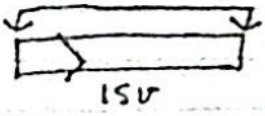
$= 8,5 \times 10^4$ A/m

11.) Sebuah resistor dibuat dari batang karbon. Luas penampang seragam 5,00 mm^2. Ketika beda potensial 15,0 V diterapkan pada ujung batang dan panjang batang. Ke arus sebesar $4,00 \times 10^{-3}$ A mengalir pada batang.

(a) hambatan batang!

(b) panjang batang!

Resistivitas karbon: $4,0 \times 10^{-5}\ \Omega m$

↳ 

a) $R = \frac{\Delta V}{I} = \frac{15\ V}{4 \times 15^3 A}$

$R = 3750\ \Omega$

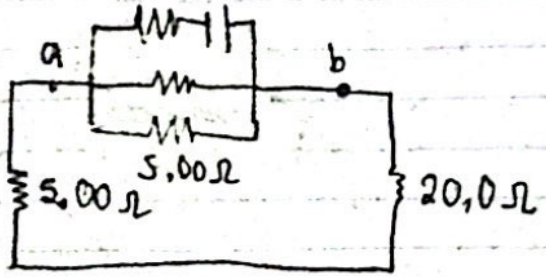
$\boxed{R = 3,7 \times 10^3\ \Omega}$

b) $R = \frac{\rho l}{A}$

$l = \frac{R.A}{\rho} = \frac{(3,75 \times 10^3\ \Omega)(5 \times 10^{-6}\ m^2)}{4 \times 10^{-5}\ \Omega m}$

$l = 4,68 \times 10^2\ m$

$= 468,7\ m$

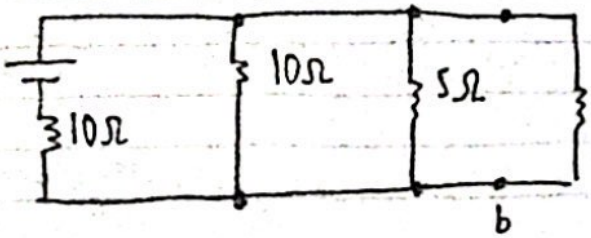
12.) 

a) arus nank 2,0

b) Beda potensial?

5 Ω dan 20 Ω → seri

$R_P = 20 + 5 = 25\ \Omega$



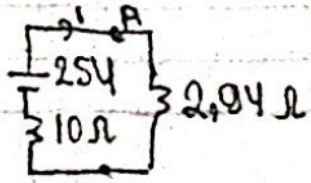
paralel: beban sama

.... gambar II

$\frac{1}{R_{P_1}} = \frac{1}{10} + \frac{1}{5} + \frac{1}{25}$

$R_{P_2} = 2,94\ \Omega$

↳ Rangkaian menjadi



$R_P = 10\ \Omega + 2,94\ \Omega$

$= 12,94\ \Omega$

Arus yang melalui baterai adalah: $I = \frac{\Delta V}{R_p} = \frac{25\,V}{12{,}94\,\Omega} = 1{,}93\,A$

pada gambar (1)
arus 1,93 A
$R = 2{,}94\,\Omega$
memberikan beda potensial

"seri = arus sama"

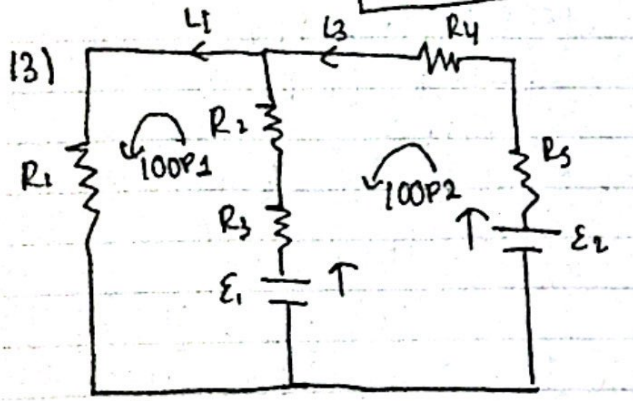
$\Delta V = I \cdot R_{P_2}$
$= 1{,}93\,A\,(2{,}94\,\Omega)$
$= 5{,}68\,V$

a) pada gambar kedua (2) beda potensial sama yg melalui
$R = 5\,\Omega$ & $R = 10\,\Omega$
$\Delta V_{ab} = 5{,}68\,V$

b) karena arus yang melalui 20 Ω juga melalui 25 Ω pada ab

$I = \frac{\Delta V_{ab}}{R_{ab}} = \frac{5{,}68\,V}{25\,\Omega}$
$= 0{,}227\,A$
$I = 227\,mA$

3)



$R_1 = 0\,\Omega$ $R_4 = 9\,\Omega$
$R_2 = 5\,\Omega$ $R_5 = 1\,\Omega$
$R_3 = 1\,\Omega$ $\varepsilon_1 = 4\,V$
$\varepsilon_2 = 12\,V$

$i_1 + i_2 = i_3$
$i_2 = i_3 - i_1$

LOOP1
$\varepsilon_1 + i_2 \cdot R_3 + i_2 \cdot R_2 - i_1 \cdot R_1 = 0$
$4 + i_2 + 5i_2 - 8i_1 = 0$
$6i_2 - 8i_1 = -4$
$3i_2 - 4i_1 = -2$
$3i_3 - 3i_1 - 4i_1 = -2$
$-7i_1 + 3i_3 = -2 \times 5$

$-35i_1 + 15i_3 = -10$
$9i_1 - 15i_3 = -12$ +
$-26i_1 = -22$
$i_1 = 0{,}85\,A$

$3i_1 - 5i_3 = -4$

$3 \cdot 0{,}85 - 5i_3 = -4$

$2{,}55 - 5i_3 = -4$

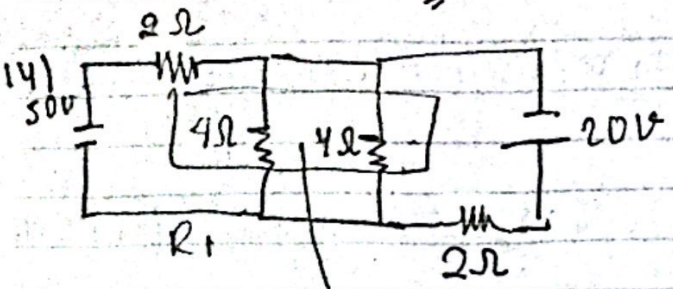
$-5i_3 = -6{,}55$

$i_3 = 1{,}31\ A$

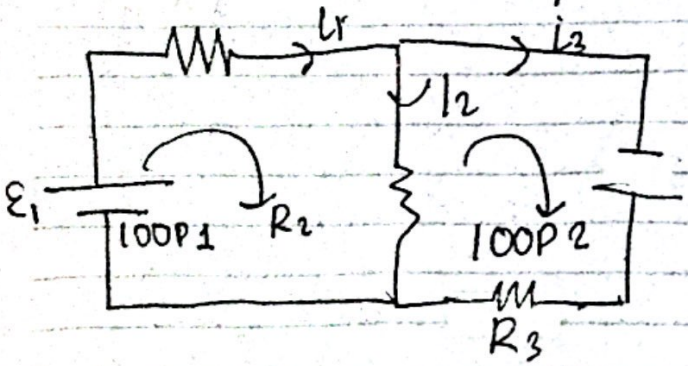
$i_2 = i_3 - i_1$

$= 1{,}31 - 0{,}85$

$= 0{,}46\ A$



$\frac{1}{R} = \frac{1}{4} + \frac{1}{4} = \frac{2}{4} = \frac{1}{2}$ → $R = 2\ \Omega$



$\varepsilon_1 = 50v$ $R_1 = 2\ \Omega$

$\varepsilon_2 = 20v$ $R_2 = 2\ \Omega$

$R_3 = 2\ \Omega$

LOOP 1 $i_1 = i_2 + i_3$

$\varepsilon_1 - i_1 \cdot R_1 - i_2 \cdot R_2 = 0$

$50 - 2i_1 - 2i_2 = 0$

$50 - 2i_1 - 2i_1 + 2i_3 = 0$

$-4i_1 + 2i_3 = 50$

$4i_1 - 8i_3 = -40$ +

$-6i_3 = -90$

$i_3 = 15\ A$

$i_1 - 2i_3 = -10$

$i_1 - 30 = -10$

$i_1 = 20\ A$

LOOP 2 $i_1 - i_3$

$\varepsilon_2 - i_3 \cdot R_3 + i_2 \cdot R_2 = 0$

$20 - 2i_3 + 2i_2 = 0$

$20 - 2i_3 + 2i_2 - 2i_3 = 0$

$2i_3 - 4i_3 = -20$

$i_3 - 2i_3 = -10 \times 4$

$4i_3 - 8i_3 = -40$

$i_2 = i_1 - i_3$

$= 20 - 15 = 5\ A$

LOOP 2:

$\varepsilon_2 - i_3 \cdot R_5 - i_3 \cdot R_4 - i_2 \cdot R_2 - i_2 \cdot R_3 - \varepsilon_1 = 0$

$i_2 - i_3 - 3i_3 - 5i_2 - i_2 - 4 = 0$

$-6i_2 - 4i_3 = -8$

$-3i_2 - 2i_3 = -4$

$-3i_2 + 3i_2 - 2i_3 = -4$

$3i_1 - 5i_3 = -4 \times 3$

$9i_1 + 5i_3 = -12$

$P_1 = i_1 - V_1 = i_1^2 \cdot R_1$

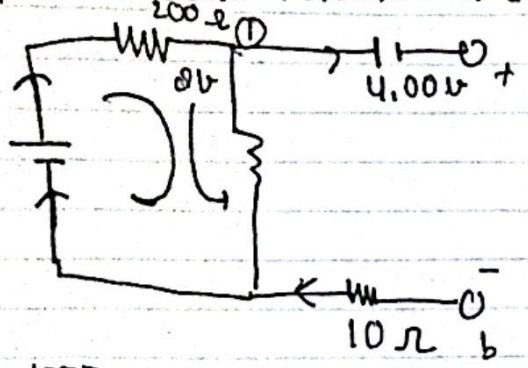
$= 20^2 \cdot 2 = 800\ W$

Pd $4\Omega = \left|\frac{12}{2}\right|^2 = 75\ W$

Separuhnya i_2 karena paralel

$P_3 = i_3^2 \cdot R_3 = 15^2 \cdot 2 = 450\ W$

15.) Hitung Beda potensial a & b



LOOP

$\Sigma\mathcal{E} = \mathcal{E}IR$

$12 = 2I + 4I$

$I = 2V$

$4V + V_{ab} + (D)(10\,\Omega) - (2A)(4\,\Omega) = 0$

$V_{a-b} = 8V - 4V$

$= 4V$

V di titik A lebih tinggi potensialnya //