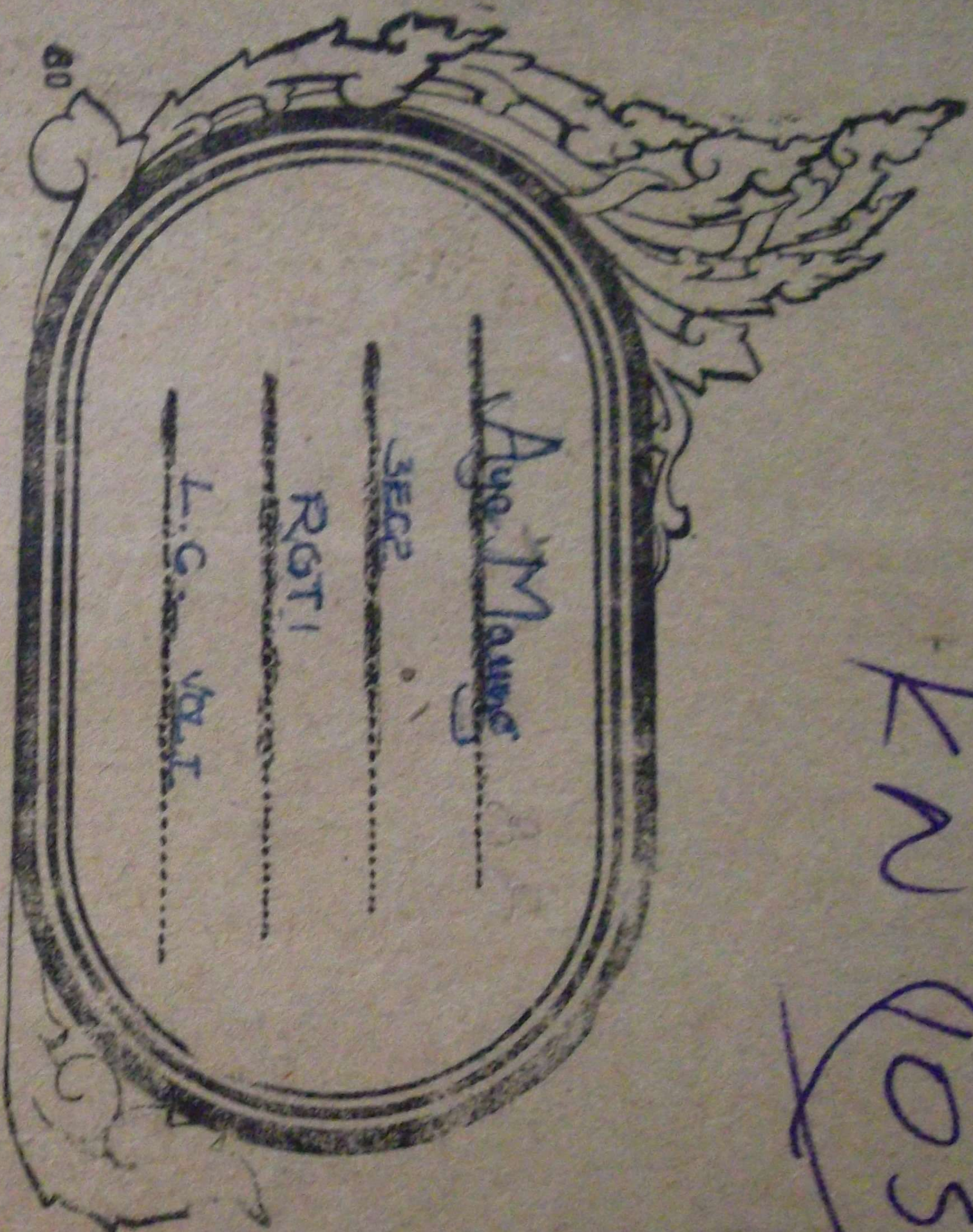


c ①

KN 105-



✓

LC 10192 CALCULATIONS.

Vocational Training

Imp: $\rightarrow$ CO of 15 jobs $\rightarrow$ Final ~~Ans~~

U Myo Lwin
(Dep. Head)
Line Communication

111102

DCA

Departments of Civil Aviation

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Complex algebra

In solving problems,
if not done, use vector

Complex Number $z = e^{i\theta}$

$$= F \sin \theta + F_j \sin \theta.$$

$+j = |F| \angle 0^\circ$ (polar)
 $|F|$ $\xrightarrow{\text{factor}}$ deg.

$\left\{ |F| \angle 0^\circ = -|F| \angle \pm 180^\circ \right\}$ I know well.

$$e^{e+j1} \rightarrow \begin{matrix} \pi \rightarrow 180^\circ \\ 1 \rightarrow 0^\circ \end{matrix}$$

CHAP	TITLE	DATE	PAGE	RMK.
I	OPENING FOR J-PLAYING (EX1)	10.11.82.	3-4	AT ALL.
II	MESH CURRENT METHOD (EX2)	24.11.82.	11-15	YES BUT NO
III	NETWORK TRANSFORMATION (EX3)	25.11.82.	16-21	IKW
IV	THE LATTICE NETWORK (EX4)	2.12.82	26-28	OK.
V	SUPER. POSITION THEOREM (EX5)	13.12.82.	29-30	YES.
VI	THEVENIN'S THEOREM	16.12.82	35	A LOT
VII	NORTON'S THEOREM (EX6)	16.12.82	36	A LOT
VIII	MAX POWER TRANSFER THEOREM (EX7)	23.12.82.	42.	IKW.
IX	NOISE, DECIBEL, & REF. LEVEL (EX8)	19.1.83.	57	IKW.
X	CHARACTERISTIC IMPEDANCE (EX9)	9.2.83	68.	
XI	PRO AND ATTENUATOR (EX9)	16.2.83.	73.	
XII	EX-10 GENERAL	23.2.83.	78.	IKW.
	FIRST TERM COURSE ENDED IN	LC THEORY (BACK).		

Filter / Section T II composite etc
 Telephone / long line system / panel system
 all relay / cross bar and
 Telegraphy
 Telephone repeater / 21 type repeater
 carrier telephone
 simultaneous telephone & telegraphy
 Teleprinter

CHAPTER 2 (J-PLAYING OPENING)

Changing ^{into} Polar Form ($\bar{A} = |A| \angle \theta$) from Rectangular Form ($A = a + jb$) by using Slide Rule

0-11.11.82.

- ကောက်၍ နှစ်ဘက် component သည် နှစ်ဘက် component $\frac{1}{\sqrt{2}}$ နှင့် ပြောင်းလဲသည်။
 နှစ်ဘက် component သည် slide rule normal operation စတင်သည်။
 $3 + j4 = 5 \angle 53.1^\circ$, $4 + j3 = 5 \angle 36.9^\circ$
- ကောက်၍ နှစ်ဘက် component သည် နှစ်ဘက် component $\frac{1}{\sqrt{2}}$ နှင့် ပြောင်းလဲသည်။
 $\frac{1}{\sqrt{2}}$ နှစ်ဘက် component $\frac{1}{\sqrt{2}}$ scale ကို သုံးသပ်သည်။ နှစ်ဘက် component ကို magnitude နှင့်
 စာသုံးပါ။
 (a) $0.3 + j4 = 4 \angle 85.7^\circ$, (b) $\frac{4}{100}$, (c) $0.3 \angle 0.6^\circ$.
 (d) $4 + j0.3 = 4 \angle 4.3^\circ$, (e) $0.5 + j7 = 7 \angle 85.9^\circ$, (f) $7 + j0.5 = 7 \angle 4.1^\circ$.
- ကောက်၍ နှစ်ဘက် component သည် နှစ်ဘက် component $\frac{1}{\sqrt{2}}$ နှင့် ပြောင်းလဲသည်။
 နှစ်ဘက် component သည် နှစ်ဘက် component $\frac{1}{\sqrt{2}}$ နှင့် ပြောင်းလဲသည်။
 $900 + j7 = 900 \angle 0.4^\circ$ ($\cos 0 = 1 = \cos 0^\circ$)
 $7 + j900 = 900 \angle 90^\circ$ ($\sin 90 = 1 = \sin 90^\circ$)

$j = \sqrt{-1}$
 $j^2 = -1$

EX 1 & 2 (10 PROBLEMS.)

- Ex ① $100 \angle 53.2^\circ \times \frac{50 \angle 30^\circ}{8 - j6}$, ② (a) $(3 - j7)^2$,
 (b) $(100 \angle 63^\circ)^2$, (c) $(3 - j7) + (100 \angle 63^\circ)$.
- ③ Resistance 0.05 ohm inductive reactance 0.01 H ဖြစ်သော နှစ်ဘက် component
 60 Hz ဆက်သွယ်လိုက်သည်။ ကောက်၍ သဘာဝ 0.05 - j 12.9 ဖြစ်သည်။ ၆၀ Hz ကို
 polar form ပြန်သည်။ နှစ်ဘက် component သဘာဝ ပုံစံ ပြန်သည်။
- ④ resistance 3 ohm inductive reactance 4 ohm ဖြစ်သော နှစ်ဘက် component
 110V ဖြစ်သော နှစ်ဘက် component သဘာဝ ပုံစံ ပြန်သည်။ ၁၀ ဖြစ်သော နှစ်ဘက် component
 သဘာဝ ပုံစံ ပြန်သည်။ polar form, rectangular form, power ပုံစံ ပြန်သည်။

5) emf $\bar{E} = 80 - j60$ and current $\bar{i} = 6 + j8$ in a circuit. Find the average power in the circuit.
 Given: $\bar{E} = 80 - j60$ and $\bar{i} = 6 + j8$
 Average power $P = \frac{1}{2} \text{Re}(\bar{E} \bar{i}^*)$
 $\bar{E} = 100 \angle -36.9^\circ$ and $\bar{i} = 10 \angle 53.1^\circ$
 $P = \frac{1}{2} \times 100 \times 10 \cos(90^\circ) = 0$
 Answer: 0 W

1) $\frac{100 \angle 53.1^\circ}{8 - j6} \times \frac{50 \angle 30^\circ}{10 \angle -36.9^\circ}$
 $= \frac{5000 \angle 89.1^\circ}{10 \angle -36.9^\circ}$
 $= 500 \angle 126.0^\circ = -250 + j433$

2(a) $(3 - j7)^2 = (9 - 49 - 42j) = -40 - 42j$
 $= 52 \angle -133.6^\circ$
 $= (7.6 \angle 133.6^\circ)^2 = 57.8 \angle 267.2^\circ = -39.8 - j41.8$

2(b) $(100 \angle 63^\circ)^2 = 10000 \angle 126^\circ = -5878 + j8085$

2(c) $(3 - j7) + (100 \angle 63^\circ) = 3 - j7 + 45.45 + j39.1$
 $= 48.45 + j32.1 = 55.2 \angle 33.4^\circ$

3) $\bar{E} = 100 \angle -36.9^\circ$
 $\bar{i} = 6 + j8 = 10 \angle 53.1^\circ$
 $Z = 3 + j4 = 5 \angle 53.1^\circ$
 $\bar{E} = \bar{i} Z = 10 \angle 53.1^\circ \times 5 \angle 53.1^\circ = 50 \angle 106.2^\circ$
 $\bar{E} = 50 \angle 106.2^\circ = -25 + j43.3$

225 $3.8 \rightarrow 2100W$
 $P = I^2 R = (14.64)^2 \times 10.49 = 2250W$
 $P = VI \cos \theta = 153.4 \times 14.64 \cos(61.7 - 40.64) = 2092W$

4) $\bar{E} = 110 \angle 30^\circ$
 $Z = 3 + j4 = 5 \angle 53.1^\circ$
 $\bar{i} = \frac{\bar{E}}{Z} = \frac{110 \angle 30^\circ}{5 \angle 53.1^\circ} = 22 \angle -23.1^\circ A$
 $\bar{i} = 20.24 - j8.635 A$

AC power loss $P = \bar{E} \bar{i} = 110 \times 22 = 2420 W$
 $P = \bar{i}^2 Z = 22^2 \times 5 = 2420 W$

DC power loss $P = 22^2 \times 3 = 1452 W$

5) $\bar{E} = 80 - j60$, $\bar{i} = 6 + j8$, $Z = ?$
 $\bar{E} = 100 \angle -36.9^\circ$
 $\bar{i} = 10 \angle 53.1^\circ$
 $Z = \frac{\bar{E}}{\bar{i}} = \frac{100 \angle -36.9^\circ}{10 \angle 53.1^\circ} = 10 \angle -90^\circ = -j10 \Omega$

$\bar{E} = \frac{141.4}{\sqrt{2}} \angle 45^\circ = 100V (rms)$
 $\text{Deg} = \frac{\pi}{2} \text{ rad}$
 $\bar{E} = 100 \angle 90^\circ$
 $\bar{i} = \frac{100 \angle 90^\circ}{10 \angle -90^\circ} = 10 \angle 180^\circ = -10 A$

17.11.22
 12/10 $\Rightarrow a + jy$ (slide rule)

(EX. CONT.)

Change the following Complex Numbers from Rectangular to Polar Form:-

(a) $0.345 + j0.216$, (b) $0.123 - j0.784$,

(c) $-0.0134 + j0.637$, (d) $343 + j$,

(e) $-1.73 \times 10^6 - j3.12 \times 10^6$,

Find the Magnitudes of the following Complex Numbers:-

(a) $2 + j3$, (b) $2 - j3$, (c) $\frac{1}{2 + j3}$, (d) $(2 - j3)$, (e) $(2 + j3)$

(f) $e^{(1 + j\frac{\pi}{4})}$

$= e \times e^{j\frac{\pi}{4}}$

following

Write the Polar Form for the complex Numbers which are complex-conjugate to the ones given below.

(a) $7 - j13 \rightarrow 7 + j13$

(b) $(1 + j)(1 - j)$, (c) $\frac{1}{1 + j}$

(d) $4 \angle 60^\circ + e^{j\frac{\pi}{4}}$, (e) $e^{(2 + j\frac{\pi}{2})}$

Evaluate the following expressions and write answers in polar and rectangular form:-

(a) $(2 + j4)(3 - j4)$, (b) $\frac{1}{3 + j4}$, (c) $3 + \frac{10}{1 + j}$

(d) $\frac{2 + j3}{3 + j2}$, (e) $\frac{3 - j2}{-2 + j3}$

Evaluate the following expressions and write the answers in polar and rectangular form:-

rationalization used mostly.

(a) $3 + \frac{4 + j5}{6 + j7}$, (b) $\frac{1}{-1 - j} + \frac{1}{-4 + j5}$, (c) $2 \angle -45^\circ + \frac{1 + j2}{4 - j3}$

(d) $\frac{(1 + j2)(4 + j3)}{5 + j4}$, (e) $\frac{10 \angle 53^\circ + 7 \angle -13^\circ}{4 \angle 3^\circ - 10 \angle 120^\circ}$

(6) (a) $0.345 + j0.216 = 0.4095 \angle 32.007^\circ$ (0.4095 $\angle 32^\circ$)

(b) $0.123 - j0.784 = 0.804 \angle -81.2^\circ$ (0.805 $\angle -81.2^\circ$)

(c) $-0.0134 + j0.637 = 0.637 \angle 91.1^\circ$ (0.637 $\angle 91.1^\circ$)

(d) $343 + j = 343 \angle 0.29^\circ$ (343 $\angle 0.29^\circ$)

(e) $-1.73 \times 10^6 - j3.12 \times 10^6 = 3.57 \times 10^6 \angle 241.1^\circ$ (3.57 $\times 10^6 \angle 241.1^\circ$)

(7) (a) $2 + j3 = 3.61 \angle 56.3^\circ$ (directional)

(b) $2 - j3 = 3.61 \angle -56.3^\circ$

(c) $\frac{1}{2 + j3} = \frac{1}{3.61 \angle 56.3^\circ} = 0.278 \angle -56.3^\circ$ (0.277)

(d) $(2 - j3)(2 + j3) = 3.61 \angle -56.3^\circ \times 3.61 \angle 56.3^\circ = 12.94 \angle 0^\circ$ (13)

(e) $e^{(1 + j\frac{\pi}{4})} = e \cdot e^{j\frac{\pi}{4}} = e \angle 45^\circ = 2.72 \angle 45^\circ$

(8) (a) $7 - j13 \rightarrow 7 + j13 = 14.75 \angle 61.7^\circ$

(b) $(1 + j)(1 - j) = 1^2 - j^2 = 2 \angle 0^\circ$

(c) $\frac{1}{1 + j} = \frac{1}{\sqrt{2} \angle 45^\circ} = 0.707 \angle -45^\circ \rightarrow 0.707 \angle 45^\circ$

(d) $4 \angle 60^\circ + 2 \angle -83^\circ = 2 + j3.463 + 0.244 - j1.984$

$= 2.244 + j1.479 = 2.688 \angle 33.4^\circ$

$\therefore$ conjugate complex $= 2.688 \angle -33.4^\circ$

(8) (e) $e^{e+j\frac{\pi}{2}} \rightarrow e^{e-j\frac{\pi}{2}} = e^e \cdot e^{-j\frac{\pi}{2}} = e^e \angle -90^\circ$
 $= 7.0 \angle -90^\circ \checkmark$

$$\boxed{e}(a)(3+j0)(3-j4) = 9 - j^2 16 = 25 = 25 + j0 \quad \checkmark$$

$$c_b) \frac{1}{3+j\omega} = \frac{1}{5 \angle 53.15^\circ} = 0.2 \angle -53.15^\circ = 0.12 - j 0.16 \quad \checkmark$$

$$C_c) 3 + \frac{10}{1+j} = 3 + \frac{10 \angle 0^\circ}{\angle 45^\circ}$$

$$= 3 + 5\sqrt{2} \angle 45^\circ = 3 + 7.07 \angle -45^\circ$$

$$= 8 - j5 \sqrt{2} \quad 9.43 \quad \underline{-32^\circ} \quad \checkmark$$

$$\text{Cul)} \quad \frac{2+j3}{3+j2} = \frac{(3-j2)(2+j3)}{9+4} = \frac{12+j5}{13}$$

$$Z = \frac{0.9235 + j0.3845}{0.928 + j0.369} = 1 \angle 22.6^\circ / 1 \angle 21.6^\circ$$

Ans:-

$$\frac{2+j3}{3+j2} = \frac{3.6 \angle 56.3^\circ}{3.6 \angle 33.7^\circ} = 1 \angle 22.6^\circ$$

$$(e) \frac{3-j2}{-2+j3} = \frac{3-j2}{-2+j3} = \frac{3 \cdot 6 \angle -33.7^\circ}{3 \cdot 6 \angle -56.3^\circ + 180^\circ}$$

$$2 \quad 1 \quad \sqrt{\begin{array}{r} 22.6 - 180 \\ -157.4 \end{array}} \quad 2 \quad 1 \quad \sqrt{\begin{array}{r} 180 + 22.6 \end{array}}$$

$$z = 0.323 - j0.3845$$

$$(-0.228 - j0.363) \quad (-1 \angle 126^\circ) \quad \checkmark$$

$$\boxed{10} \text{ (a) } 3 + \frac{4+j5}{6+j7} = \frac{22+j26}{6+j7} = \frac{34.1 \angle 49.8^\circ}{9.22 \angle 49.4^\circ}$$

$$z = 3.7 \angle 0^\circ = 3.7 + j0$$

$$(3.7 \angle -0.365^\circ) \cap \cap (3.7 \angle 0.0235^\circ)$$

$$(b) \frac{1}{-1-j} + \frac{1}{-4+j5} \quad (-0.71 \angle -32.2^\circ)$$

$$= 0.707 \angle -135^\circ + 0.15625 \angle -128.7^\circ = 0.707 \angle 180^\circ + 45^\circ + 0.156 \angle 180^\circ + 51.3^\circ$$

$$= -0.5 - j0.5 - 0.0977 - j0.122 = -0.5977 - j0.622 = 1.075 \angle 228.15^\circ$$

$$(-0.598 + j0.398)$$

c) $3 \angle -45^\circ + \frac{1+j2}{1-j3}$ ~~$1+j2$~~

$$= 3 \frac{1-45}{5} + \frac{2.24 \frac{63.43}{5}}{5} = 3 \frac{1-45}{5} + 0.448 \frac{100.29}{5}$$

$$= 2.12 - j 2.12 \cdot 0.08 + j 0.441 = 2.04 - j 1.679 = 2.645 \angle -39.45^\circ$$

$$cd). \frac{(1+j2)(4+j3)}{5+j4} = \frac{-2+j11}{5+j4} = \frac{11.2 \angle 100.3^\circ}{6.4 \angle 38.65^\circ}$$

$$= 1.75 \angle 61.65^\circ \checkmark \quad \cancel{0.83 \angle 15.4^\circ} = 0.83 \angle 15.4^\circ + j 1.54$$

$$= 0.83 + j 1.54 \quad (1.75 \angle 62^\circ) \quad (0.816 + j 1.54)$$

$$(e) \cdot \frac{10 \angle 53^\circ + 9 \angle -13^\circ}{4 \angle 3^\circ - 10 \angle 120^\circ} = \frac{6.015 + j7.985 + 6.82 - j1.574}{4 + j0.2095 + 5 - j8.66}$$

$$Z = \frac{12.835 + j6.411}{9 - j8.4905} = \frac{14.38 \angle 26.55^\circ}{12.35 \angle -43.2^\circ} = 1.163 \angle 75^\circ \checkmark$$

$$(1.15 \cancel{1.15} \cancel{1.15} \cancel{1.15} / 69.8) \sqrt{} \approx 0.403 + j 1.09$$

Ex) convert to rectangular form.

$$= \frac{10 \angle 53^\circ + 7 \angle -13^\circ}{4 \angle 3^\circ - 10 \angle 120^\circ}$$

$$= \frac{(6.02 + j7.98) + (6.83 - j1.58)}{(4 + j0.021) - (-5 + j8.66)}$$

$$= \frac{12.85 + j6.4}{9 - j8.65} = \frac{14.41 \angle 26.9^\circ}{12.35 \angle 43.2^\circ} = 1.1425 \angle 70.1^\circ$$

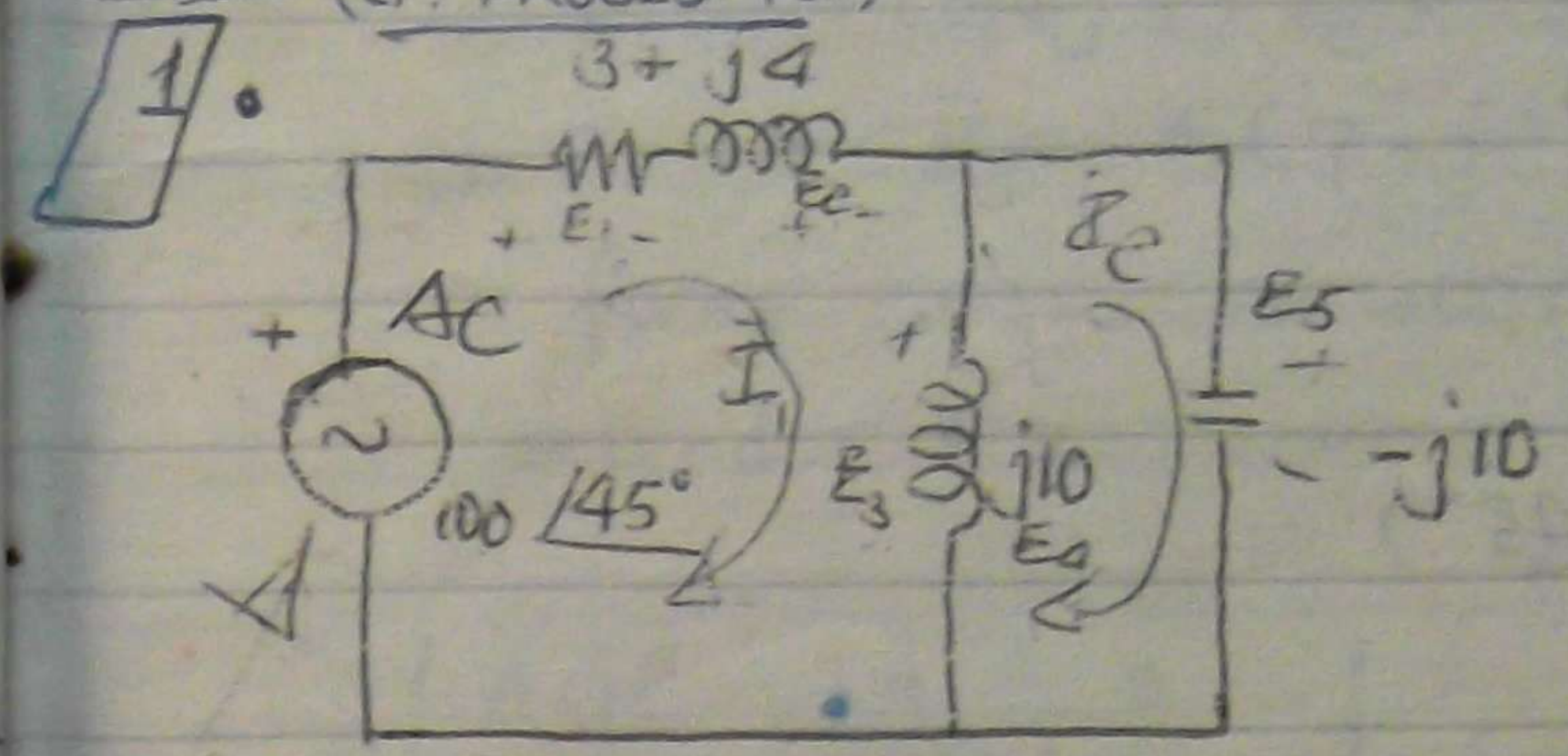
$\rightarrow 1.1425 \angle 70.1^\circ = 0.39 + j1.075$ (Ans)

Active Sources & Equations,
Passive Elements & Equations

Clockwise direction

Mesh Current Method

Exe (1. PROBLEMS.)



or Loop Current.

$$-100 \angle 45^\circ + \bar{E}_1 + \bar{E}_2 + \bar{E}_3 = 0 \quad (\text{or } \times -1)$$

$$\bar{E}_4 + \bar{E}_5 = 0$$

Generator left loop

$$-100 \angle 45^\circ + 3 \times I_1 + j4 I_1 + j10(I_1 - I_2) = 0$$

$$(3 + j14) I_1 - j10 I_2 = 100 \angle 45^\circ$$

right loop

$$(I_2 - I_1) j10 + (-j10) I_2 = 0$$

$$-I_1 j10 + I_2 (0) = 0$$

$$-j10 I_1 + 0 = 0 \quad \text{--- (2)}$$

Loop active part, passive (energy storage) component

Active Component $\rightarrow$ V and I source

$$D = \begin{vmatrix} 3+j14 & -j10 \\ -j10 & 0 \end{vmatrix} \quad N_1 = \begin{vmatrix} 100 \angle 45^\circ & -j10 \\ 0 & 0 \end{vmatrix}$$

$$N_2 = \begin{vmatrix} 3+j14 & 100 \angle 45^\circ \\ -j10 & 0 \end{vmatrix}$$

$$\therefore I_1 = \frac{N_1}{D}, \quad I_2 = \frac{N_2}{D}$$

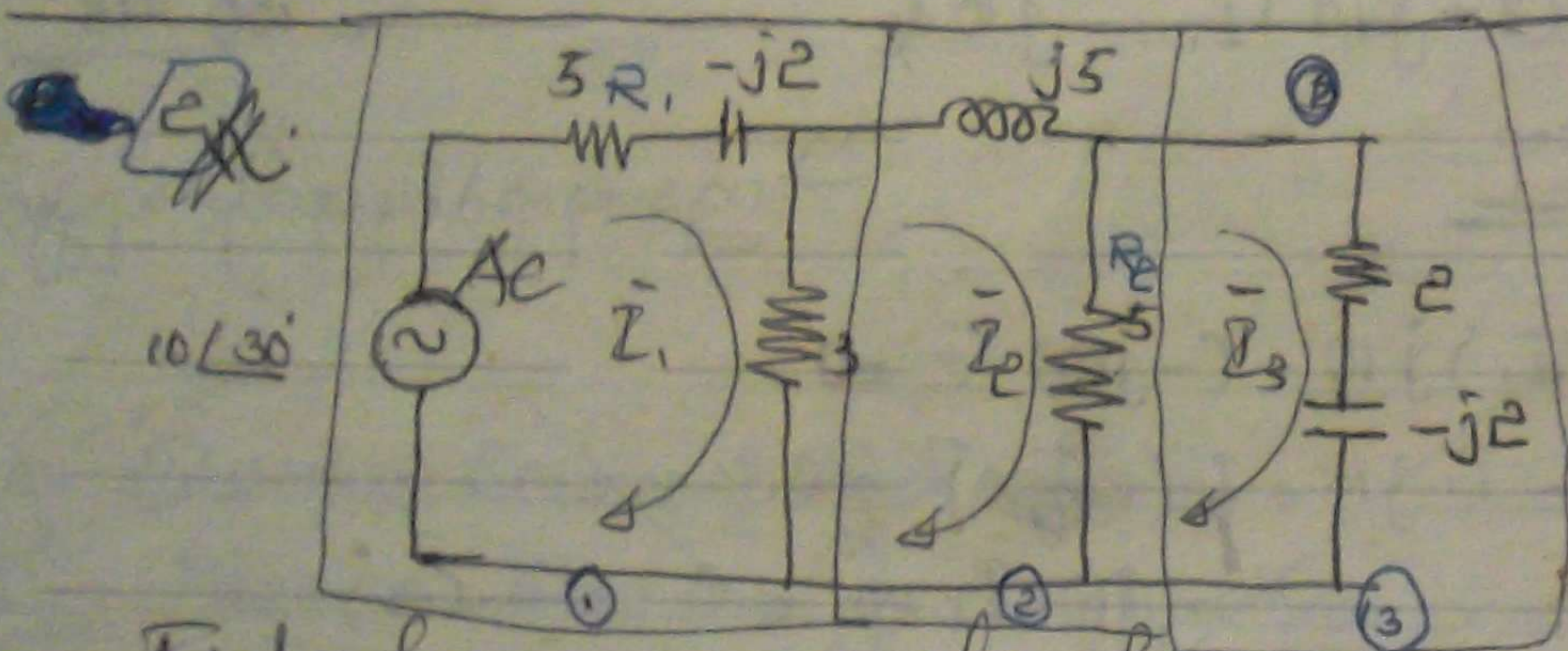
$$D = 0 - (-j10)(-j10) \\ = 100$$

$$N_1 = 0$$

$$N_2 = -(-j10) e^{j100 \angle 45^\circ} \\ = 1000 \angle 135^\circ$$

$$\therefore I_1 = 0 \text{ A}$$

$$I_2 = 10 \angle 135^\circ \text{ A}$$



Find the currents through 5Ω resistor.

Loop (1) equation-

$$(5 - j2 + 3) \bar{I}_1 - 3 \bar{I}_2 = 10 \angle 30^\circ \quad \text{--- (1)}$$

Loop (2) equation-

$$-3 \bar{I}_1 + (3 + j5 + 5) \bar{I}_2 - 5 \bar{I}_3 = 0 \quad \text{--- (2)}$$

Loop (3) equation-

$$0 - 5 \bar{I}_2 + (2 - j2) \bar{I}_3 = 0 \quad \text{--- (3)}$$

using Cramer's determinant method.

$$(8 - j2) \bar{I}_1 - 3 \bar{I}_2 + 0 \bar{I}_3 = 10 \angle 30^\circ \quad \text{--- (1)}$$

$$-3 \bar{I}_1 + (8 + j5) \bar{I}_2 - 5 \bar{I}_3 = 0 \quad \text{--- (2)}$$

$$0 \bar{I}_1 - 5 \bar{I}_2 + (7 - j2) \bar{I}_3 = 0 \quad \text{--- (3)}$$

first 5Ω resistor current = I_1

second 5Ω resistor current = $I_2 - I_3$

$$D = \begin{vmatrix} 8-j2 & -3 & 0 \\ -3 & 8+j5 & -5 \\ 0 & -5 & 7-j2 \end{vmatrix}$$

$$= 8-j2 \begin{vmatrix} 8+j5 & -5 \\ -5 & 7-j2 \end{vmatrix} - (-3) \begin{vmatrix} -5 & -5 \\ 0 & 7-j2 \end{vmatrix} + 0$$

$$= 303 + j88 = 316 \angle 16.2^\circ$$

$$N_1 = 453 \angle 56.8^\circ, \quad N_2 = 218.2 \angle 15^\circ, \quad N_3 = 150 \angle 30^\circ$$

using Cramer's method.

$$\therefore I_1 = \frac{N_1}{D} = \frac{453 \angle 56.8^\circ}{316 \angle 16.2^\circ} = 1.4325 \angle 39.8^\circ \text{ A}$$

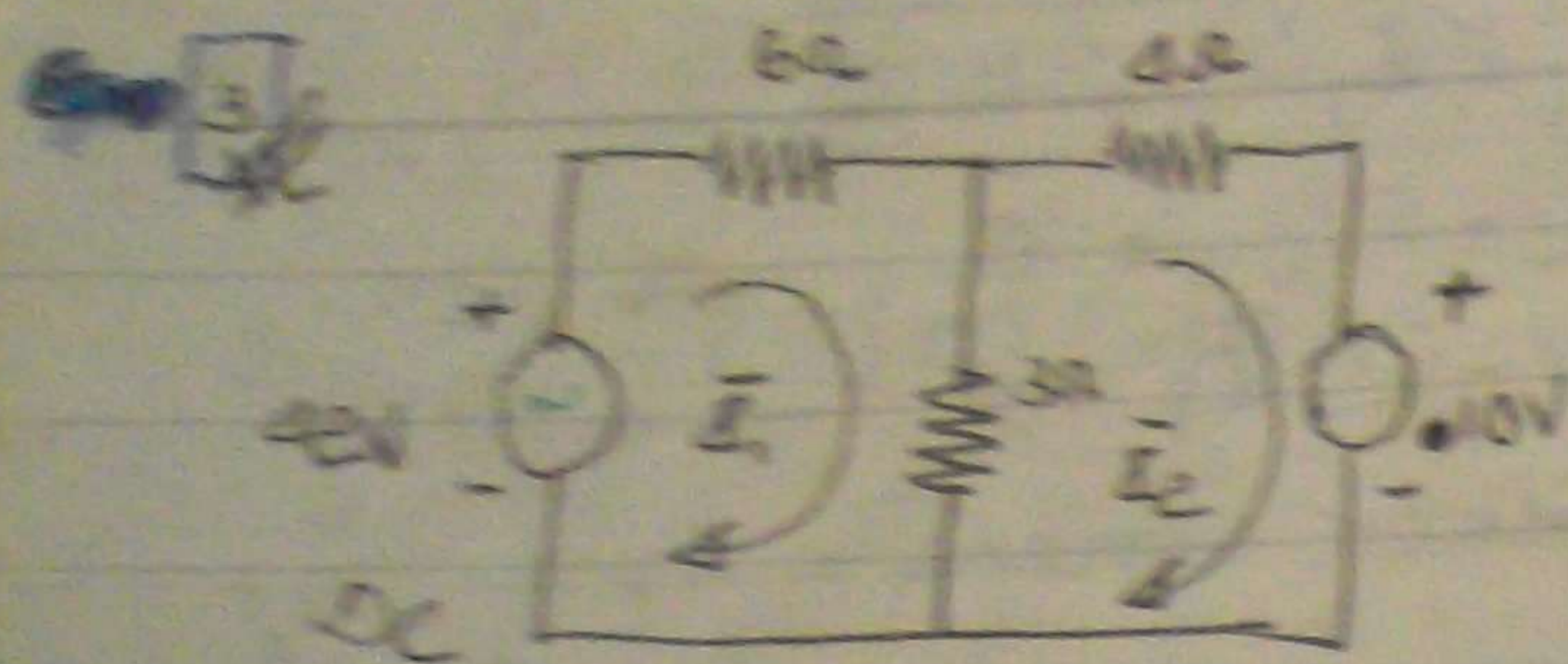
$$I_2 = \frac{N_2}{D} = \frac{218.2 \angle 15^\circ}{316 \angle 16.2^\circ} = 0.691 \angle -1.4^\circ \text{ A}$$

$$I_3 = \frac{N_3}{D} = \frac{150 \angle 30^\circ}{316 \angle 16.2^\circ} = 0.475 \angle 13.6^\circ$$

$$\begin{matrix} 0.69 \\ 0.4963 + j0.1152 \\ 1.186 + j0.115 \end{matrix}$$

$$\therefore I_{R1} = I_1 = 1.43 \angle 40^\circ \text{ A}, \quad I_{R2} = I_2 - I_3 = 0.21 \angle 5.57^\circ \text{ A}$$

$$\text{Ans: } \bar{I}_1 = 1.44 \angle 38.6^\circ, \quad \bar{I}_2 = -0.69 \angle -2.15^\circ, \quad \bar{I}_3 = 0.475 \angle 13.6^\circ$$



for first loop,

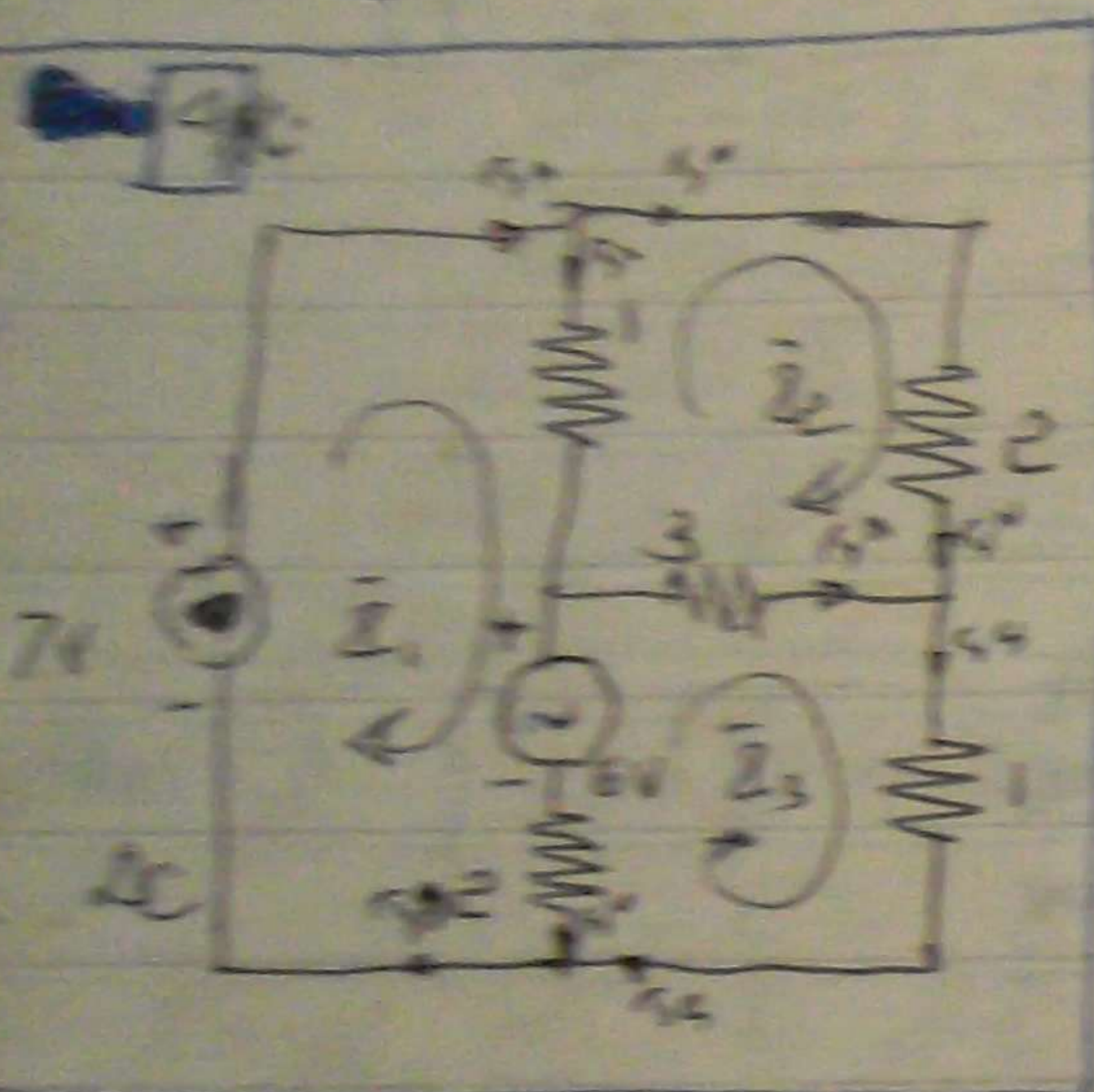
$$(6+3)I_1 - 3I_2 = 42$$

$$30I_1 - 3I_2 = 42 \quad (1)$$

for right-side loop,

$$(4+3)I_2 - 3I_1 = 10$$

$$8I_2 - 3I_1 = 10 \quad (2)$$



$$D = \begin{vmatrix} 3 & -1 \\ 3 & -7 \end{vmatrix} = -21 + 3 = -18$$

$$N_1 = \begin{vmatrix} 10 & -1 \\ 10 & -7 \end{vmatrix} = -98 + 10 = -88$$

$$N_2 = \begin{vmatrix} 3 & 10 \\ 3 & 10 \end{vmatrix} = 3(-4) = -12$$

$$\therefore I_1 = \frac{N_1}{D} = \frac{-88}{-18} = 4.89 \text{ A}, \quad I_2 = \frac{N_2}{D} = \frac{-12}{-18} = 0.67 \text{ A}$$

$$\therefore I_{R_{3\Omega}} = I_1 - I_2 = 4.23 \text{ A}$$

$$(1+2)I_1 - I_2 - 2I_3 = 7 - 6$$

$$3I_1 - I_2 - 2I_3 = 1 \quad (1)$$

$$-I_1 + 6I_2 - 3I_3 = 0 \quad (2)$$

$$-2I_1 - 3I_2 + 6I_3 = 0 \quad (3)$$

$$D = \begin{vmatrix} 3 & -1 & -2 \\ -1 & 6 & -3 \\ -2 & -3 & 6 \end{vmatrix} = 108 - 6 - 6 - 24 - 27 - 6 = 39$$

$$N_1 = \begin{vmatrix} 1 & -1 & -2 \\ 0 & 6 & -3 \\ 6 & -3 & 6 \end{vmatrix} = \begin{vmatrix} 1 & 1 & 2 \\ 0 & -6 & 3 \\ 6 & 3 & -6 \end{vmatrix} = \begin{vmatrix} -6 & 3 \\ 3 & -6 \end{vmatrix} + 6 \begin{vmatrix} 1 & 2 \\ -6 & 3 \end{vmatrix}$$

$$= 9 - 2 + 18 - 12 = 15$$

$$= 30 - 9 + 18 - 12 = 27$$

$$= 117$$

$$N_2 = \begin{vmatrix} 3 & 1 & -2 \\ -1 & 0 & -3 \\ -2 & 6 & 6 \end{vmatrix} = 0 + 6 + 12 - 0 + 54 + 6 = 78$$

$$N_3 = \begin{vmatrix} 3 & -1 & 1 \\ -1 & 6 & 0 \\ -2 & -3 & 6 \end{vmatrix} = 108 + 0 + 3 + 12 - 0 - 6 = 117$$

$$\therefore I_1 = \frac{N_1}{D} = \frac{117}{39} = 3 \text{ A}$$

$$I_2 = \frac{N_2}{D} = \frac{78}{39} = 2 \text{ A}$$

$$I_3 = \frac{N_3}{D} = \frac{117}{39} = 3 \text{ A}$$

Mech Current Method

Second Year, Course Kirchhoff's Law

တွက်ကြည့်ပါ (အထက်ပါပညာရေးဌာနမှ)

4.1.83.

နိဂုံးပ. တွက်ကြည့်ကြပါ

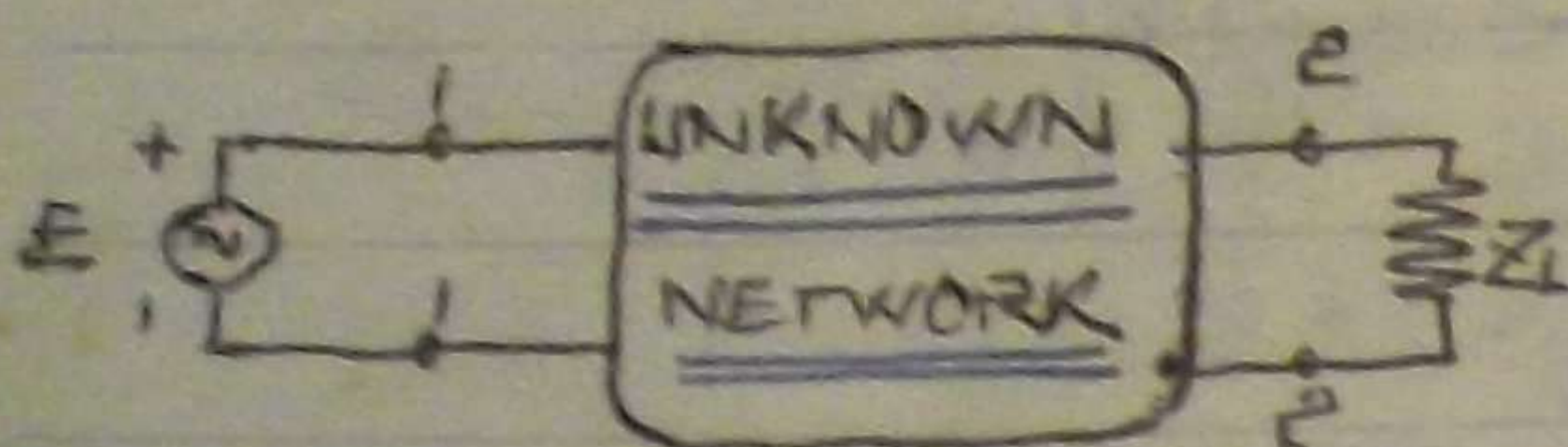
0000 000 5. 1. 83.

Kirchhoff's Law မှ တွက်ကြည့်ကြပါ

25.11.82 - 5.12.82 SUN.

Network Transformation:-

(OBSERVATION & UNDERSTOOD).



4 Terminal Network

$\{ Z_1, \infty, Z_2, \infty \}$ & $\{ Z_1, \infty, Z_2, \infty \}$ $\rightarrow$ Z_1, Z_2, Z_3 $\rightarrow$ Z_1, Z_2, Z_3

$$\left\{ \begin{array}{l} Z_1, \infty = Z_1 + Z_3 \\ Z_1, \infty = Z_1 + \frac{Z_2 Z_3}{Z_2 + Z_3} \end{array} \right\} \left\{ \begin{array}{l} Z_2, \infty = Z_2 + Z_3 \\ Z_2, \infty = Z_2 + \frac{Z_1 Z_3}{Z_1 + Z_3} \end{array} \right\} \text{ 1KW.}$$

$$Z_1, \infty - Z_1, \infty = Z_3 - \frac{Z_2 Z_3}{Z_2 + Z_3} = \frac{Z_3^2}{Z_2 + Z_3}$$

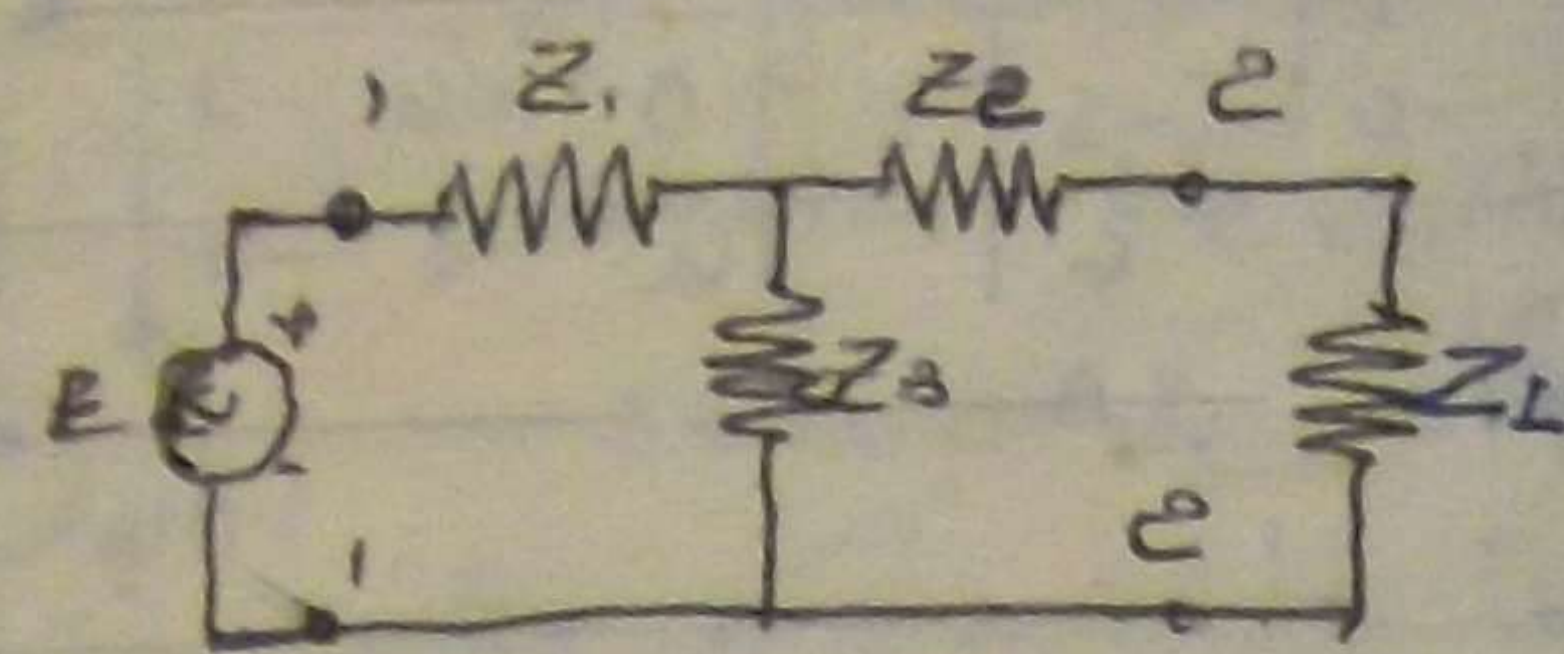
$$\therefore Z_3^2 = (Z_1, \infty - Z_1, \infty) (Z_2 + Z_3)$$

$$\therefore Z_3 = \sqrt{Z_{1, \infty} (Z_1, \infty - Z_1, \infty)} \quad \text{C: } Z_2 + Z_3 = Z_{2, \infty}$$

$$\therefore Z_1 = Z_{1, \infty} - Z_3, \quad Z_2 = Z_{2, \infty} - Z_3 \quad \text{1KW.}$$

$$Z_{1, \infty} Z_{2, \infty} = Z_{1, \infty} Z_2 \quad \text{1KW.}$$

1, 2 $\rightarrow$ PRI., SEC.
OC: OPEN CKT, SC: SHORT CKT.



Equivalent T section

$Z_1, \infty = Z_1 + Z_3$
 $Z_2, \infty = Z_2 + Z_3$
 $Z_1, \infty = Z_1 + \frac{Z_2 Z_3}{Z_2 + Z_3}$
 $Z_2, \infty = Z_2 + \frac{Z_1 Z_3}{Z_1 + Z_3}$

1. 4 Terminal network $\rightarrow$ $Z_{1, \infty} = 10 + j10 \Omega$, $Z_{2, \infty} = 10 - j10 \Omega$ $\rightarrow$ $Z_2 = 10 + j10 \Omega$ $\rightarrow$ $Z_1 = 10 - j10 \Omega$ $\rightarrow$ $Z_3 = 10 + j10 \Omega$ $\rightarrow$ $Z_3 = 10 + j10 \Omega$

$$(10 + j10)(10 + j10) = Z_{2, \infty}(10 - j10)$$

$$Z_{2, \infty} = \frac{10 \angle 45^\circ \times 10 \angle 45^\circ}{10 \angle -45^\circ} = 14.142 \angle 135^\circ \Omega$$

$$= -10 + j10 \Omega$$

Ex 3 (7. Problem.)

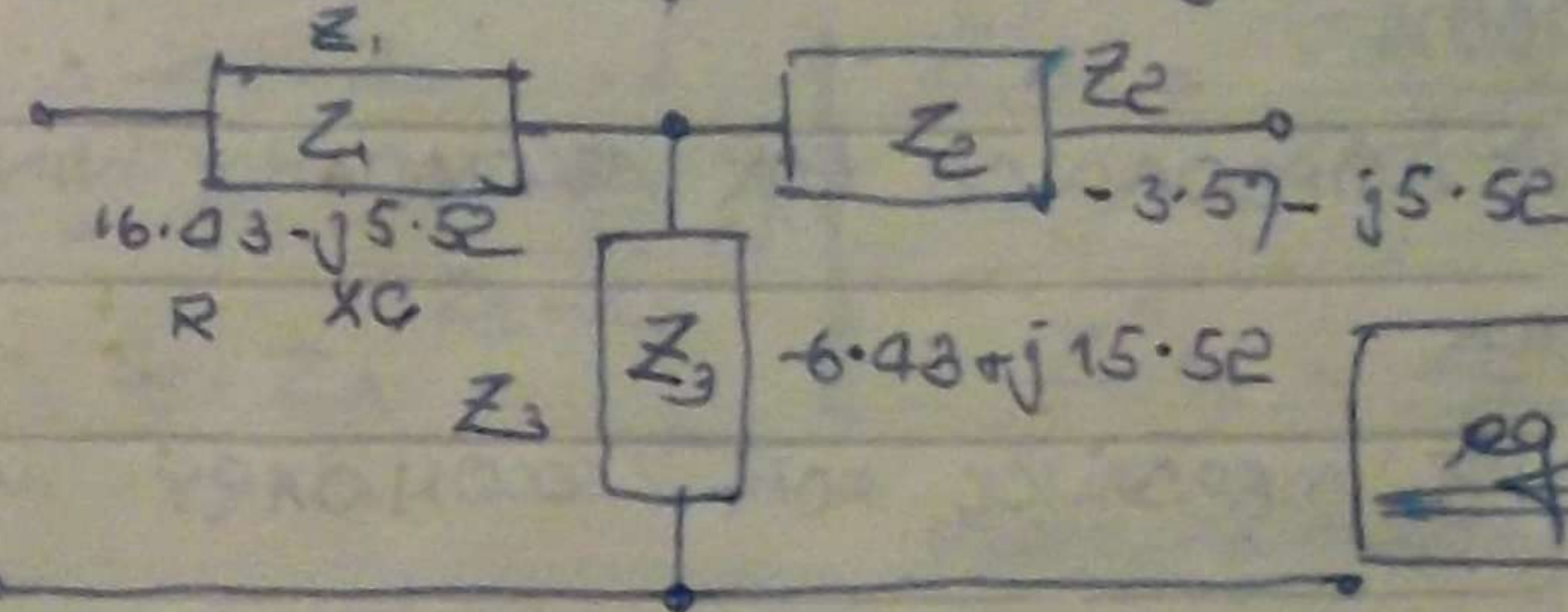
$$Z_3 = \sqrt{Z_{2, \infty} (Z_{1, \infty} - Z_{1, \infty})} = \sqrt{(-10 + j10)(10 + j10 - 10 + j10)}$$

$$= \sqrt{(-200 - j200)} = 10 \sqrt{-2 - j2} = 10 \sqrt{2.83 \angle 225^\circ}$$

$$= 16.8 \angle 112.5^\circ = -6.43 + j15.52$$

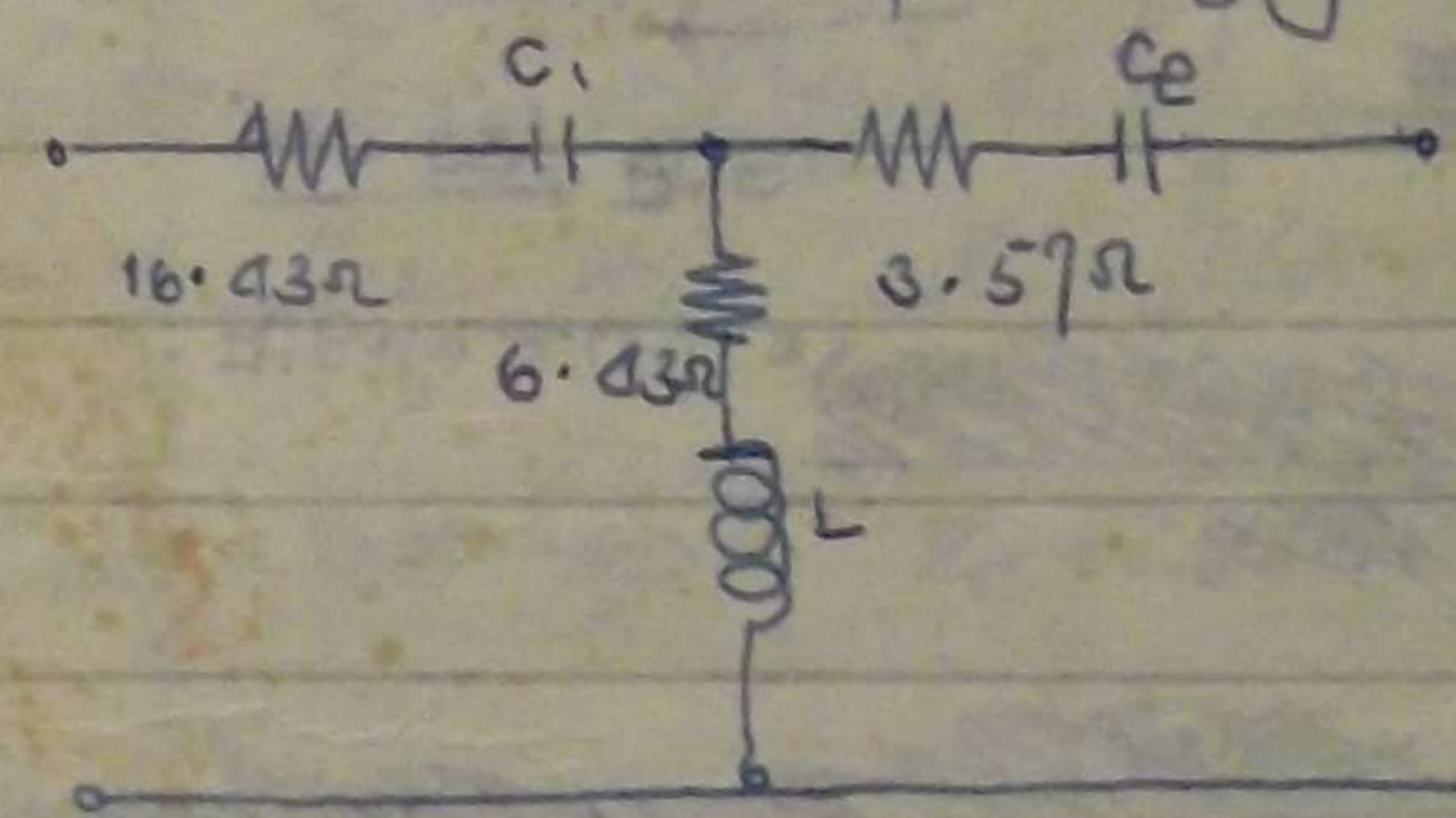
$$Z_1 = Z_{1, \infty} - Z_3 = 10 + j10 + 6.43 - j15.52 = 16.43 - j5.52$$

$$Z_2 = Z_{2, \infty} - Z_3 = -10 + j10 + 6.43 - j15.52 = -3.57 - j5.52$$



equivalent T section

2. $\omega = 5000$ radians/sec. $\rightarrow$ $C_1 = \frac{1}{\omega X_1} = \frac{10^6}{5000 \times 5.52} \mu F$



$$C_1 = \frac{10^6}{5000 \times 5.52} \mu F$$

$$C_2 = \frac{10^6}{5000 \times 5.52} \mu F = 36.2 \mu F$$

$$L = \frac{15.52}{5000} = 3.108 \text{ mH}$$

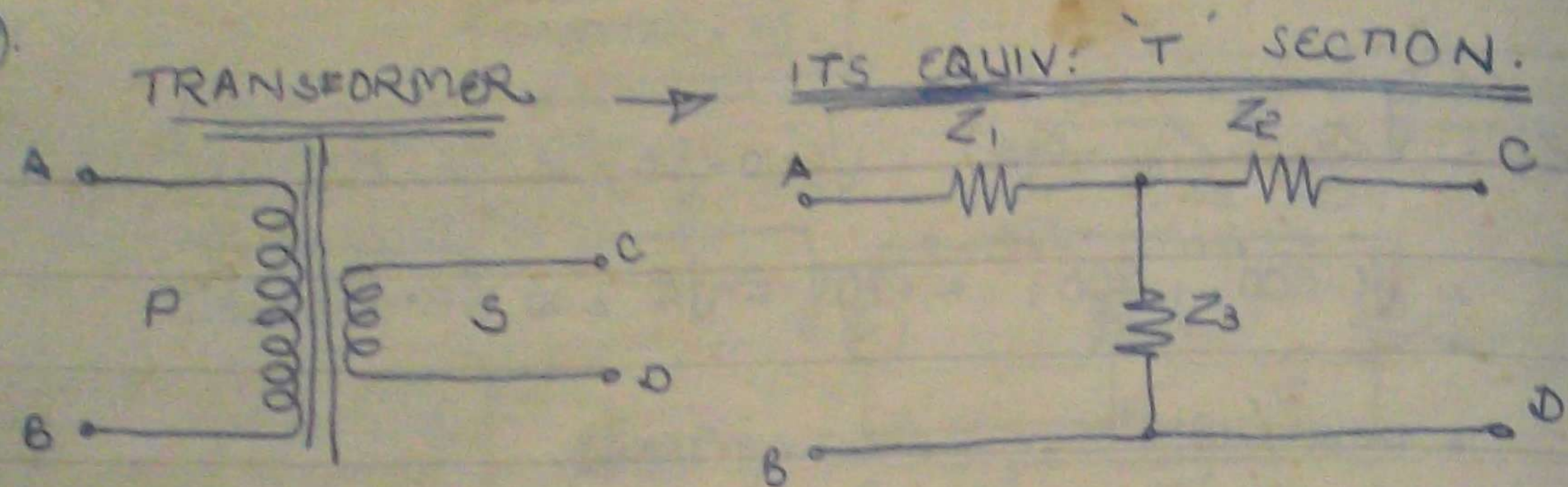
2. Trans. $\rightarrow$ input & output terminal $\rightarrow$ $Z_{1, \infty} = 400 + j4000 \Omega$, $Z_{2, \infty} = 100 + j1000 \Omega$, $Z_{1, \infty} = 38 + j380 \Omega$

$\rightarrow$ $Z_{1, \infty} = 400 + j4000 \Omega$, $Z_{2, \infty} = 100 + j1000 \Omega$, $Z_{1, \infty} = 38 + j380 \Omega$ $\rightarrow$ $Z_1 = 400 + j4000 \Omega$, $Z_2 = 100 + j1000 \Omega$, $Z_3 = 38 + j380 \Omega$

$\rightarrow$ $Z_1 = 400 + j4000 \Omega$, $Z_2 = 100 + j1000 \Omega$, $Z_3 = 38 + j380 \Omega$

8.12.82

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$$Z_{1,oc} \text{ [OPEN CIRCUIT IMPEDANCE FOR PRIMARY WINDING]} \\ = 400 + j4000 \Omega$$

$$Z_{2,oc} \text{ [OPEN CIRCUIT IMPEDANCE FOR SECONDARY WINDING]} \\ = 100 + j1000 \Omega$$

$$Z_{1,sc} \text{ [SHORT CIRCUIT IMPEDANCE FOR SECONDARY WINDING]} \\ = 33 + j380 \Omega$$

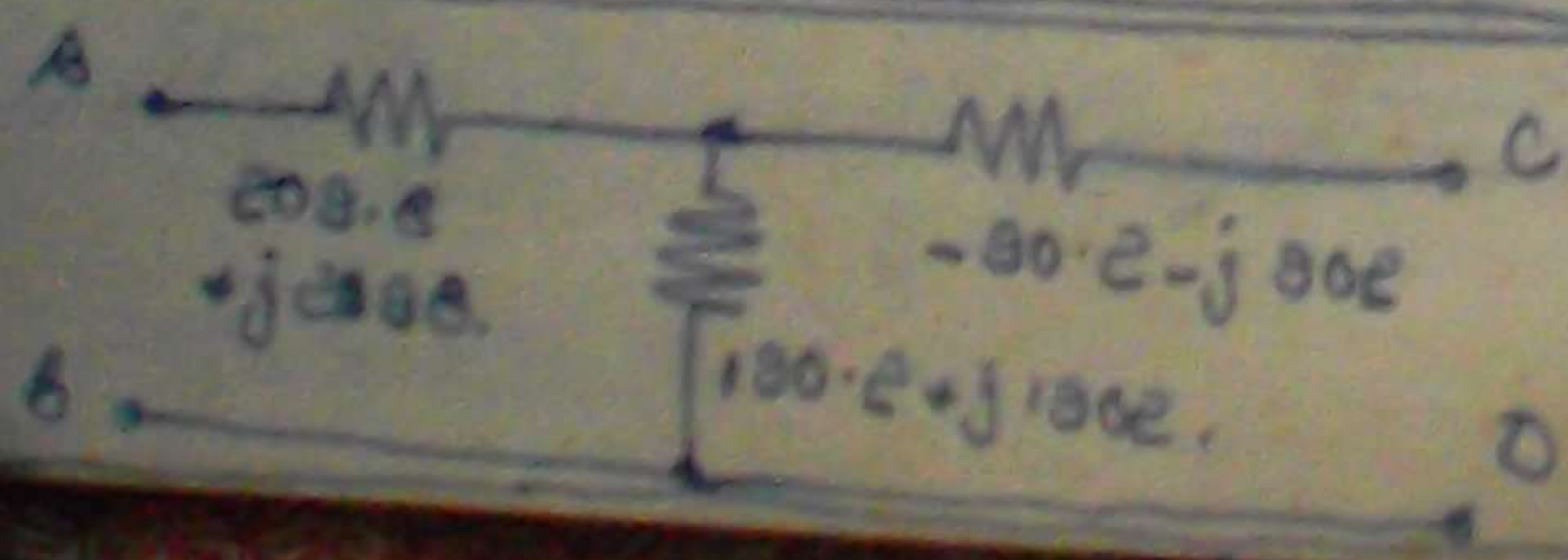
$$Z_3 = \sqrt{Z_{2,oc}(Z_{1,oc} - Z_{1,sc})} \\ = \sqrt{1005 / 83.427 \times (362 + j3620)} \\ = 190.2 / 83.427$$

$$= 190.2 + j1902$$

$$Z_1 = Z_{1,oc} - Z_3 = (400 - 190.2) + j(4000 - 1902) \\ = 209.8 + j2098 \Omega$$

$$Z_2 = Z_{2,oc} - Z_3 = (100 - 190.2) + (1000 - 1902)j \\ = -90.2 - j902 \Omega$$

REQUESTED EQUIVALENT 'T' SECTION:

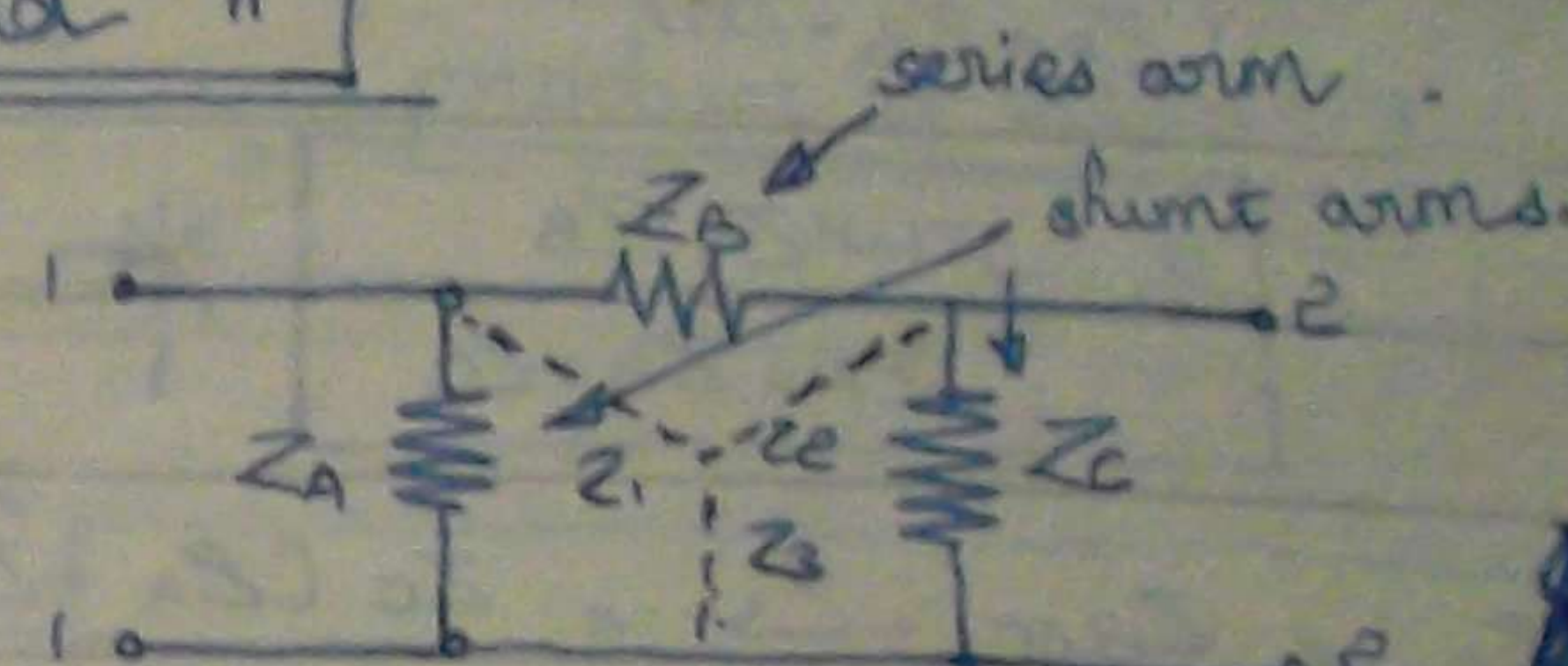
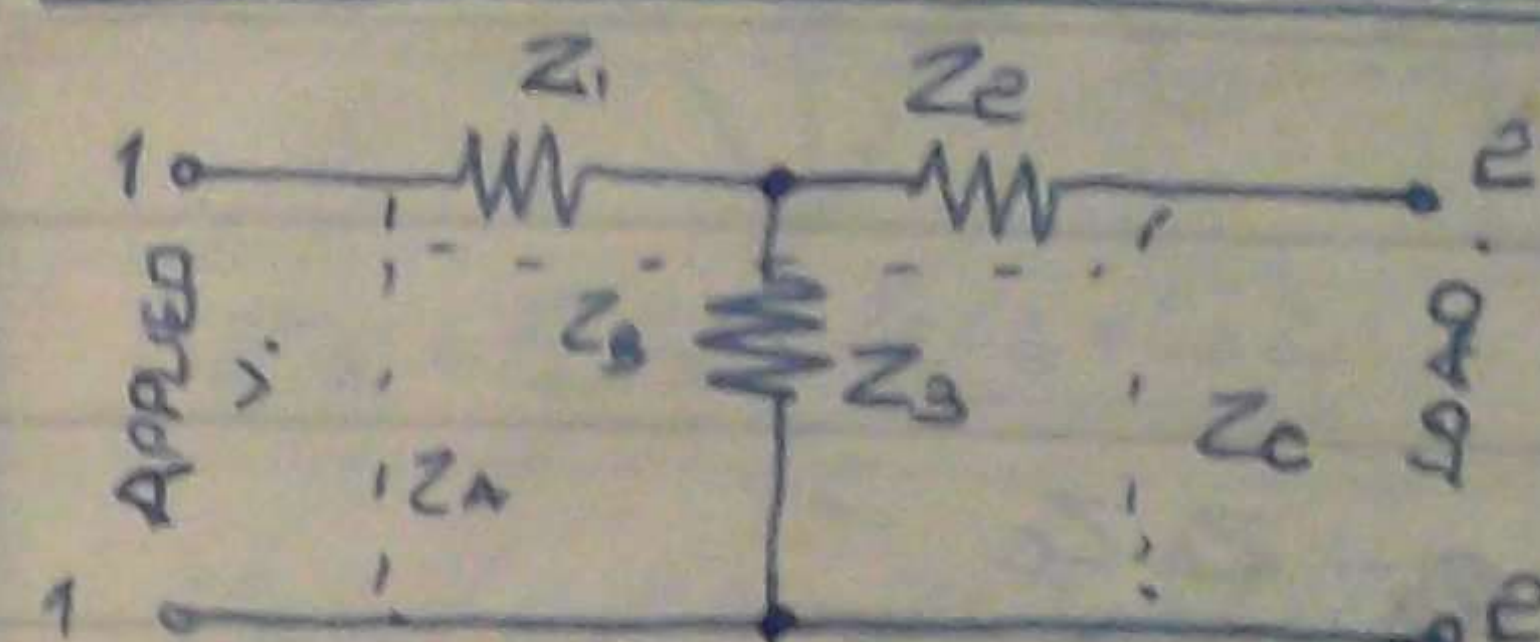


B. E. & Comp.

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NETWORK TRANSFORMATION (Cont.)

Conversion Between T and π



$$Z_{1,oc} = Z_1 + Z_3$$

$$Z_{1,sc} = Z_1 + \frac{Z_2 Z_3}{Z_2 + Z_3}$$

$$Z_{2,oc} = Z_2 + Z_3$$

$$Z'_{1,oc} = \frac{Z_A(Z_B + Z_C)}{Z_A + Z_B + Z_C}, Z'_{1,sc} = \frac{Z_A Z_B}{Z_A + Z_B}$$

$$Z'_{2,oc} = \frac{Z_C(Z_A + Z_B)}{Z_A + Z_B + Z_C}$$

For any network, the equivalent impedances $Z_{1,oc} = Z'_{1,oc}$, $Z_{2,oc} = Z'_{2,oc}$, $Z_{1,sc} = Z'_{1,sc}$, $Z_{2,sc} = Z'_{2,sc}$ (set one s.c. dash)

$$Z_{1,oc} = Z'_{1,oc} \Rightarrow Z_1 + Z_3 = \frac{Z_A(Z_B + Z_C)}{Z_A + Z_B + Z_C} \quad (1)$$

$$Z_{1,sc} = Z'_{1,sc} \Rightarrow Z_1 + \frac{Z_2 Z_3}{Z_2 + Z_3} = \frac{Z_A Z_B}{Z_A + Z_B} \quad (2)$$

$$Z_{2,oc} = Z'_{2,oc} \Rightarrow Z_2 + Z_3 = \frac{Z_C(Z_A + Z_B)}{Z_A + Z_B + Z_C} \quad (3)$$

$$\text{Eq (1)} - \text{Eq (2)} \Rightarrow Z_3 - \frac{Z_2 Z_3}{Z_2 + Z_3} = \frac{Z_A(Z_B + Z_C)}{Z_A + Z_B + Z_C} - \frac{Z_A Z_B}{Z_A + Z_B}$$

$$Z_3^2 = (Z_2 + Z_3) \times \frac{Z_A^2 Z_C}{(Z_A + Z_B)(Z_A + Z_B + Z_C)}$$

$$= \frac{Z_A^2 Z_C}{(Z_A + Z_B)(Z_A + Z_B + Z_C)} = \frac{Z_A^2 Z_C^2}{(Z_A + Z_B + Z_C)^2}$$

$$\therefore Z_3 = \frac{Z_A Z_C}{Z_A + Z_B + Z_C} *$$

Conversion of π section to T section:

(20)

 Δ -Y, Y- Δ conversion

$$Z_1 = Z_{ac} - Z_3$$

$$Z_1 = \frac{Z_a(Z_b + Z_c)}{Z_a + Z_b + Z_c} - Z_3 = \frac{Z_a Z_b}{Z_a + Z_b + Z_c}$$

$$\boxed{Z_1 = \frac{Z_a Z_b}{Z_a + Z_b + Z_c}} *$$

$$Z_2 = Z_{bc} - Z_3 = \frac{Z_c(Z_a + Z_b)}{Z_a + Z_b + Z_c} - \frac{Z_a Z_c}{Z_a + Z_b + Z_c}$$

$$\boxed{Z_2 = \frac{Z_b Z_c}{Z_a + Z_b + Z_c}} *$$

{ opposite formula and opposite sign }

Converting from T section to π sections-

$$\text{Expt 1} \Rightarrow Z_1 + \frac{Z_2 Z_3}{Z_2 + Z_3} = \frac{Z_a Z_b}{Z_a + Z_b}$$

$$\frac{Z_1 Z_2 + Z_2 Z_3 + Z_3 Z_1}{Z_2 + Z_3} = \frac{Z_a Z_b}{Z_a + Z_b}$$

$$Z_1 Z_2 + Z_2 Z_3 + Z_3 Z_1 = \frac{Z_a Z_b}{Z_a + Z_b} \cdot \frac{Z_c(Z_a + Z_b)}{Z_a + Z_b + Z_c} = \frac{Z_a Z_b Z_c}{Z_a + Z_b + Z_c} = Z_c (Z_1)$$

$$\text{i.e. } Z_c = \frac{Z_1 Z_2 + Z_2 Z_3 + Z_3 Z_1}{Z_1}$$

$$\boxed{Z_c = Z_2 + Z_3 + \frac{Z_2 Z_3}{Z_1}} *$$

ply

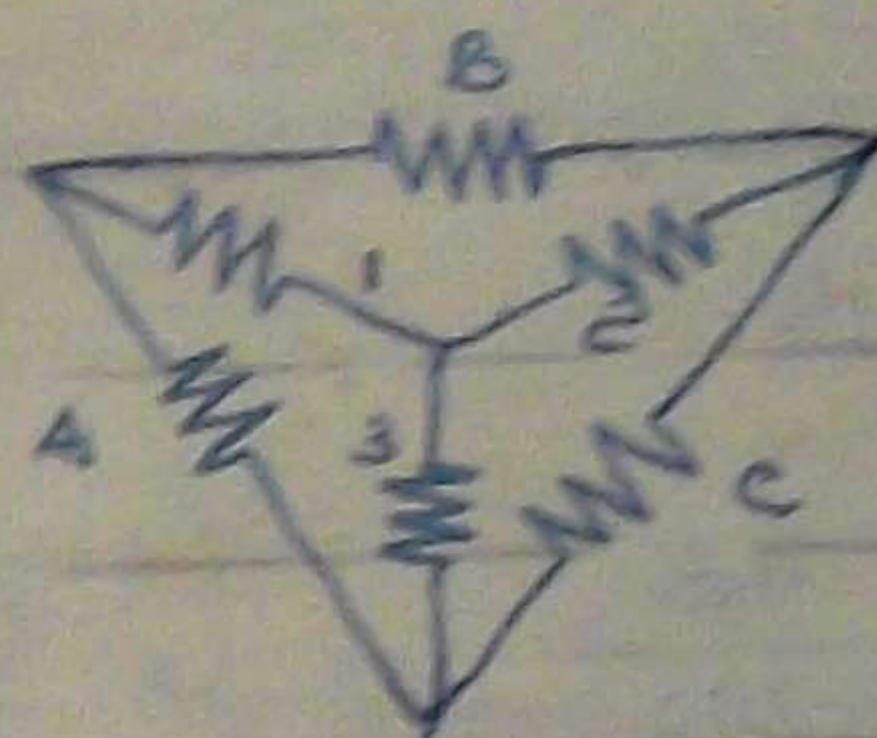
$$Z_1 Z_2 + Z_2 Z_3 + Z_3 Z_1 = Z_b \cdot \frac{Z_a Z_c}{Z_a + Z_b + Z_c} = Z_b + Z_3$$

$$\boxed{Z_b = Z_1 + Z_3 + \frac{Z_1 Z_3}{Z_2}} *$$

ply,

$$\boxed{Z_a = Z_1 + Z_3 + \frac{Z_1 Z_3}{Z_2}} *$$

(21)



$$Z_1 = \frac{Z_a Z_b}{Z_a + Z_b + Z_c}, Z_2 = \frac{Z_b Z_c}{Z_a + Z_b + Z_c}, Z_3 = \frac{Z_a Z_c}{Z_a + Z_b + Z_c}$$

$\therefore \pi$ to T = $\frac{\text{product of adjacent}}{\text{sum}}$ *

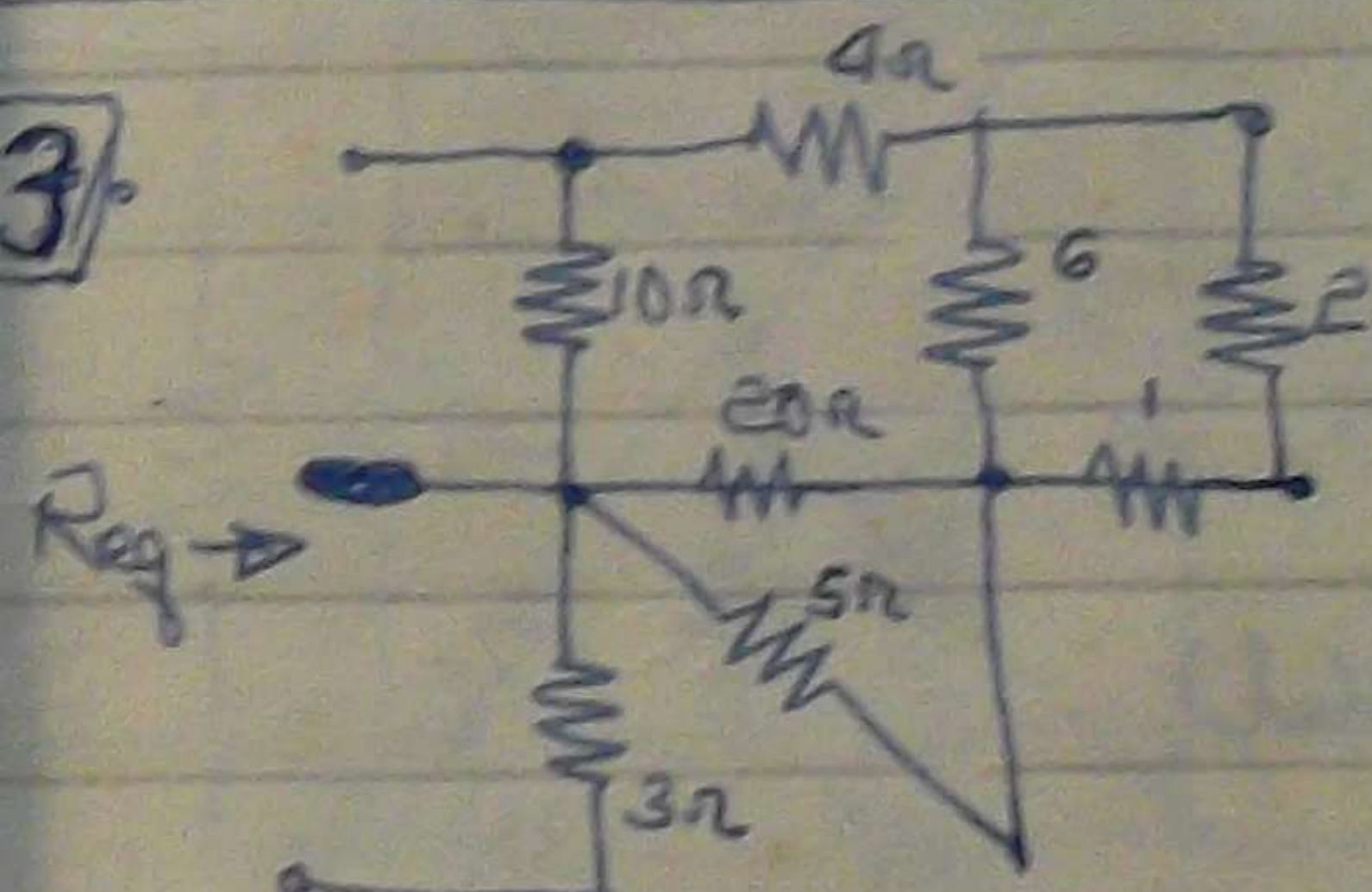
$$Z_a = \frac{Z_1 Z_2 + Z_2 Z_3 + Z_3 Z_1}{Z_2}$$

$$Z_b = \frac{Z_1 Z_2 + Z_2 Z_3 + Z_3 Z_1}{Z_3}$$

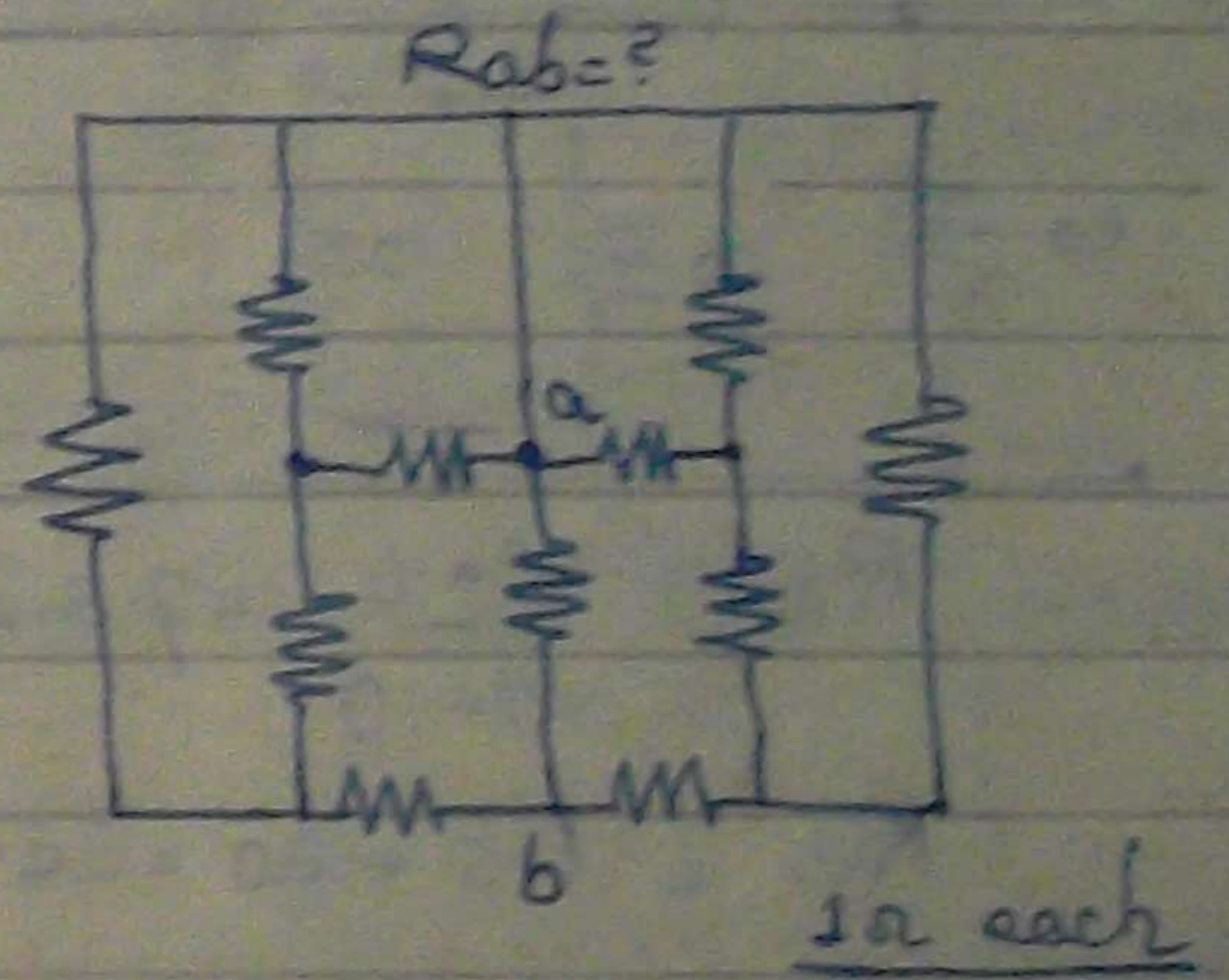
$$Z_c = \frac{Z_1 Z_2 + Z_2 Z_3 + Z_3 Z_1}{Z_1}$$

$\therefore$ T to π = $\frac{\text{sum of each product}}{\text{opposite}}$ *

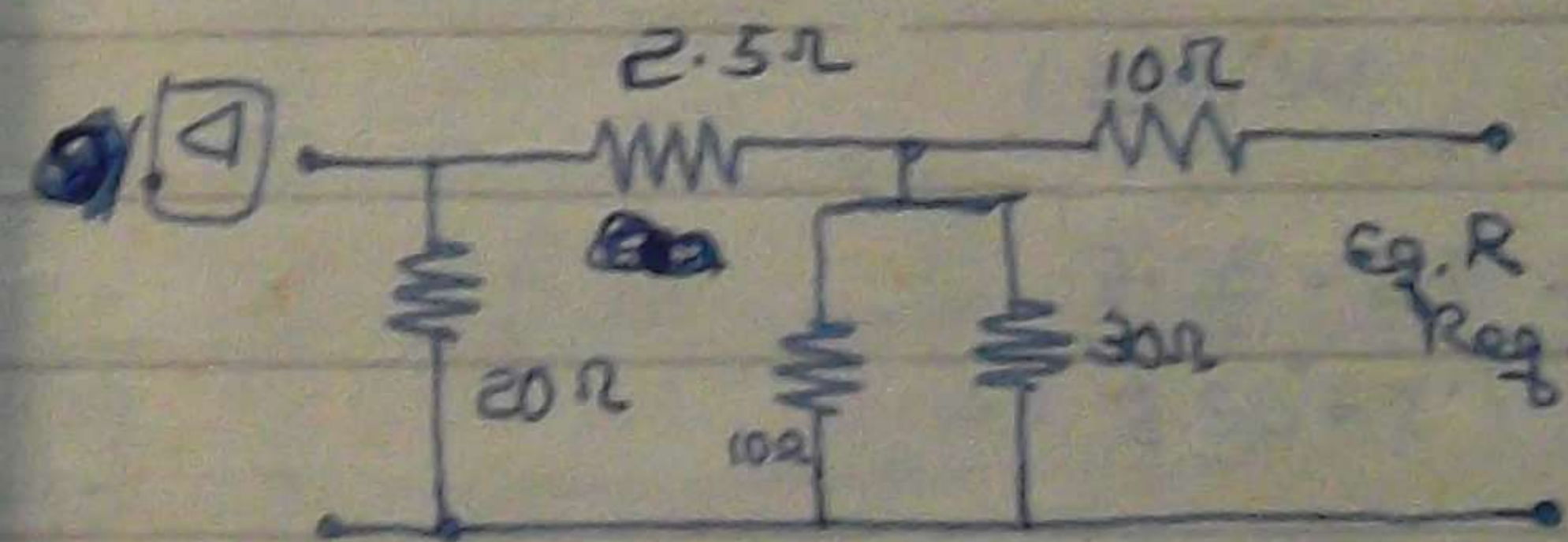
[3]



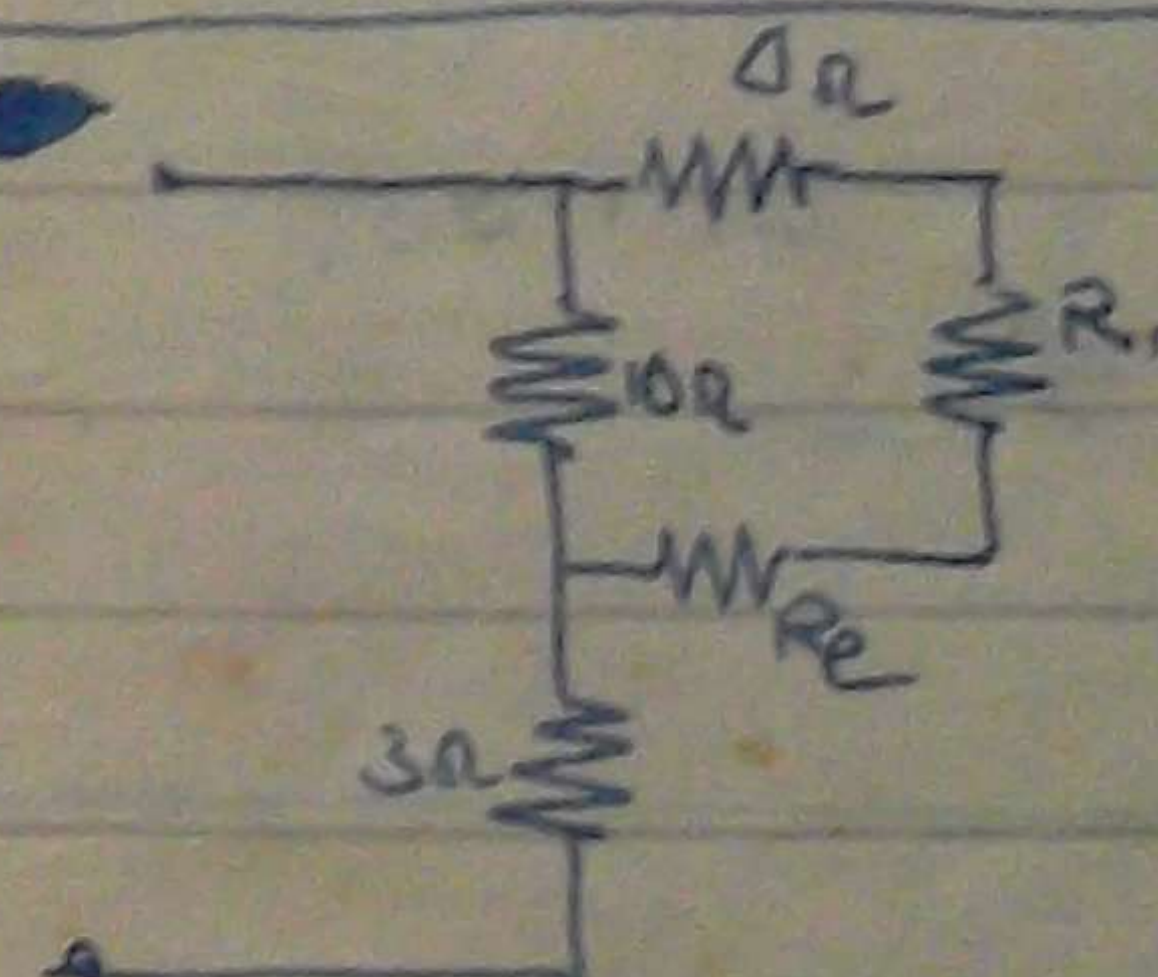
[5] a/b



[4]



[3]



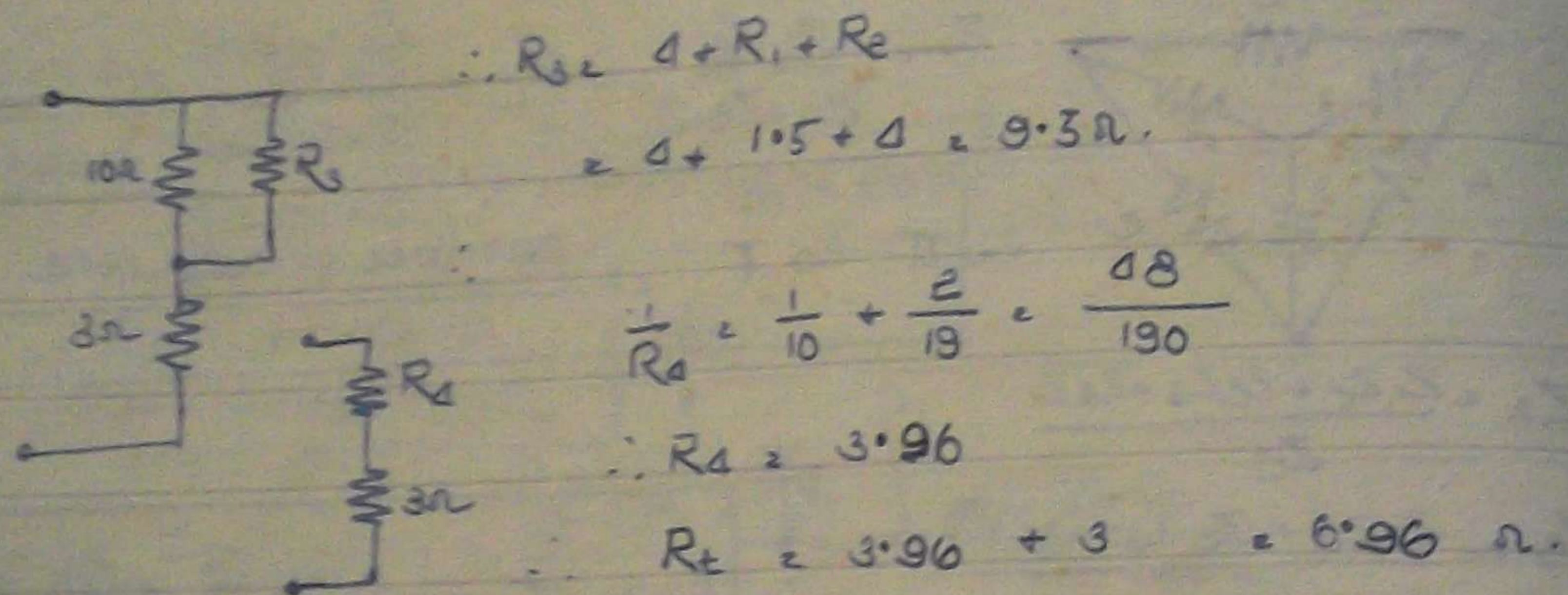
$$\frac{1}{R_1} = \frac{1}{6} + \frac{1}{2} = \frac{4}{6}$$

$$\therefore R_1 = \frac{6}{4} \Omega$$

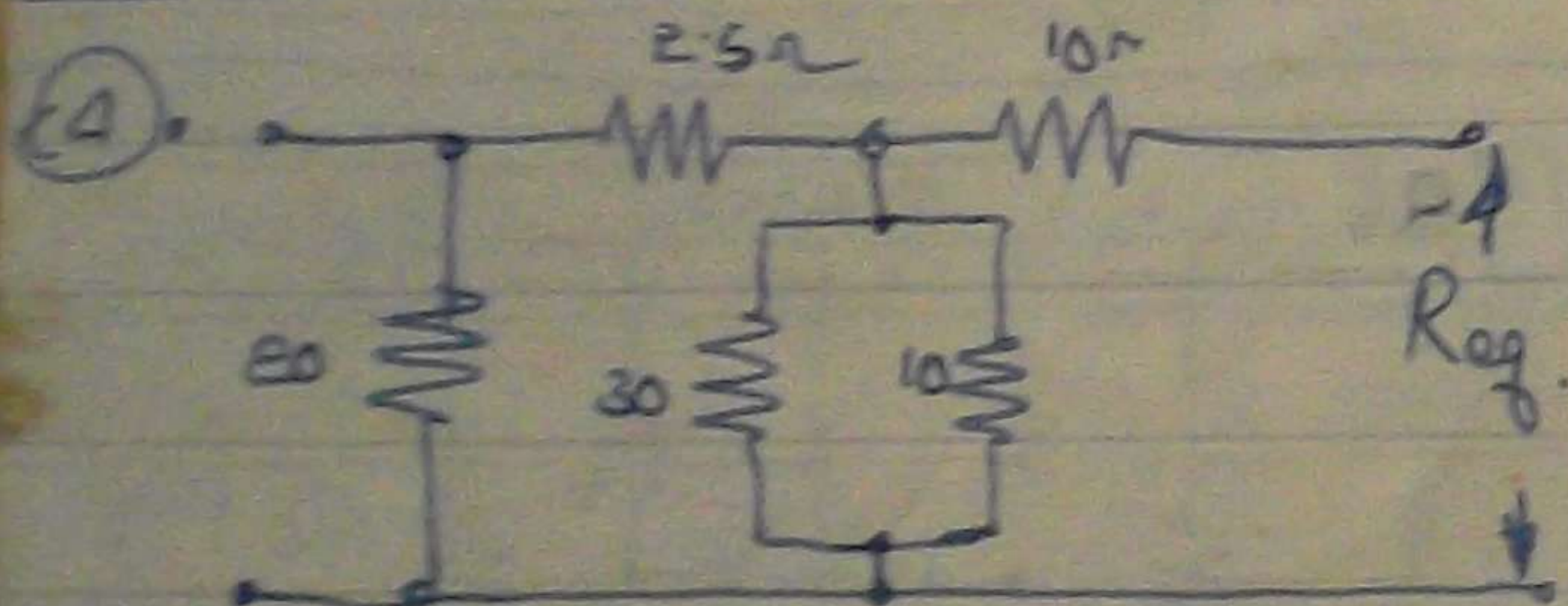
$$\frac{1}{R_e} = \frac{1}{20} + \frac{1}{5} = \frac{5}{20}$$

$$\therefore R_e = 4 \Omega$$

(22)

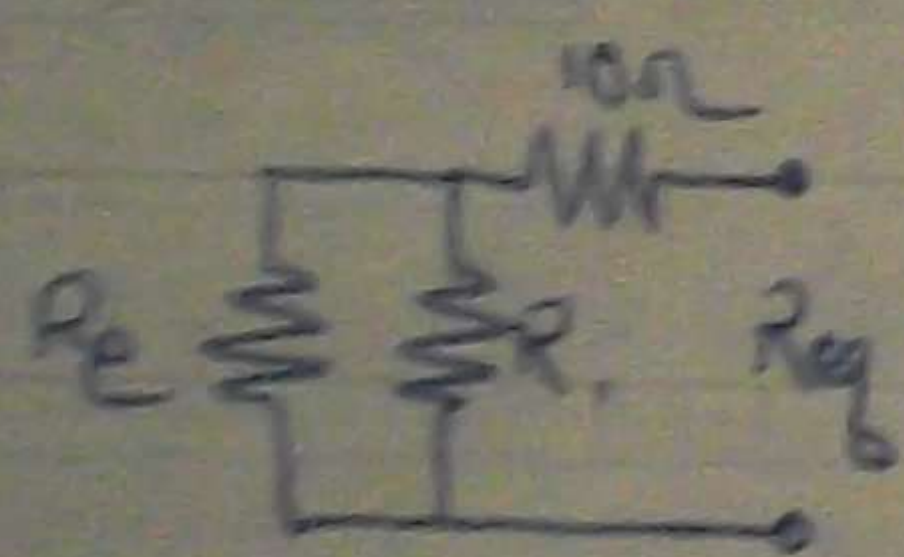


Ans - Equivalent Resistance = 6.96Ω



$$R_1 = \frac{30 \times 10}{30 + 10} = 7.5\Omega \text{ (parallel)}$$

$$R_2 = 2.5 + 20 = 22.5\Omega \text{ (series)}$$



$$\therefore R_{eq} = 10 + \frac{7.5 \times 22.5}{7.5 + 22.5}$$

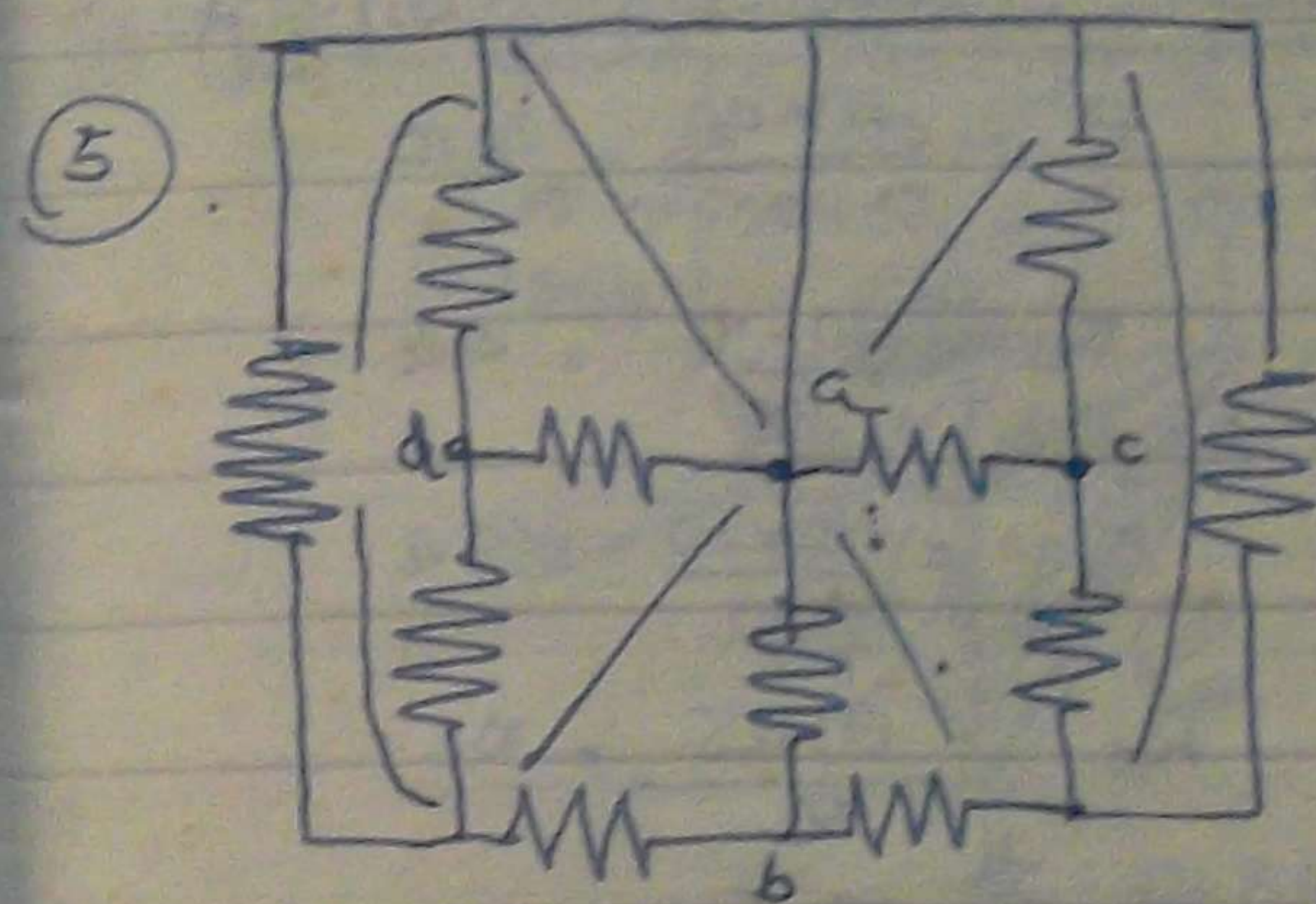
$$= 10 + 3.375$$

$$= 13.375\Omega$$

$$27.1.83.$$

(23)

in each.

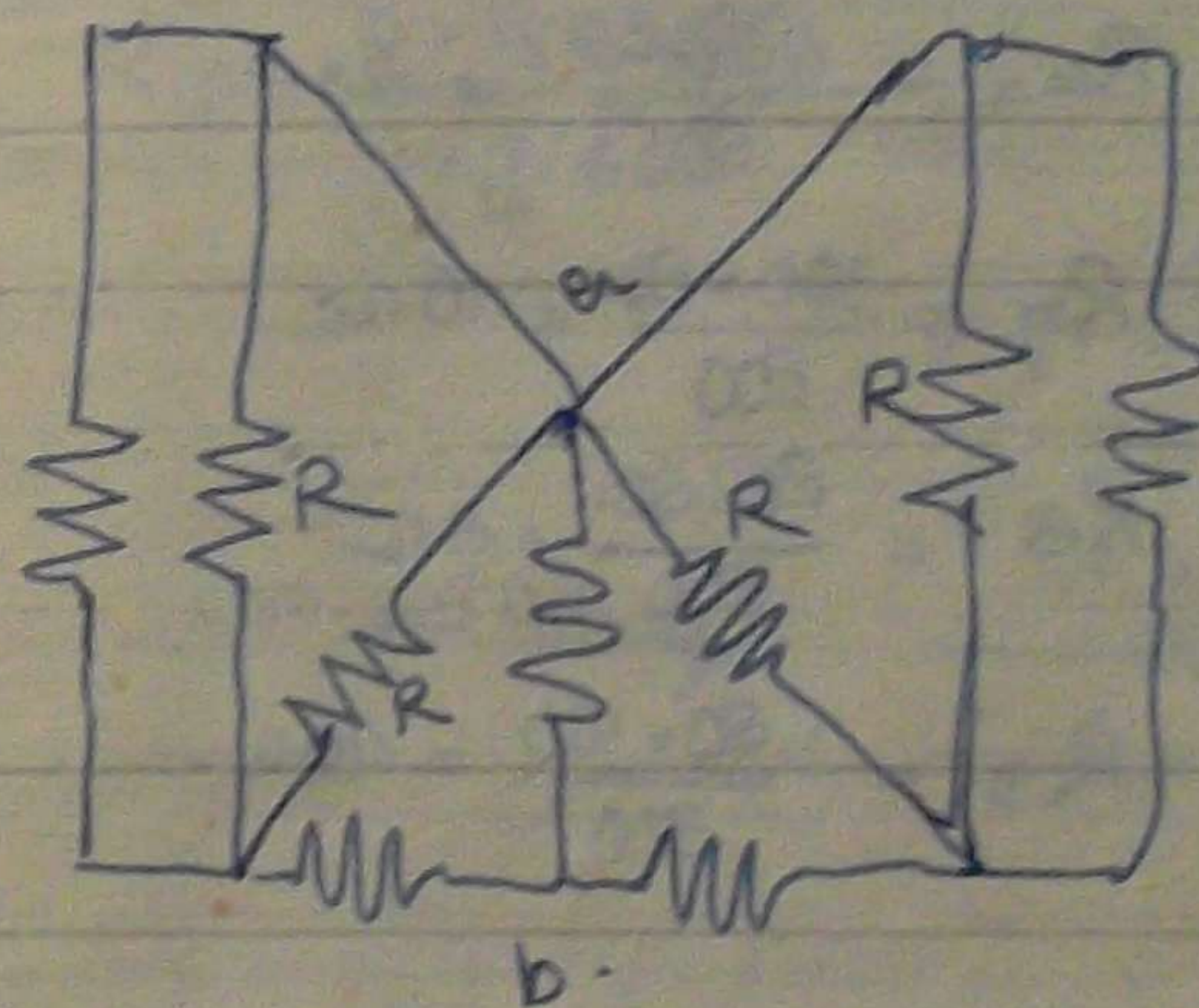


Rab = ?

POINT c & d are STAR to a point.

$$R = 1 + 1 + \frac{1 \times 1}{1} = 3\Omega$$

$$\therefore R \parallel R = \frac{3}{2}\Omega$$



$\therefore$ Now, R_t1 = ?

$$R_{t1} = 1 + \frac{1.5 \times 1}{1.5 + 1} = 0.6 + 1 = 1.6\Omega$$

Now, R_t2 = ?

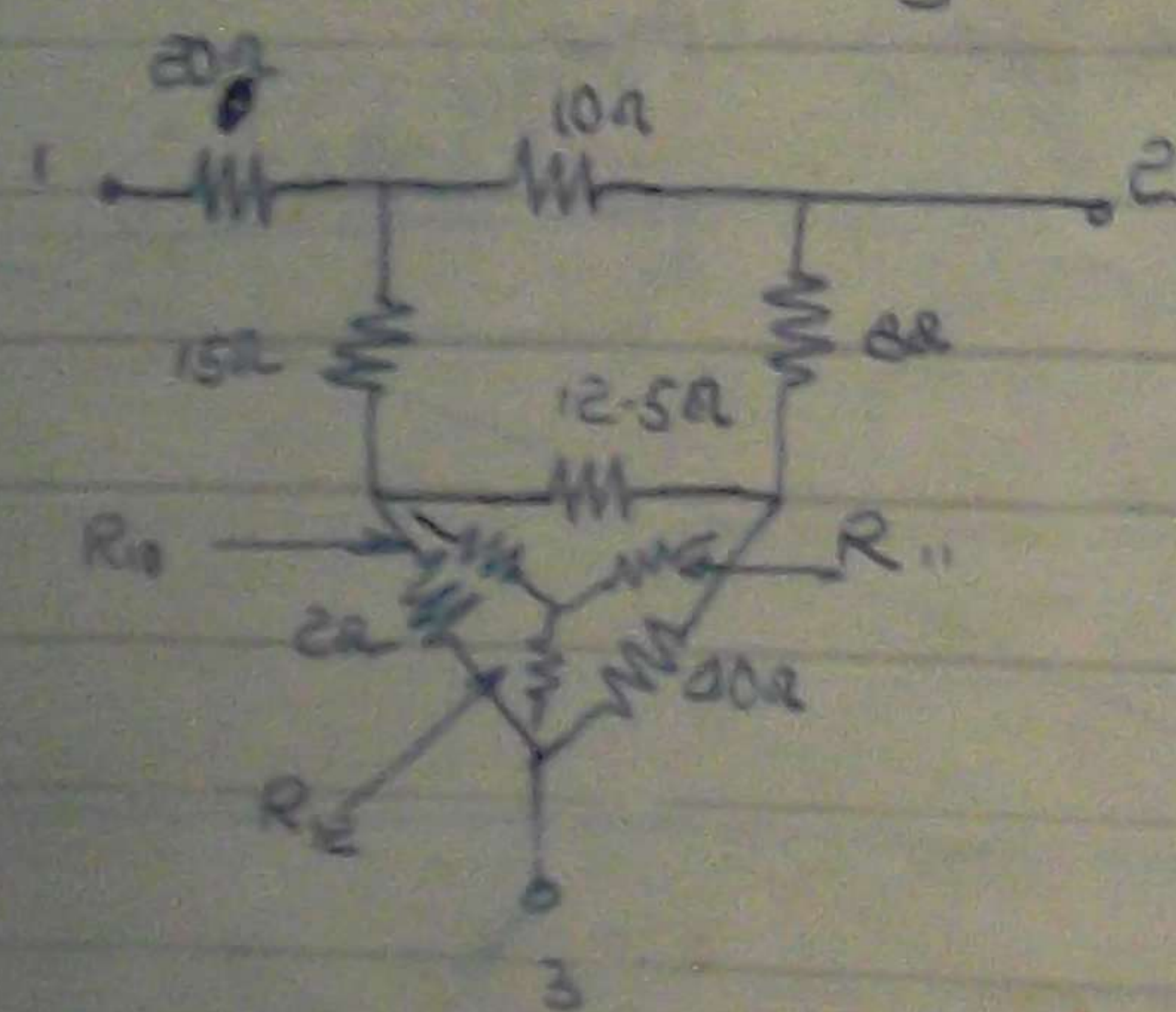
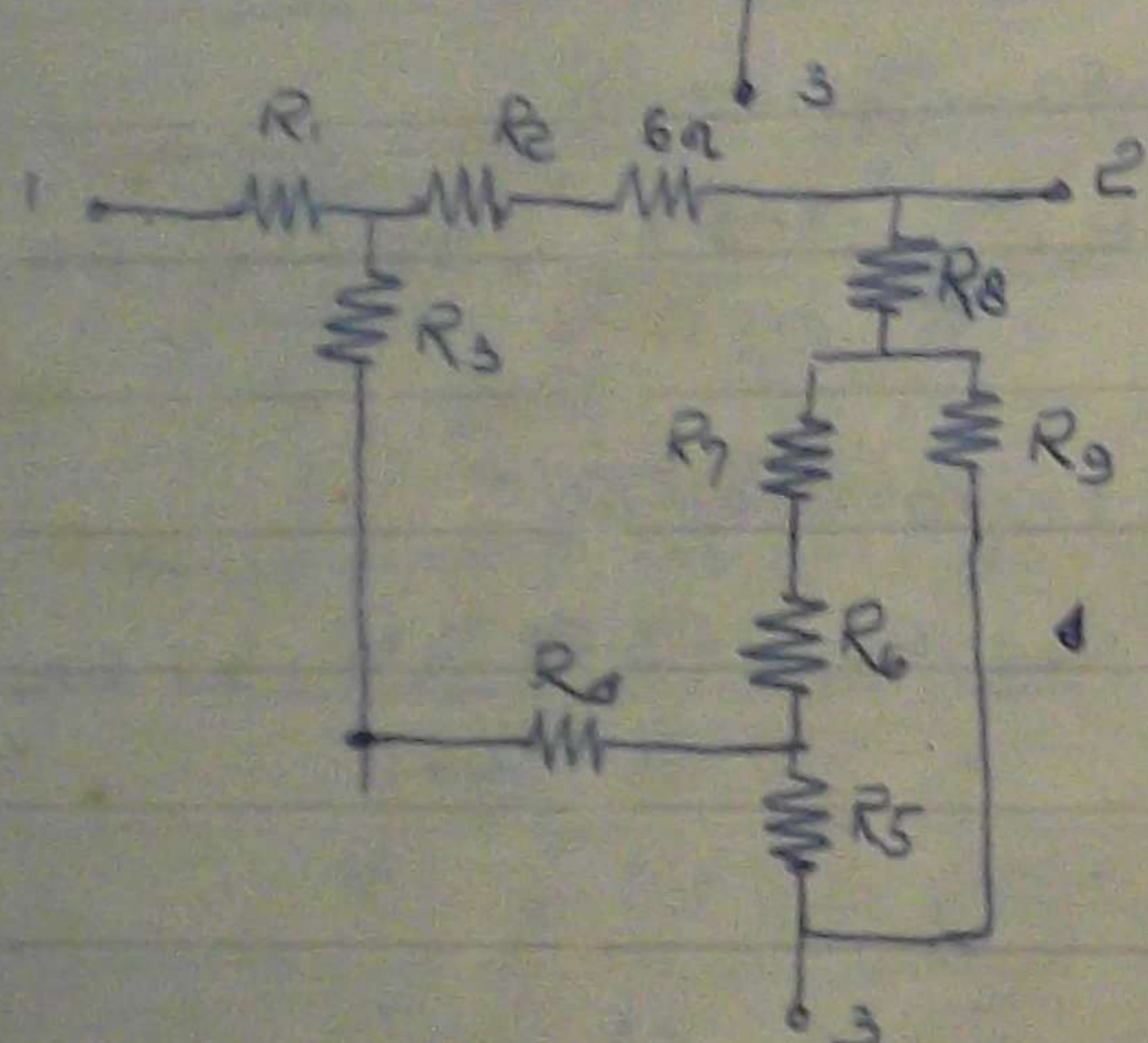
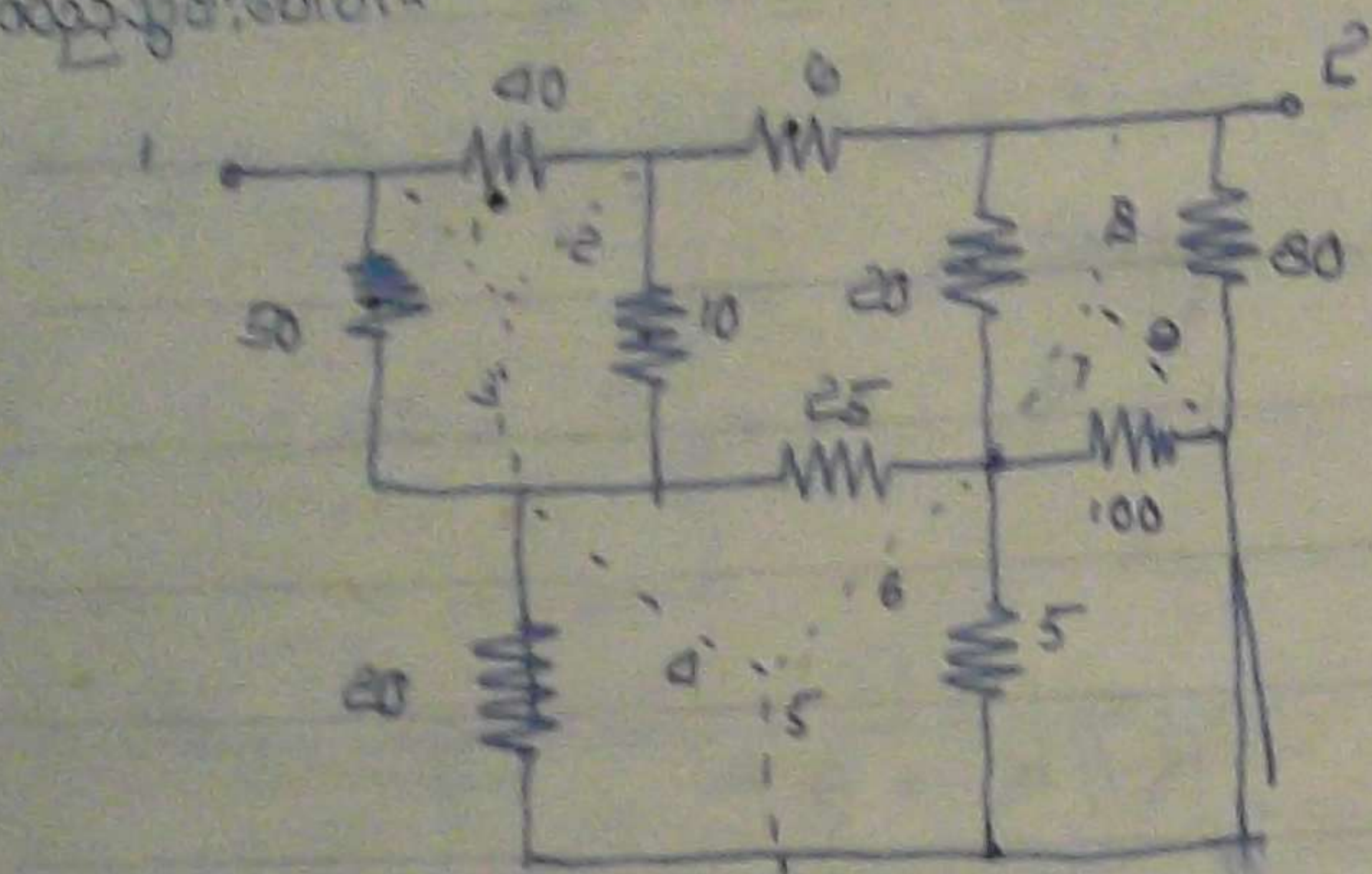
$$R_{t2} = R_{t1} = 1 + \frac{3/2 \times 1}{3/2 + 1} = 1.6\Omega$$

$$\therefore R_{ab} = \frac{1.6}{0.8 + 1} = 0.44\Omega \leftarrow \text{Ans.}$$

$$27.1.83.$$

၁.၂.၁၁.

၁၀. ၁၀၀၀: ၁၀၀၀ complex network ကို ရှင်းလင်းပြီး T network ကို ရှာဖွေပါ။
 ရှင်းလင်းပါ။



$$R_1 = \frac{50 \times 40}{50 + 40 + 10} = 20 \Omega$$

$$R_2 = \frac{40 \times 10}{100} = 4 \Omega$$

$$R_3 = \frac{10 \times 50}{100} = 5 \Omega$$

$$R_4 = \frac{20 \times 25}{50} = 10 \Omega$$

$$R_5 = \frac{20 \times 5}{50} = 2 \Omega$$

$$R_6 = \frac{5 \times 25}{50} = 2.5 \Omega$$

$$R_7 = \frac{100 \times 20}{200} = 10 \Omega$$

$$R_8 = \frac{20 \times 80}{200} = 8 \Omega$$

$$R_9 = \frac{80 \times 100}{200} = 40 \Omega$$

$$R_{10} = \frac{2 \times 2.5}{54.5} = \frac{25}{54.5} = 0.459 \Omega$$

$$R_{11} = \frac{12.5 \times 40}{54.5} = \frac{500}{54.5} = 9.174 \Omega$$

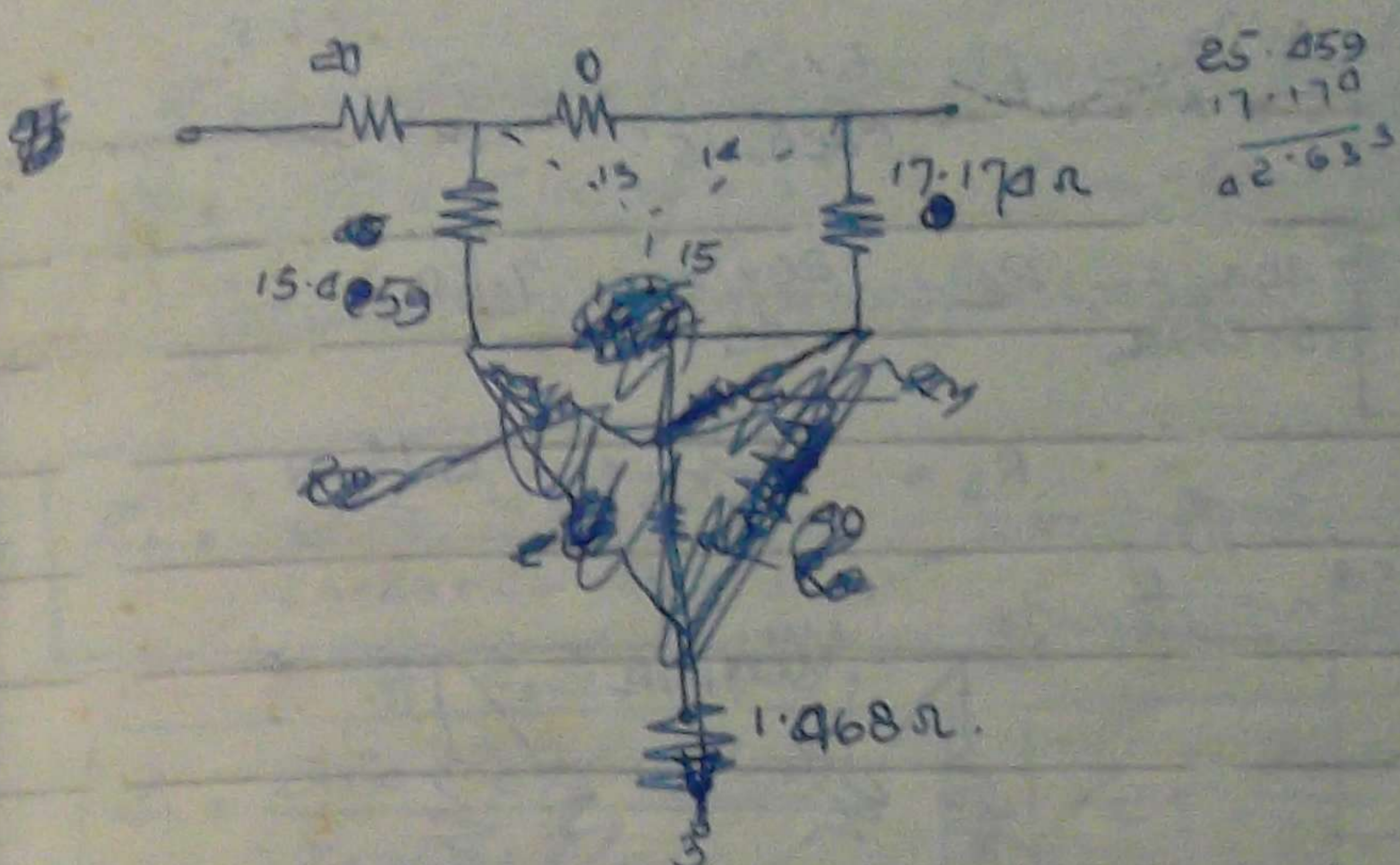
$$R_{12} = \frac{2 \times 40}{54.5} = \frac{80}{54.5} = 1.468 \Omega$$

$$R_{13} = \frac{2 \times 2.5}{54.5} = \frac{25}{54.5} = 0.459 \Omega$$

$$R_{14} = \frac{12.5 \times 40}{54.5} = \frac{500}{54.5} = 9.174 \Omega$$

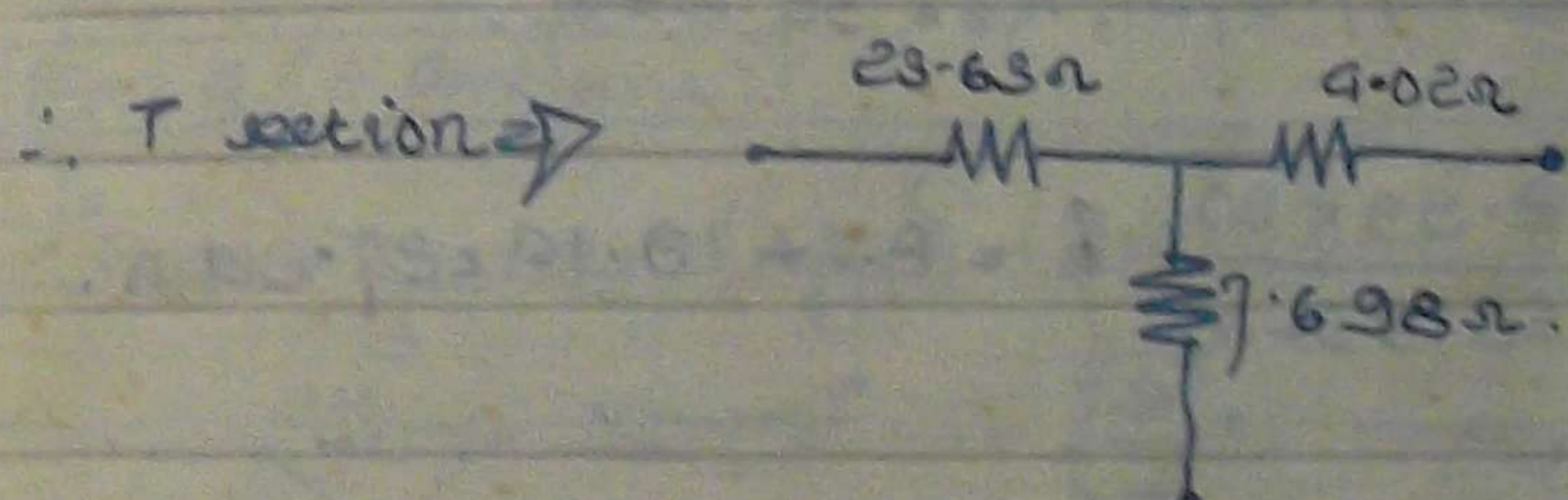
$$R_{15} = \frac{2 \times 40}{54.5} = \frac{80}{54.5} = 1.468 \Omega$$

၁၂

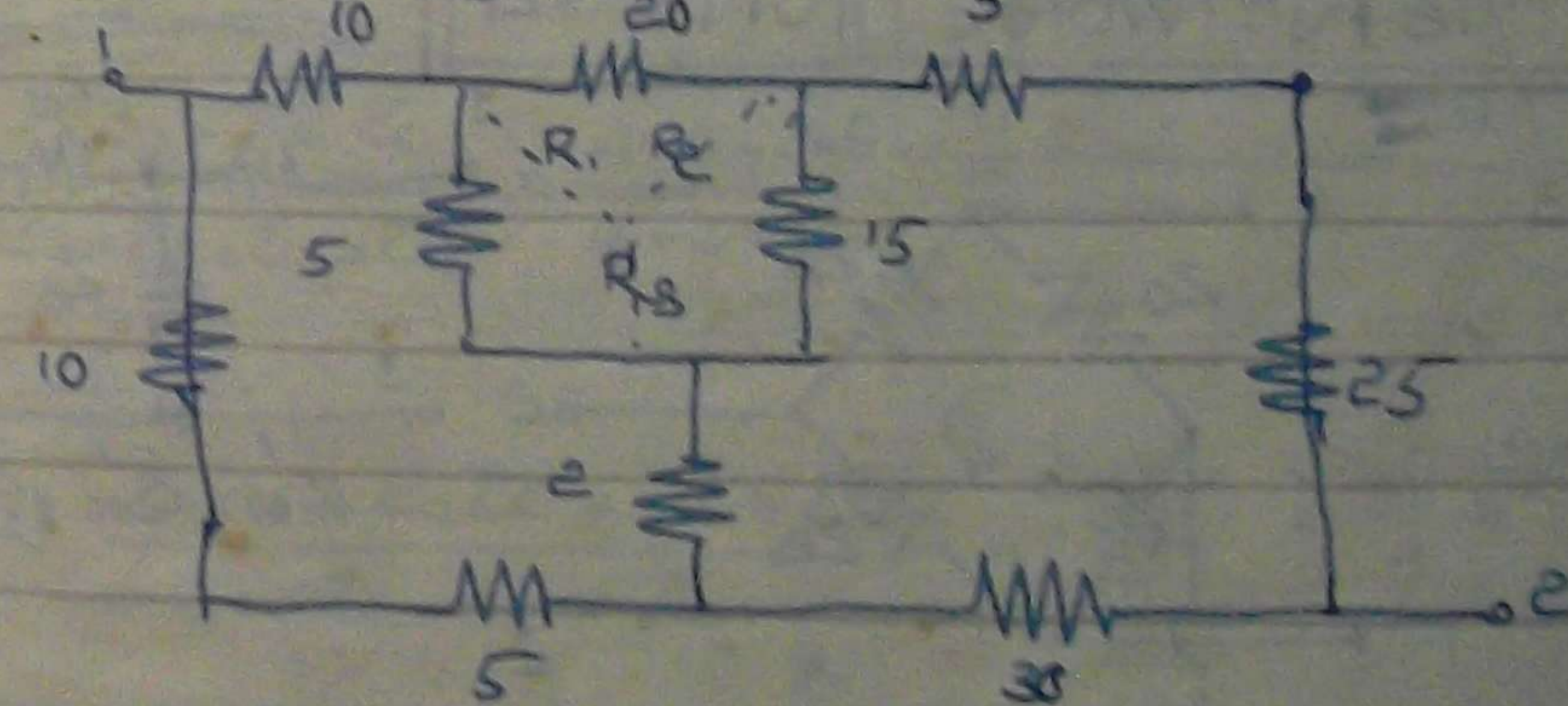


$$R_{13} = \frac{10 \times 15 \times 4.59}{42.633} = 3.63 \Omega, R_{14} = \frac{10 \times 17.17}{42.633} = 4.02 \Omega$$

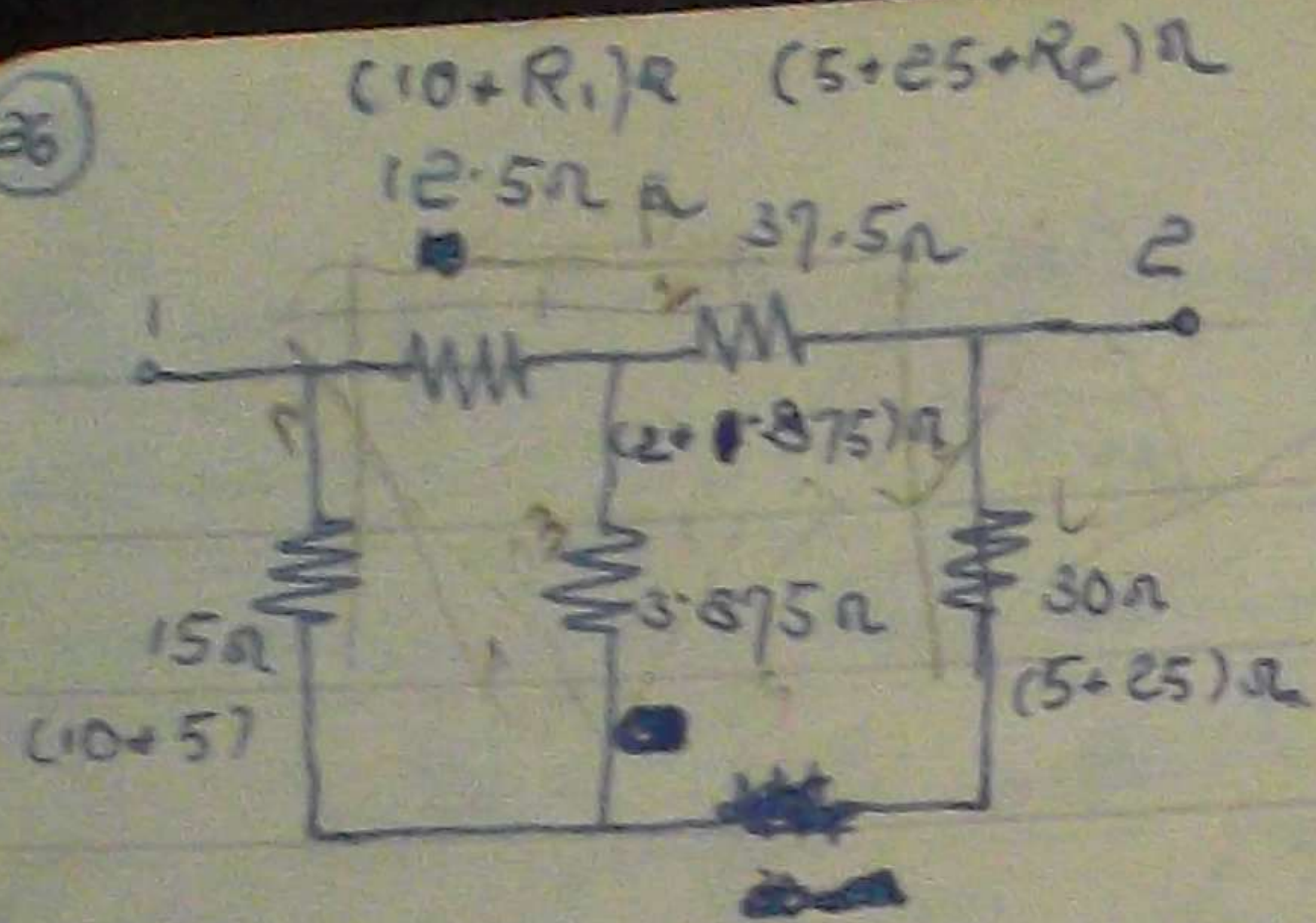
$$R_{15} = \frac{15 \times 4.59 \times 17.17}{42.633} = 6.23 \Omega$$



၇. Point ၁, ၂, ၃ ကို အတူတူ ဆက်သပါ။



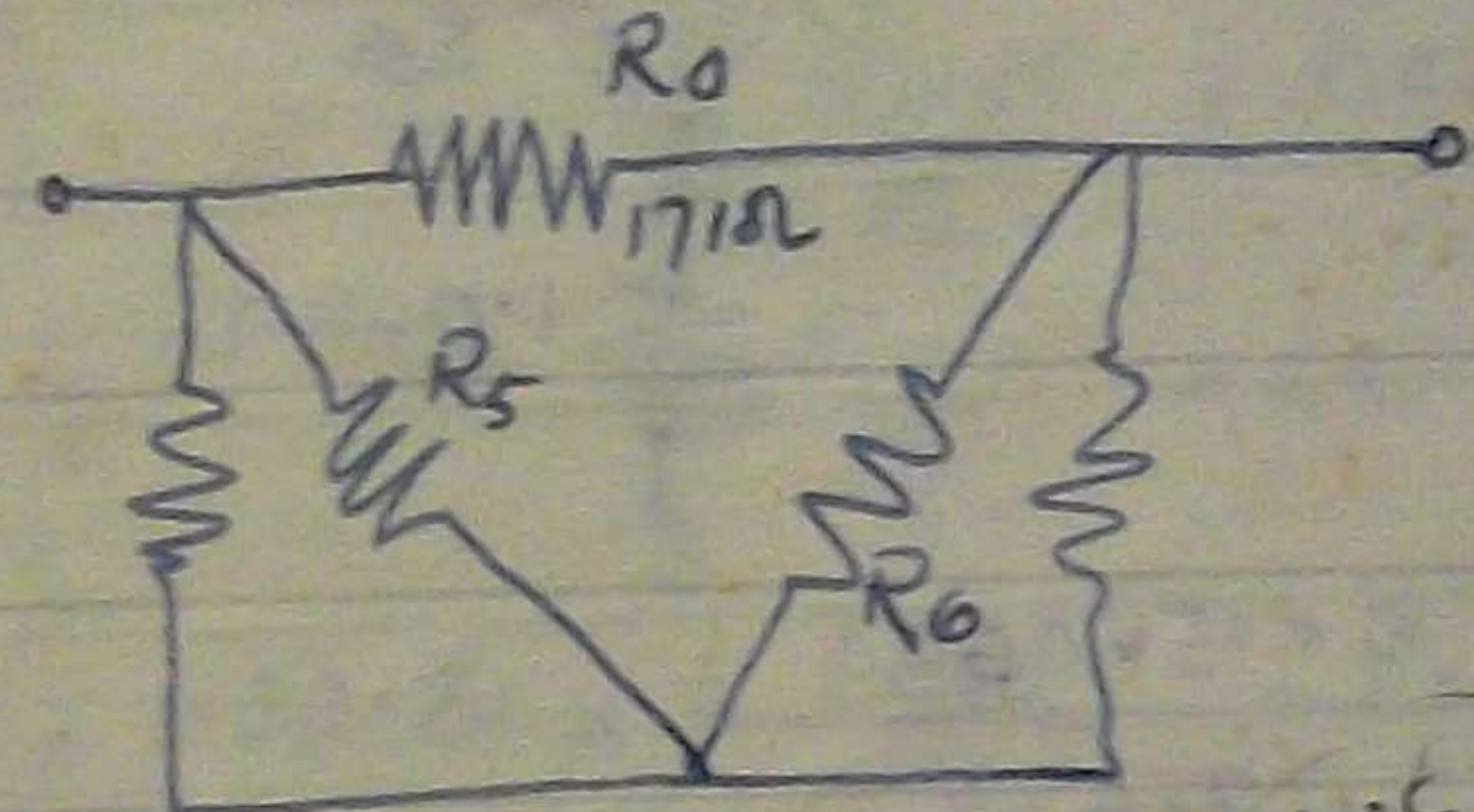
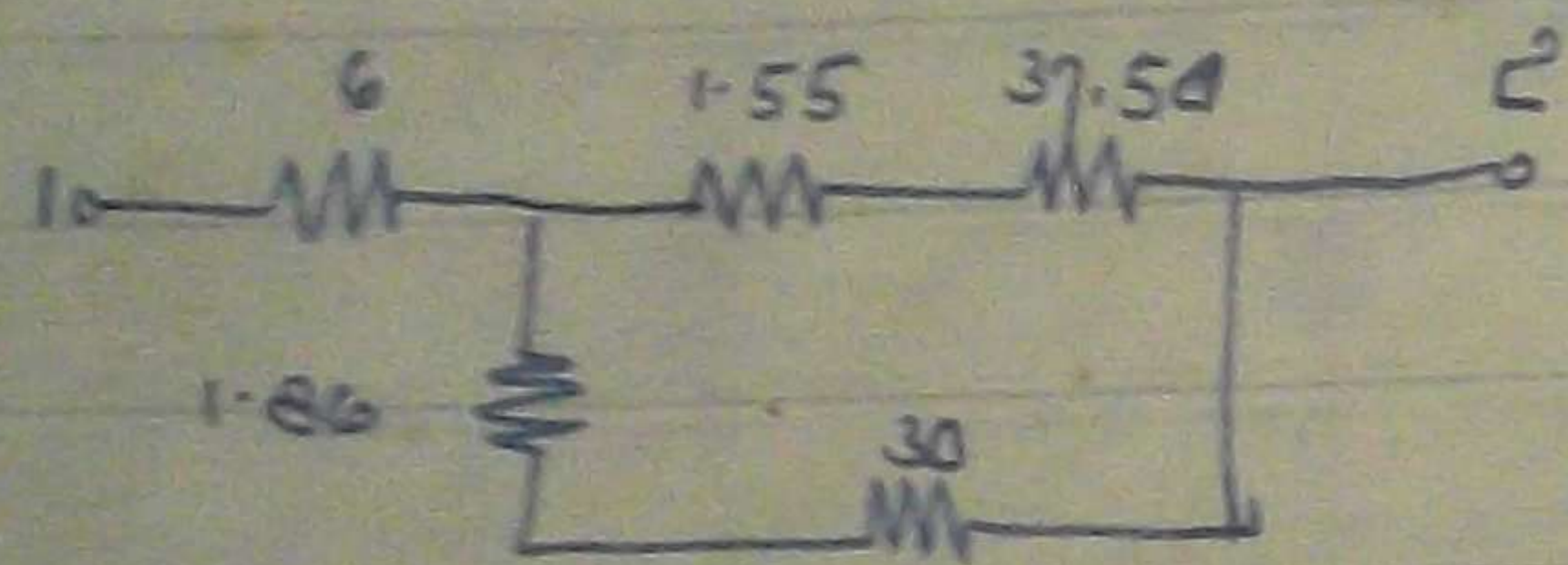
26



$$R_1 = \frac{5 \times 20}{5 + 20 + 15} = 2.5 \Omega$$

$$R_e = \frac{20 \times 15}{40} = 7.5 \Omega$$

$$R_3 = \frac{5 \times 15}{40} = 1.875 \Omega$$



$$R_4 = 12.5 + 37.5 + \frac{12.5 \times 37.5}{3.875} = 171 \Omega$$

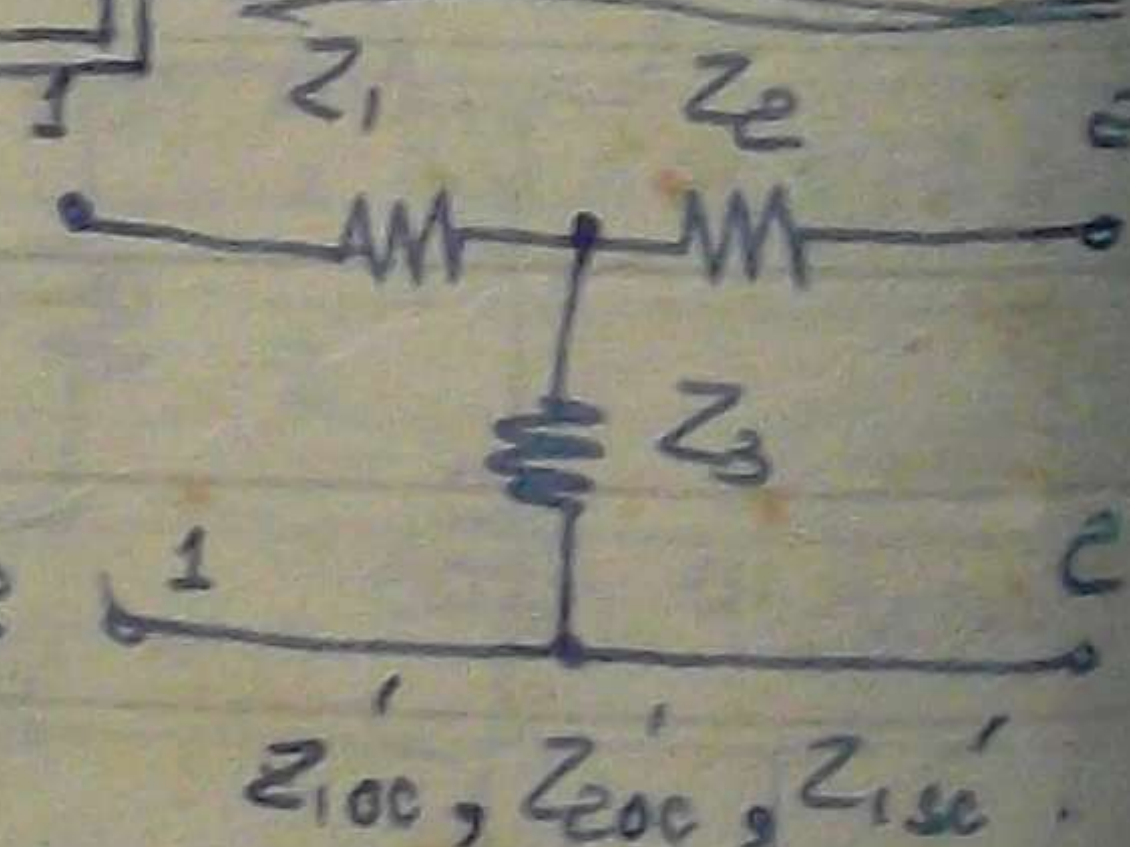
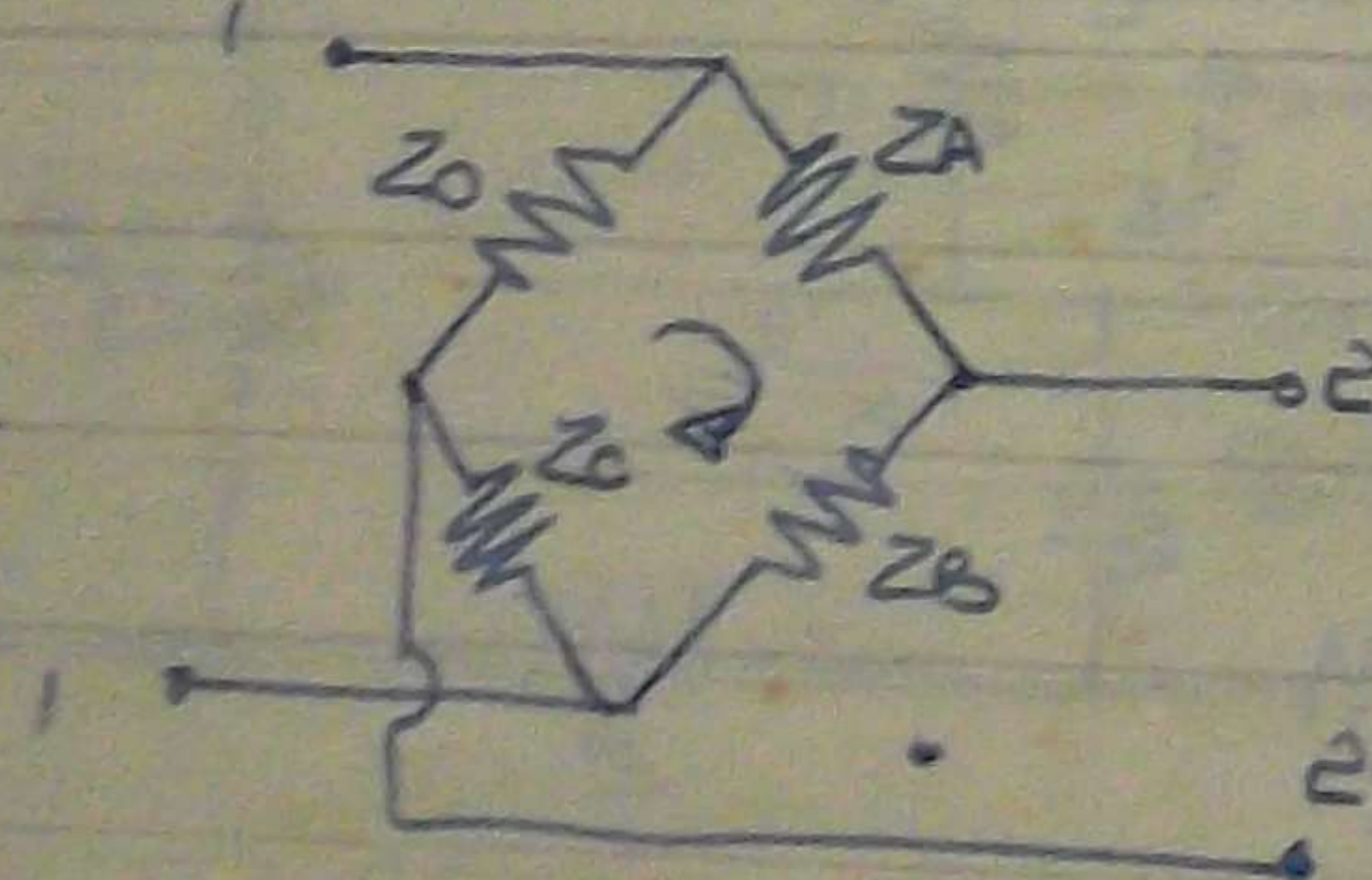
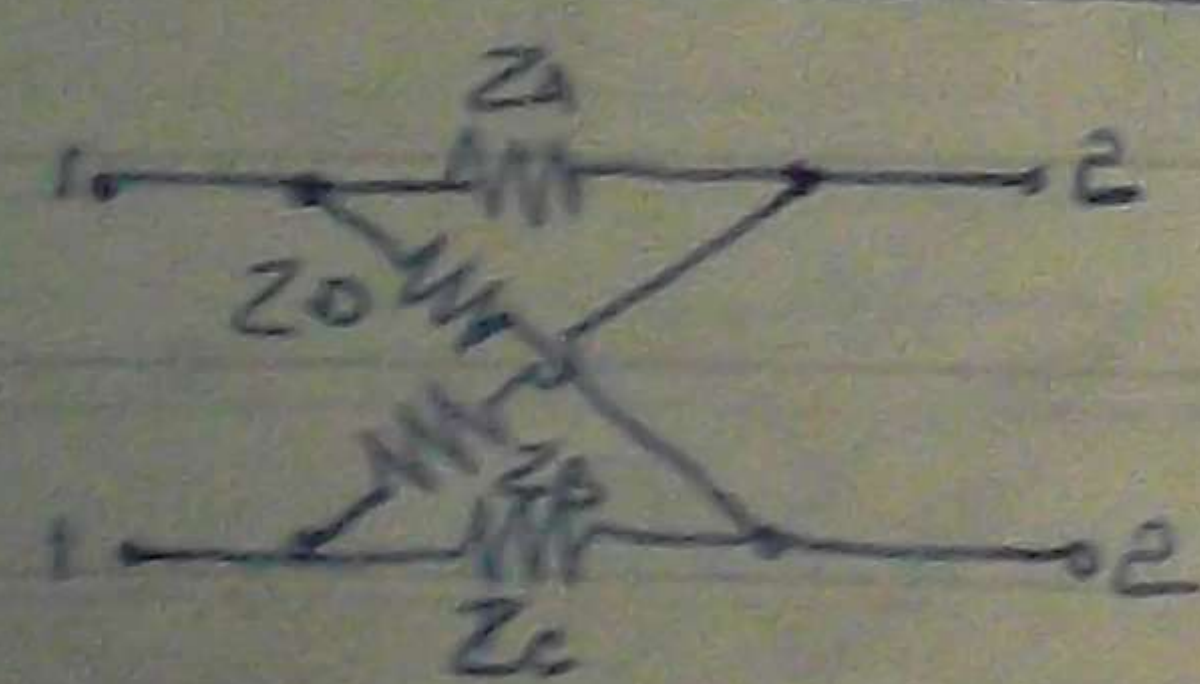
$$R_5 = 12.5 + 3.875 + \frac{12.5 \times 3.875}{37.5} = 17.67 \Omega, R_6 = 52.99 \Omega$$

$$R = \frac{17.67 \times 15}{17.67 + 15} + \frac{52.99 \times 30}{52.99 + 30} = 8.1 + 19.14 = 27.24 \Omega$$

$$R_{1 \& 2} = \frac{27.24 \times 171}{27.24 + 171} = 20.52 \Omega$$

THE LATTICE NETWORK

CHAP 8.1



$$\frac{1}{Z_{100}} = \frac{1}{Z_C + Z_D} + \frac{1}{Z_A + Z_B}$$

(series, // ပုံစံဖြင့် ရှာကြည့်ပါ)
(တူညီမျှတခြင်းဖြင့် ရှာကြည့်ပါ)

27

အနိမ့်ဆုံး ပြုပြင်မှု (Z0, 0, 0) ဖြစ်စေရန် လိုအပ်သည်။

ဥပမာ $Z_1 = Z_{100} - Z_3$, $Z_e = Z_{e00} - Z_3$ သာဖြစ်ရန်၊
formula derivation ဟု ခေါ်ဆိုနိုင်သည်။ eFM

$$Z_3 = \frac{Z_A Z_C - Z_B Z_D}{Z_A + Z_B + Z_C + Z_D}$$

if $Z_A Z_C > Z_B Z_D$

$$Z_1 = \frac{Z_A Z_D + Z_B Z_C + 2 Z_B Z_D}{Z_A + Z_B + Z_C + Z_D}$$

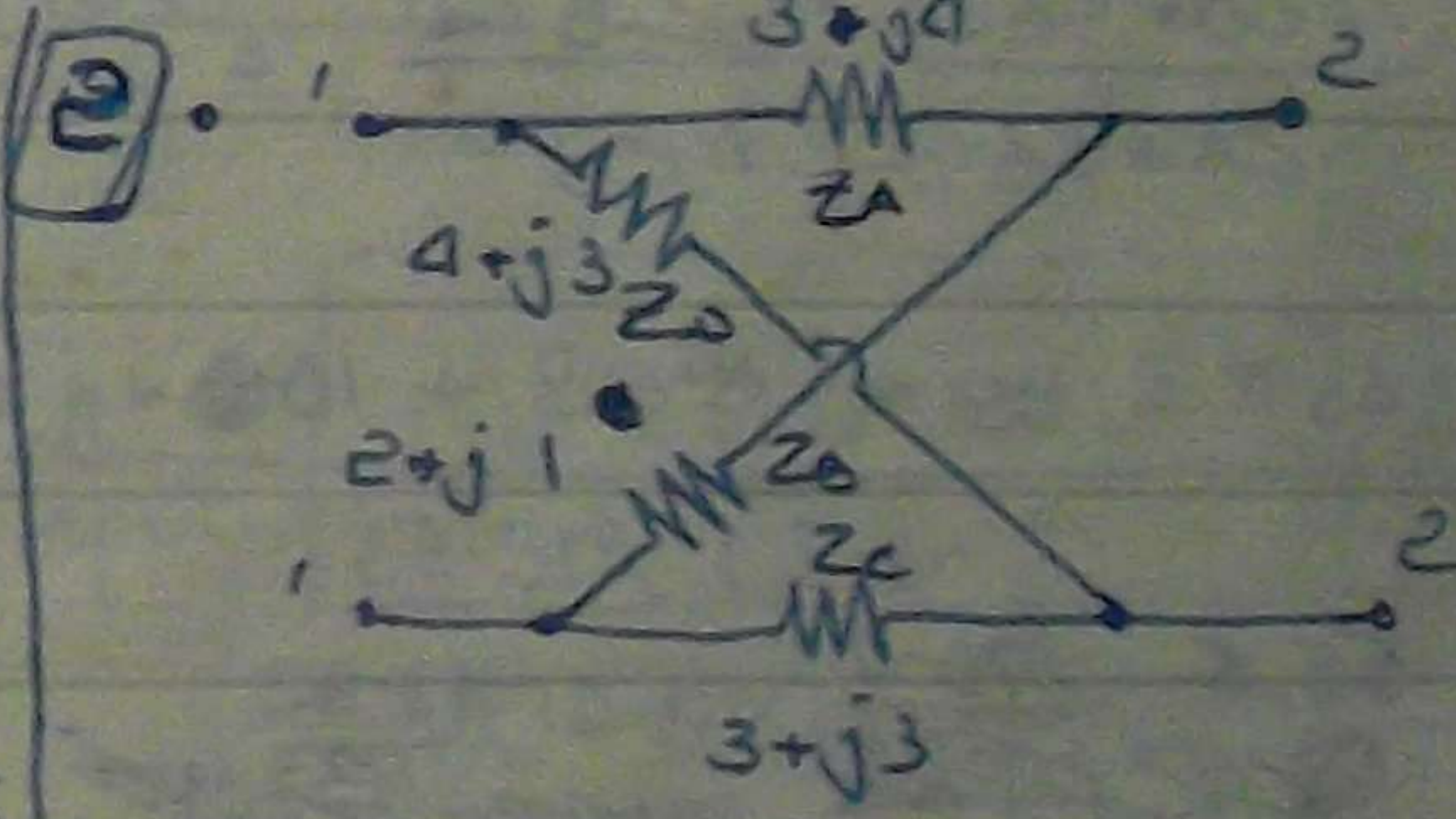
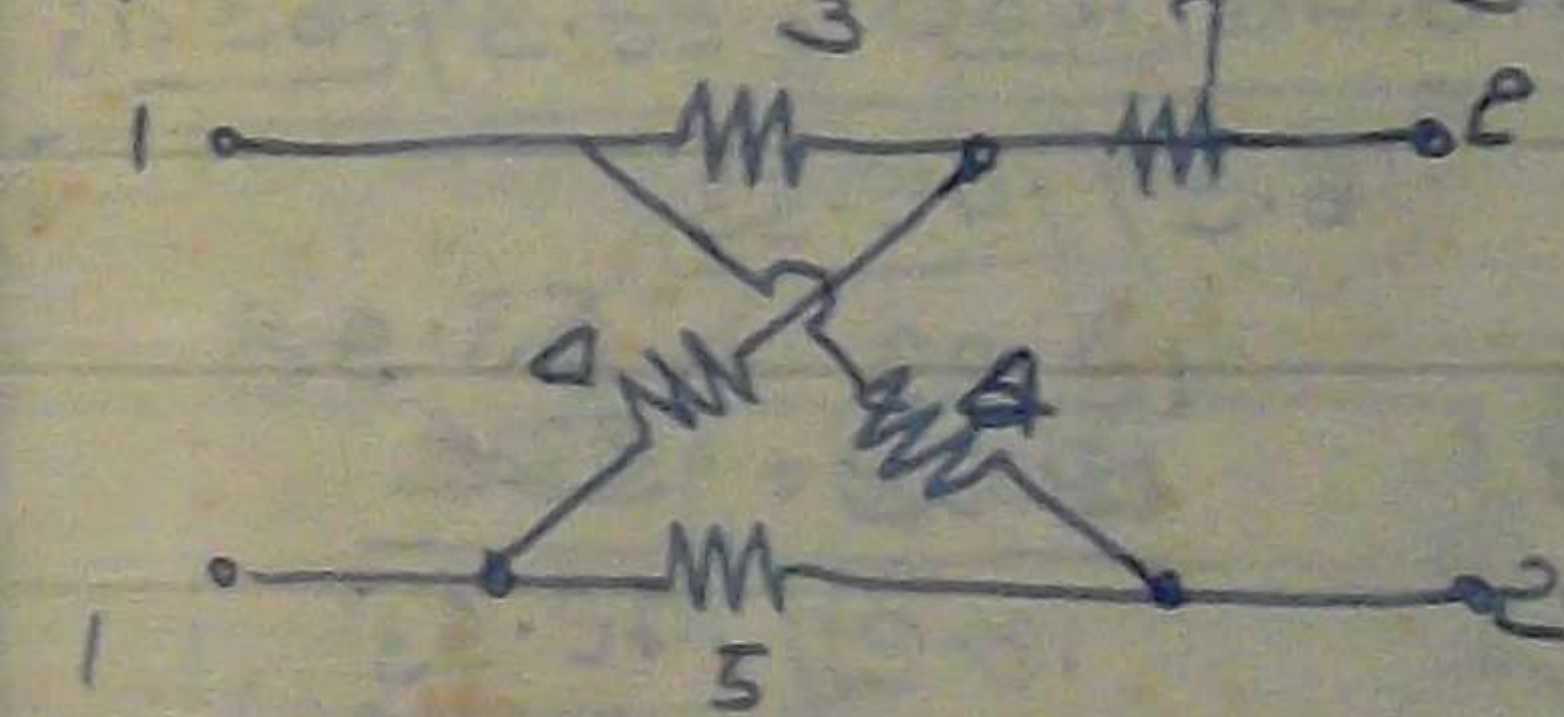
$$Z_e = \frac{Z_A Z_B + Z_C Z_D + 2 Z_C Z_D}{Z_A + Z_B + Z_C + Z_D}$$

if $Z_A Z_C < Z_B Z_D \Rightarrow 2 Z_B Z_D$ စာကွပ် 2 $Z_A Z_C$ ကို စားထိုးရမည်။

မှတ်ချက်- $Z_A Z_C$ သာရှိသည့် ဖြစ်ရန် Z_1, Z_e တွင် လိုအပ်သော $Z_A Z_C$ စား 2 $Z_B Z_D$ ကို စားထိုးရမည်။
တွက်ချက်ပါ။ နောက် product ကို ရှာကြည့်ပါ။ 1 KW calculated

Ex 8.4 (e Problems)

1. လက်ရှိကွန်ပျူတာ network ကို equivalent T section ကို ရေးပါ။

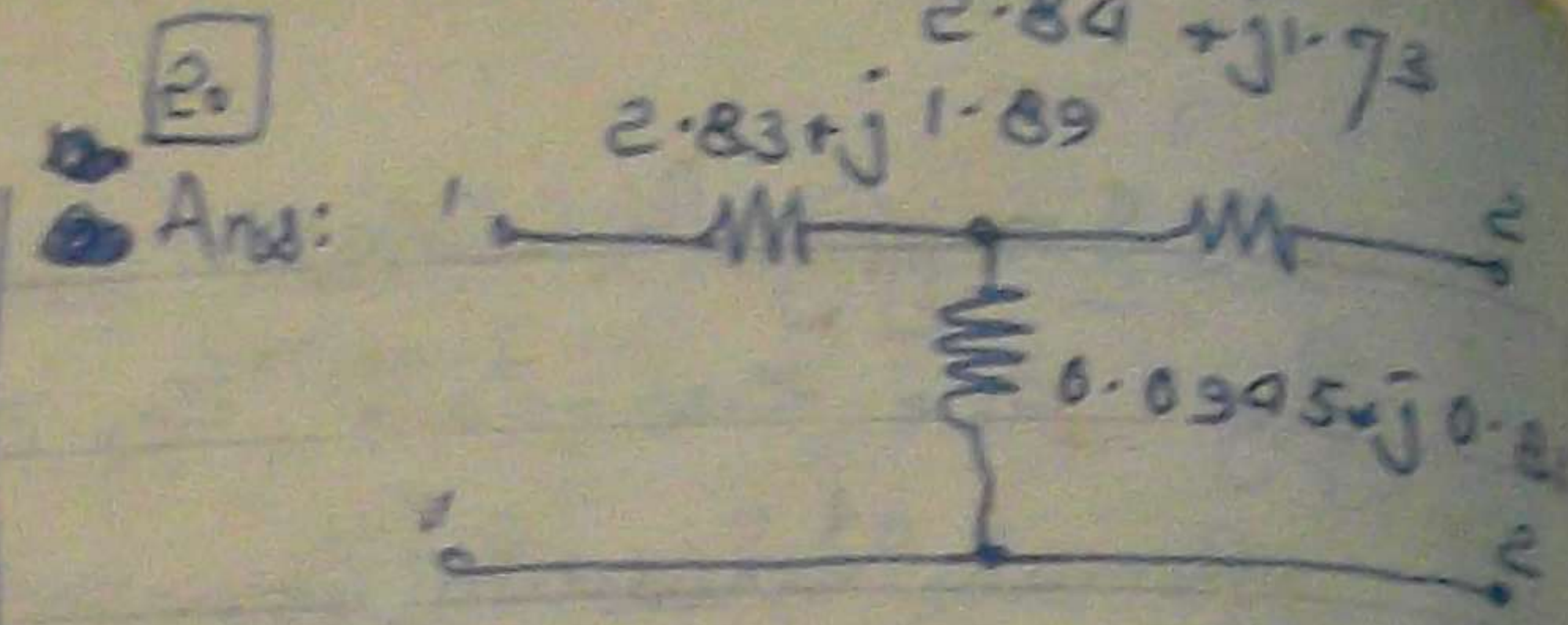
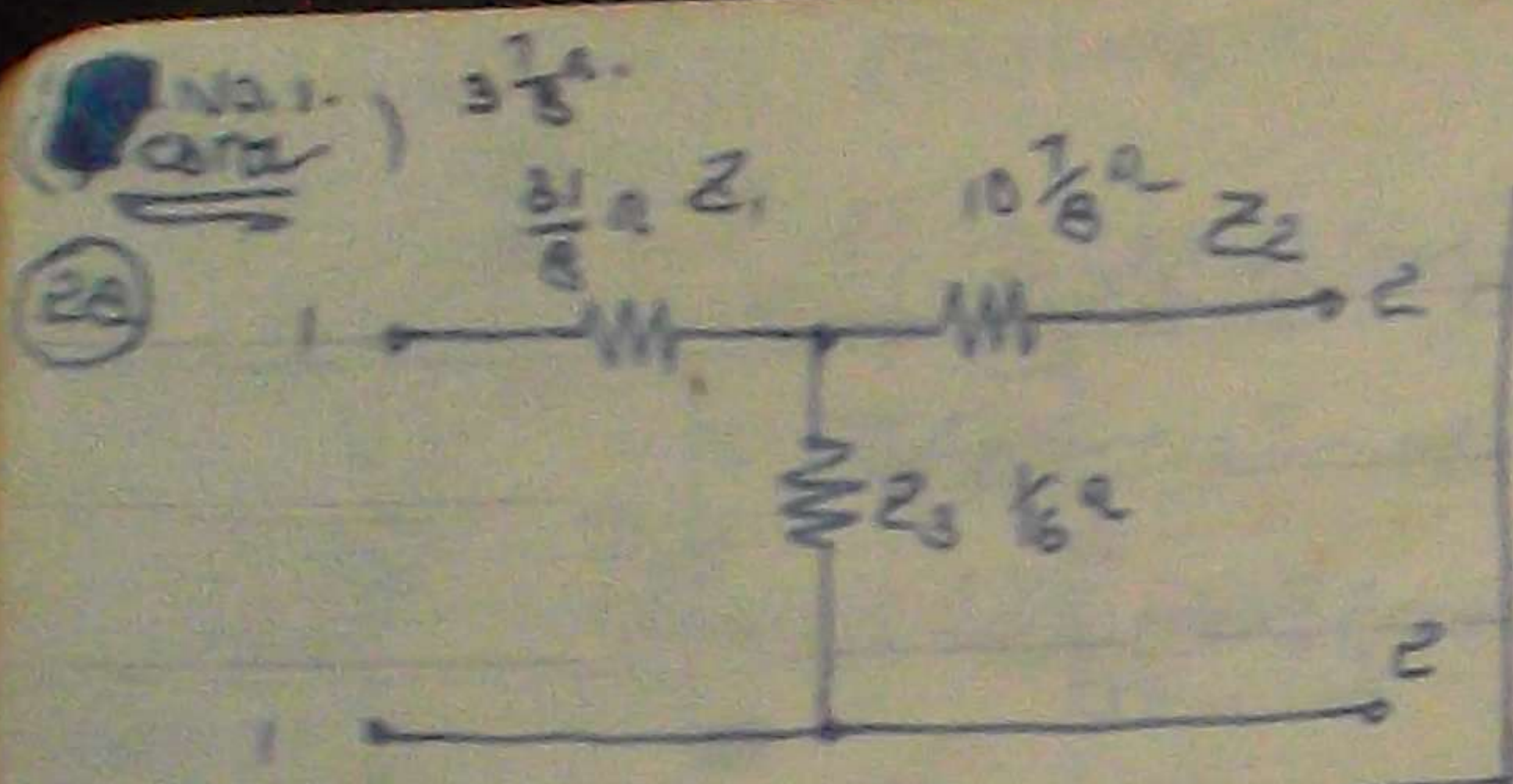


$$Z_3 = \frac{Z_B Z_D - Z_A Z_C}{Z_A + Z_B + Z_C + Z_D} = \frac{4 \times 4 - 3 \times 5}{4 + 3 + 5 + 4}$$

$$= \frac{1}{16} \Omega$$

$$Z_e = \frac{Z_A Z_B + Z_C Z_D + 2 Z_A Z_C}{Z_A + Z_B + Z_C + Z_D} = \frac{6 \times 2}{16} = \frac{3}{8} \Omega$$

$$Z_1 = \frac{Z_A Z_D + Z_B Z_C + 2 Z_B Z_D}{Z_A + Z_B + Z_C + Z_D} = \frac{3 \times 4 + 4 \times 5 + 30}{16} = \frac{31}{8} \Omega$$



Ans: $Z_3 = \frac{Z_1 Z_2 - Z_0 Z_0}{Z_1 + Z_2 + Z_0 + Z_0} = \frac{5 \angle 53.13^\circ \times 4 \angle 45^\circ - 2 \angle 237^\circ / 26.58^\circ \times 5 \angle 30^\circ}{12 + j11}$

$= \frac{21.2 \angle 98.13^\circ - 11.185 \angle 63.45^\circ}{16.27 \angle 42.53^\circ}$

$= \frac{2.995 \angle 21^\circ - 5 \angle 10^\circ}{16.27 \angle 42.53^\circ} = \frac{-7.995 + j11}{16.27 \angle 42.53^\circ}$

$= \frac{13.6 \angle 126^\circ}{16.27 \angle 42.53^\circ} = 0.836 \angle 83.47^\circ$

$= 0.0346 + j0.831$

$Z_0 = \frac{Z_1 Z_0 + Z_2 Z_0 + Z_3 Z_0}{Z_1 + Z_2 + Z_0 + Z_0} = \frac{25 \angle 80^\circ + 9.48 \angle 71.58^\circ + 22.37 \angle 63.45^\circ}{16.27 \angle 42.53^\circ}$

$= \frac{j25 + 2.99 + j8.98 + 100 + j20}{16.27 \angle 42.53^\circ} = \frac{12.99 + j53.98}{16.27 \angle 42.53^\circ}$

$= \frac{55.5 \angle 76.47^\circ + 3.41 \angle 83.93^\circ}{16.27 \angle 42.53^\circ} = \frac{2.825 + j1.904}{16.27 \angle 42.53^\circ}$

$Z_2 = \frac{Z_1 Z_3 + Z_2 Z_0 + Z_3 Z_0}{Z_1 + Z_2 + Z_0 + Z_0} = \frac{11.185 \angle 79.71^\circ + 21.2 \angle 81.87^\circ + 22.37 \angle 63.45^\circ}{16.27 \angle 42.53^\circ}$

$= \frac{2 + j11 + 3 + j21 + 10 + j20}{16.27 \angle 42.53^\circ} = \frac{54.15 \angle 73.92^\circ}{16.27 \angle 42.53^\circ}$

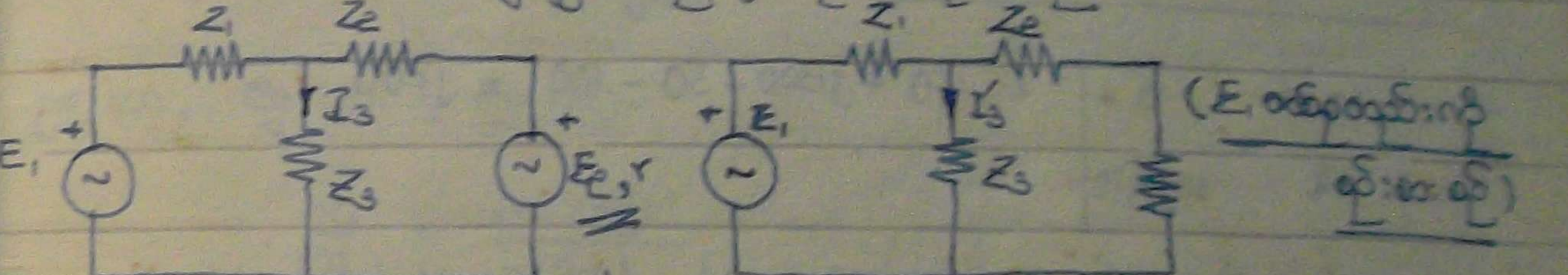
$= 3.33 \angle 31.39^\circ = 2.84 + j1.735$

3.2.3, THU.

CHAPTER. V

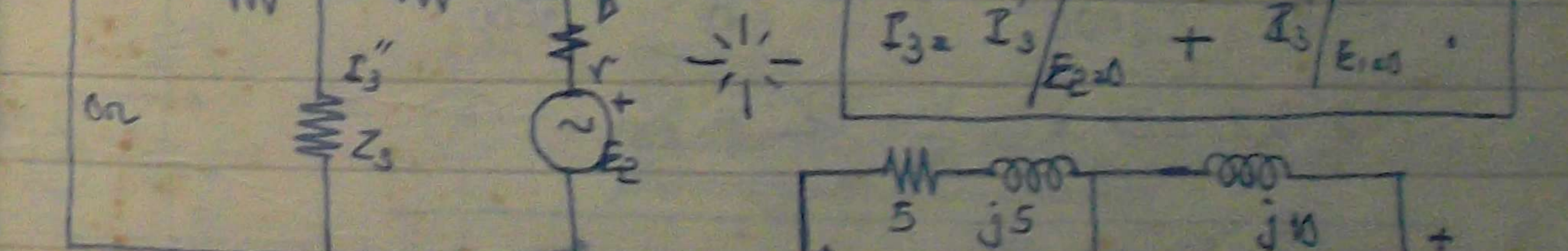
SUPER. POSITION THEOREM (78) ပညာရေး

Linear impedance ပြုငြိမ်းသော network တစ်ခုတွင် energy source တစ်ခုခုကို network ၏ တစ်ခုခုမှ ဖယ်ထားကာ နောက်ဆုံးတွင် energy source တစ်ခုခုကို စိုက်ထည့်ရသော နာမည်တူသော network တွင် ပြောင်းလဲခြင်းသည် Energy source တစ်ခုခုကို စိုက်ထည့်ခြင်းကို ကျင့်သော energy source တစ်ခုခုနှင့် ဆင်တူသည်။ Energy source တစ်ခုခုကို short ပြုခြင်းသည် Voltage source တစ်ခုခုကို short ပြုခြင်းနှင့် ဆင်တူသည်။ Voltage source တစ်ခုခုကို open ပြုခြင်းသည် Voltage source တစ်ခုခုကို short ပြုခြင်းနှင့် ဆင်တူသည်။ internal resistance မှတ်တမ်းတင်ထားသည်။



$I_3 | E_1, E_2$ (or) $I_3 | E_2=0$ V ကို short ပြုခြင်း။

I_3 belongs both E_1 & E_2 . I_3' belongs $E_2=0$ V for E_1 .



$I_3 = I_3' / E_2=0 + I_3'' / E_1=0$

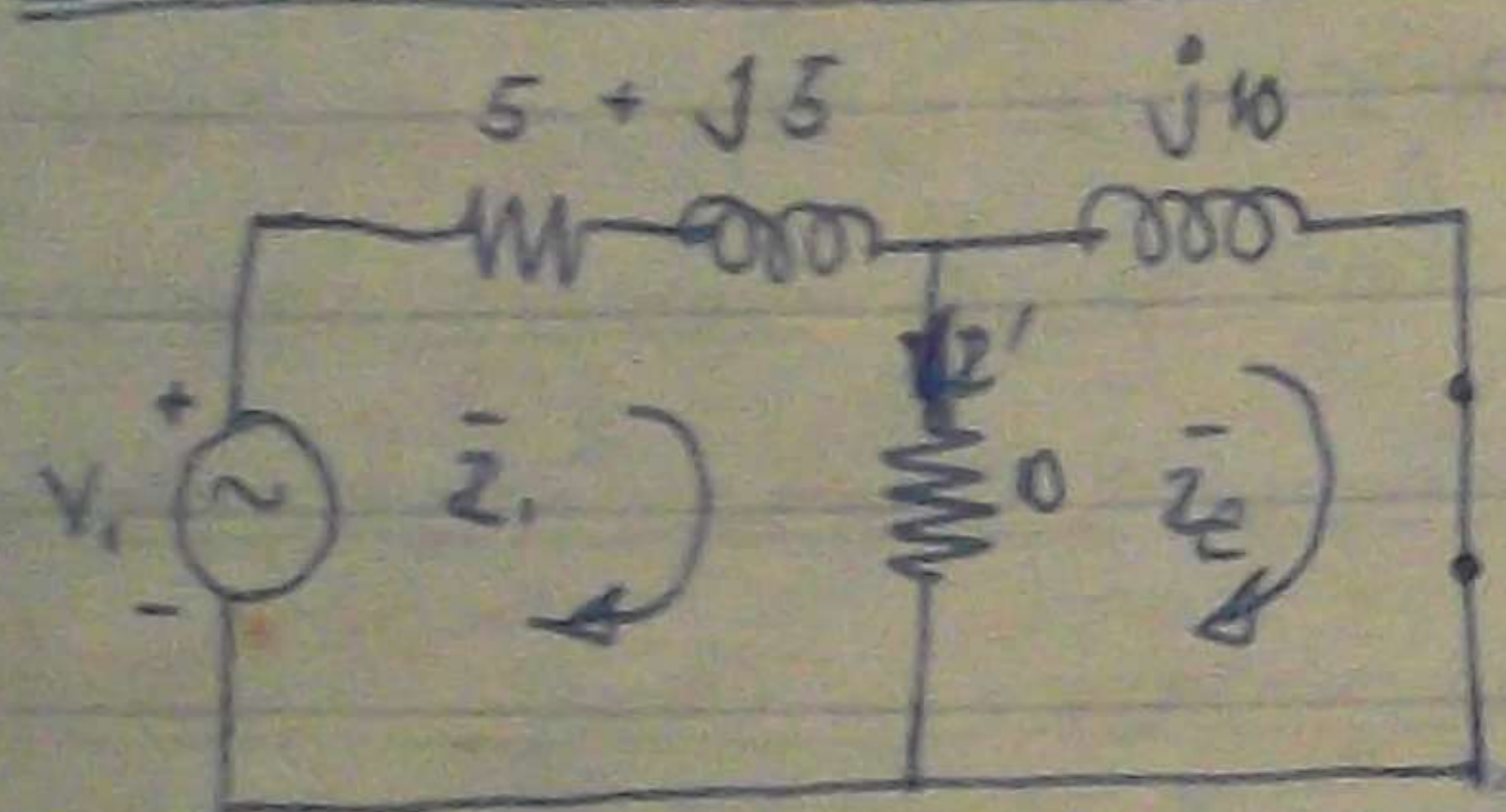
Ex. 5 (4. PROBLEMS.)

01. အောက်ပါ network မှ V_1, V_2 တို့ကို တစ်ခုခု ဖယ်ထားကာ 10Ω Resistor တွင်ရှိသော element တို့ တွင်ရှိသော V_1, V_2 ဆိုက်ကွပ်များကို ရှာဖွေပါ။

$$I/V_1, V_2 = I'/V_2=0 + I''/V_1=0 \rightarrow \text{(Eq. of Super Posn Theo.)}$$

တော့ပိုက်: $Z' = Z''$

V_1 ထပ်မံထုတ်: ထပ်မံကုန်စင် (နဲ့မဟုတ်) V_2 ထပ်မံထုတ်: ထပ်မံကုန်စင် -



$$(15+j5)I_1 - 10I_2 = V_1 \quad (1)$$

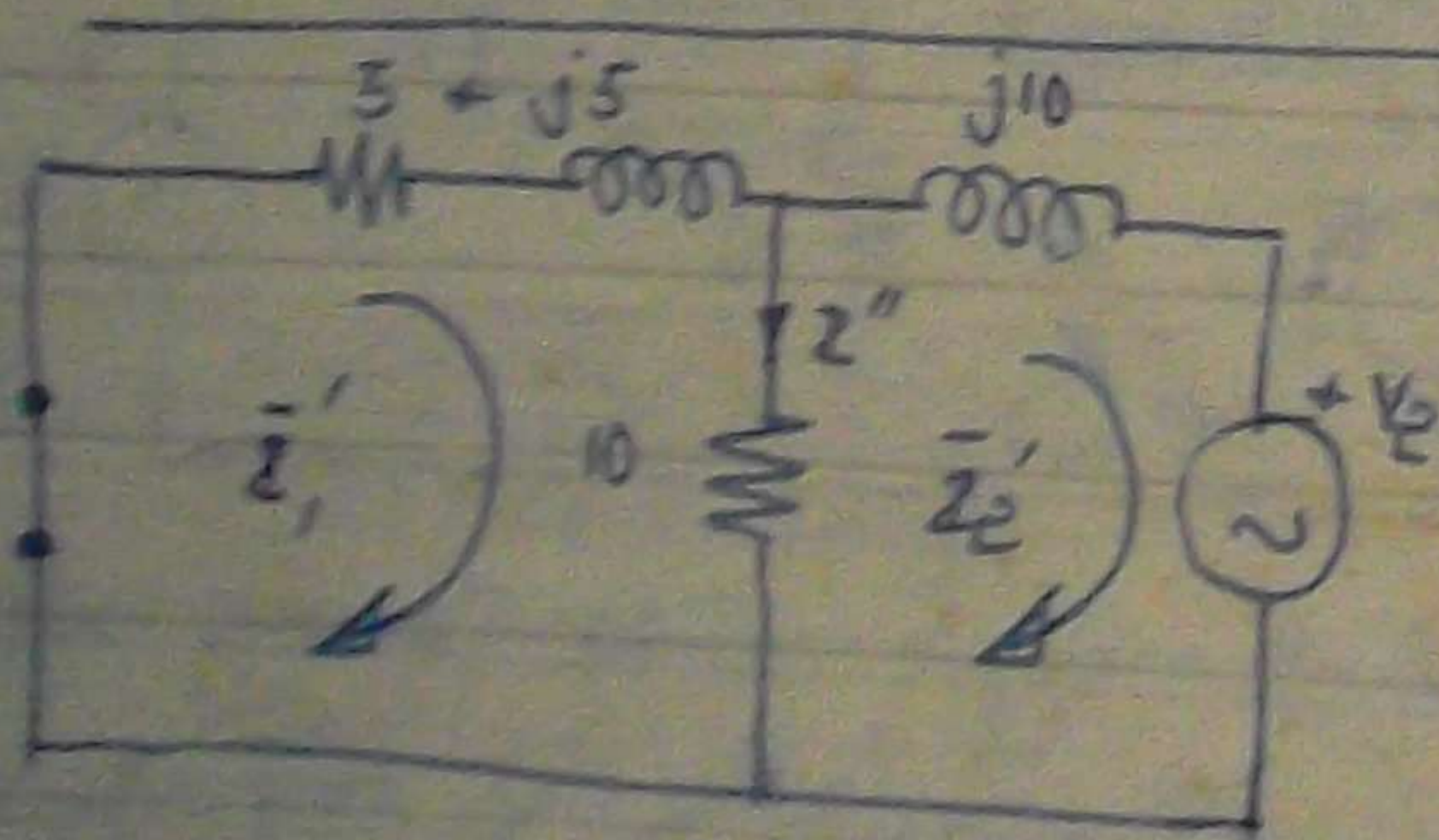
$$-10I_1 + (10+j10)I_2 = 0 \quad (2)$$

$$D = \begin{vmatrix} 15+j5 & -10 \\ -10 & 10+j10 \end{vmatrix} = 150 + j200 - 50 - 100 = j200$$

$$N_1 = \begin{vmatrix} V_1 & -10 \\ 0 & 10+j10 \end{vmatrix} = V_1(10+j10), \quad N_2 = \begin{vmatrix} 15+j5 & V_1 \\ -10 & 0 \end{vmatrix} = 10V_1$$

$$\therefore Z_1 = \frac{N_1}{D} = \frac{V_1(10+j10)}{j200}, \quad Z_2 = \frac{N_2}{D} = \frac{10V_1}{j200}$$

$$\therefore I' = I_1 - I_2 = \frac{V_1}{20} \quad (3)$$



V_2 ထပ်မံထုတ်: ထပ်မံကုန်စင် (နဲ့မဟုတ်) V_1 ထပ်မံထုတ်: ထပ်မံကုန်စင် -

$$(15+j5)Z_1' - 10Z_2' = 0 \quad (1)$$

$$-10Z_1' + (10+j10)Z_2' = -V_2 \quad (2)$$

(Denominator) Determinant ပြန်: တွေ့ရမယ်။

$$\therefore N_1' = \begin{vmatrix} 0 & -10 \\ -V_2 & 10+j10 \end{vmatrix} = -10V_2, \quad N_2' = \begin{vmatrix} 15+j5 & 0 \\ -10 & -V_2 \end{vmatrix} = -V_2(15+j5)$$

$$\therefore I_1' = \frac{N_1'}{D} = \frac{-10V_2}{j200}, \quad Z_2' = \frac{N_2'}{D} = \frac{-V_2(15+j5)}{j200}$$

$$\therefore Z'' = I_1' - I_2' = \frac{V_2(1+j1)}{j40} \quad (4)$$

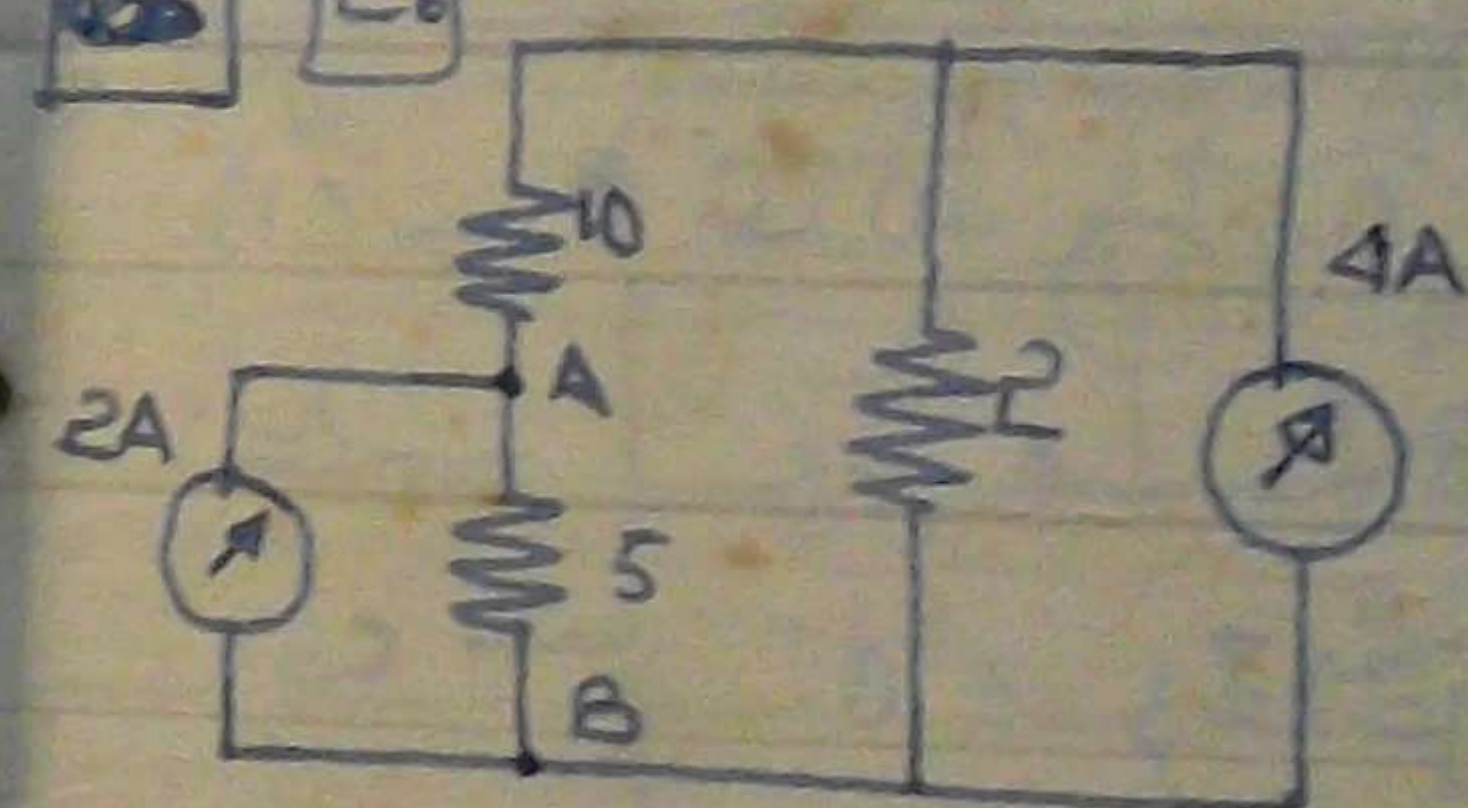
တော့ပိုက်, Eq (3) = Eq (4)

$$\therefore \frac{V_1}{20} = \frac{V_2(1+j1)}{j40}$$

$$\therefore V_1 : V_2 = (1+j1) : (0+j2)$$

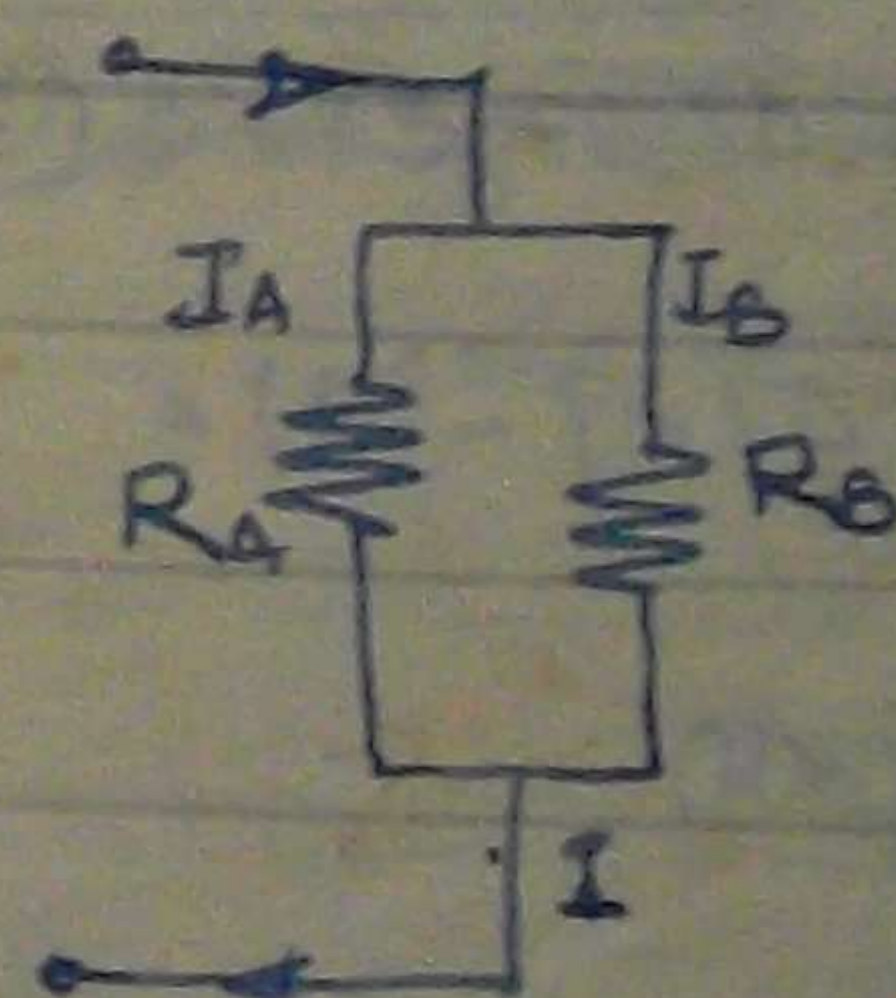
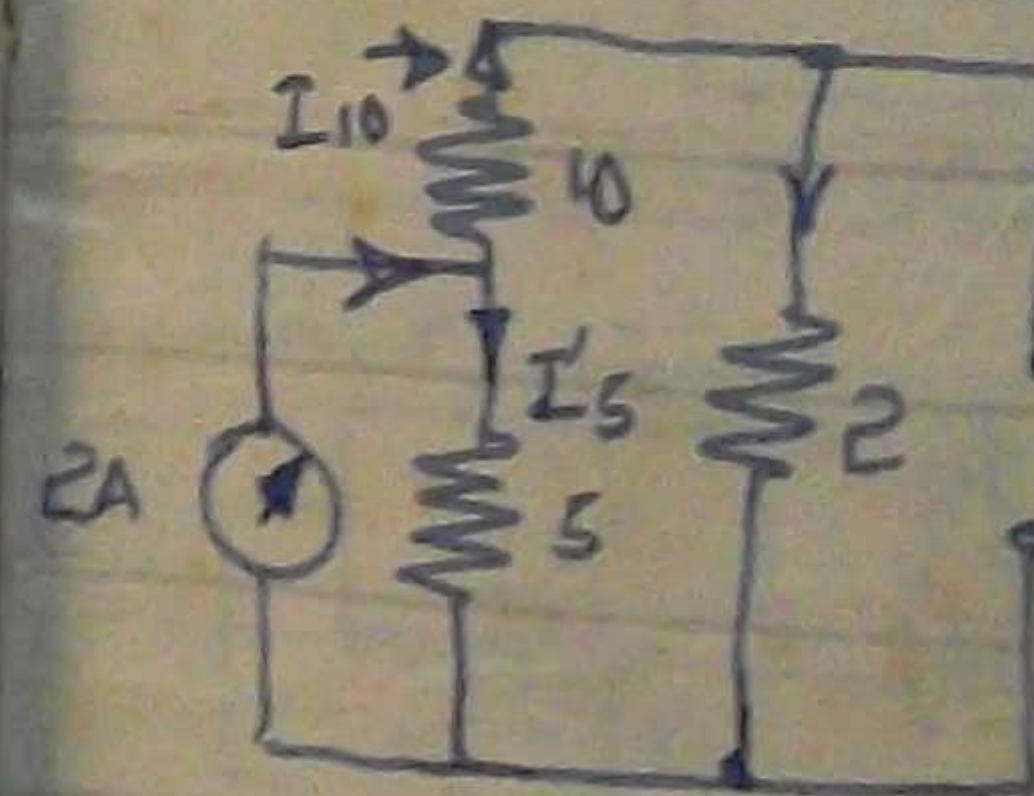
$$\frac{V_1}{V_2} = \frac{1+j1}{0+j2} = \frac{j2}{2} = \frac{1}{j} \leftarrow \text{Ans.}$$

2.



Super Position Theory ကိုသုံးပြီး V_{AB} ကို

ရှာရမယ်။
2A SOURCE
ထပ်မံထုတ်: ထပ်မံကုန်စင် -

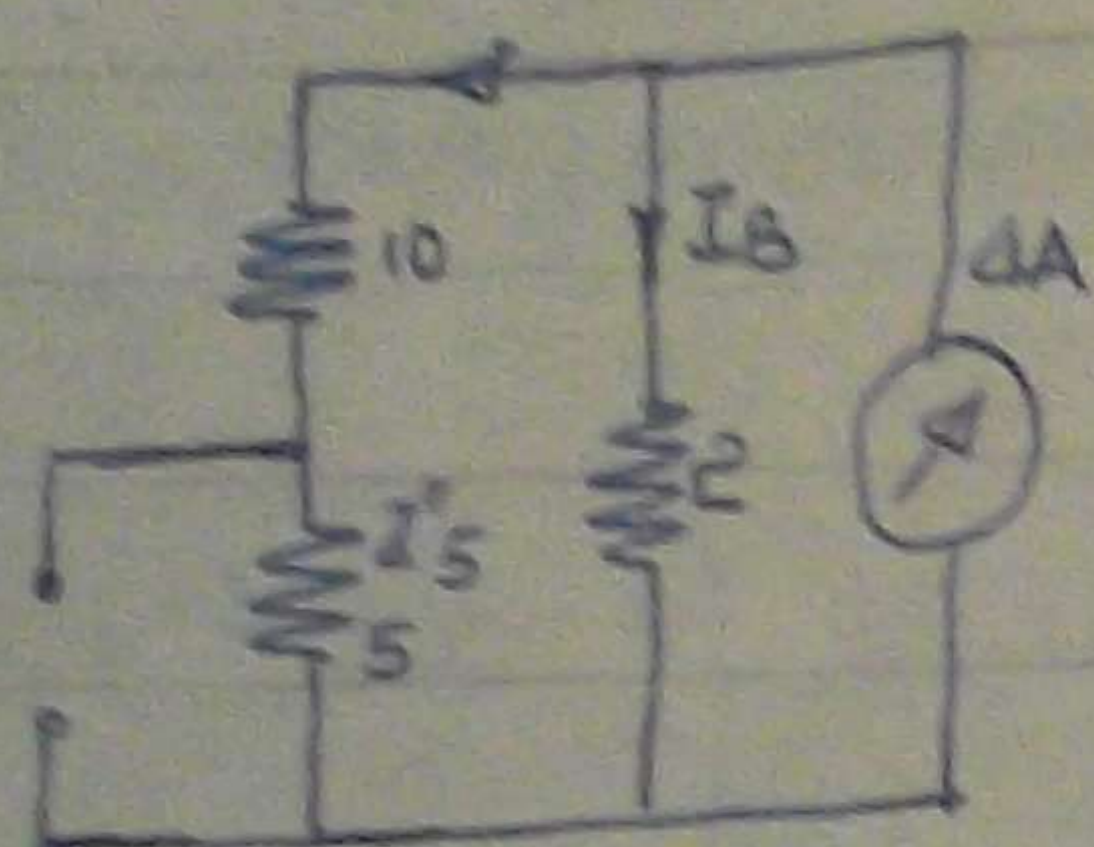


$$I_A = I = \frac{R_B}{R_A + R_B}$$

$$I_B = I = \frac{R_A}{R_A + R_B}$$

$$\therefore I_5 = 2 \times \frac{12}{12+5} = \frac{24}{17} \text{ Amp.}$$

30

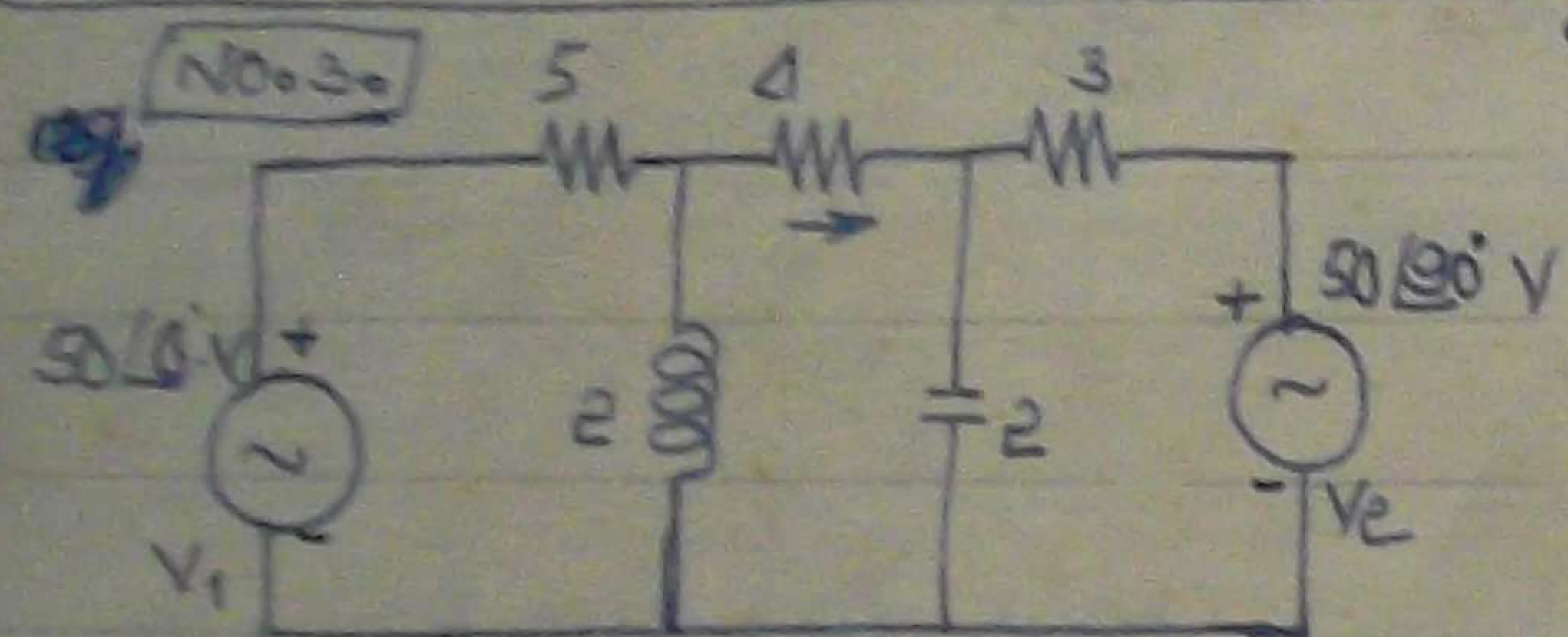


4A အားစုဝင်တိုက်ကိုင်ဆောင်ထားသည်။

$$I_5 = I_A = 4 \times \frac{2}{2+5} = \frac{8}{7} \text{ A}$$

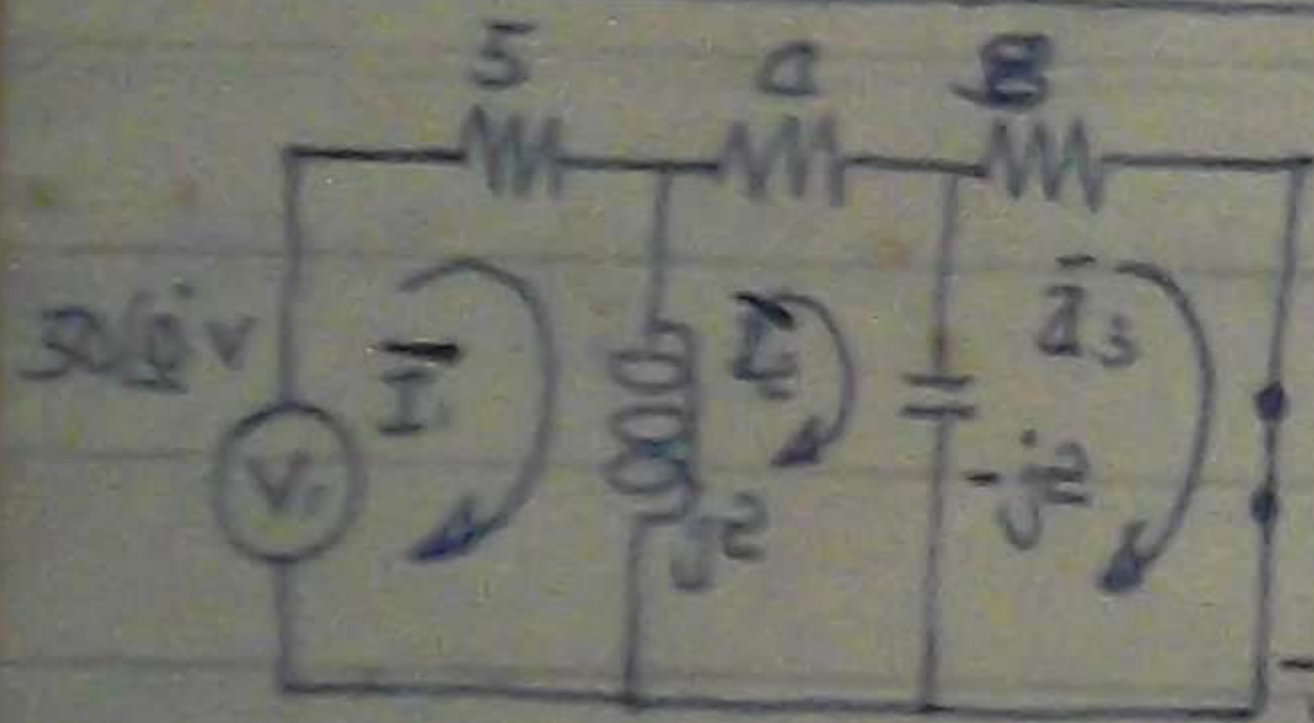
$$\therefore I_5 = I_5' + I_5'' = \frac{20}{17} + \frac{8}{17} = \frac{28}{17} \text{ Amps.}$$

$$\therefore V_{AB} = I_5 \cdot R = \frac{28}{17} \times 5 = \frac{140}{17} = 8 \frac{1}{17} \text{ A.} \leftarrow \text{Ans.}$$



Super Position Theoremကို
အသုံးပြု၍ 4 ohm ရလဒ်တစ်ခုကို
စစ်ဆေးရန် အားစုဝင်တိုက်ကိုင်ဆောင်ထားသည်။
လားရှာရန်လိုအပ်သည်။

$$I = \frac{I_1}{V_2=0} + \frac{I_2}{V_1=0}$$



50V Voltage source ဝင်တိုက်ကိုင်ဆောင်ထားသည်။

$$(5+j2)I_1 - j2 I_2 + 0 = 50 \angle 0^\circ \quad (1)$$

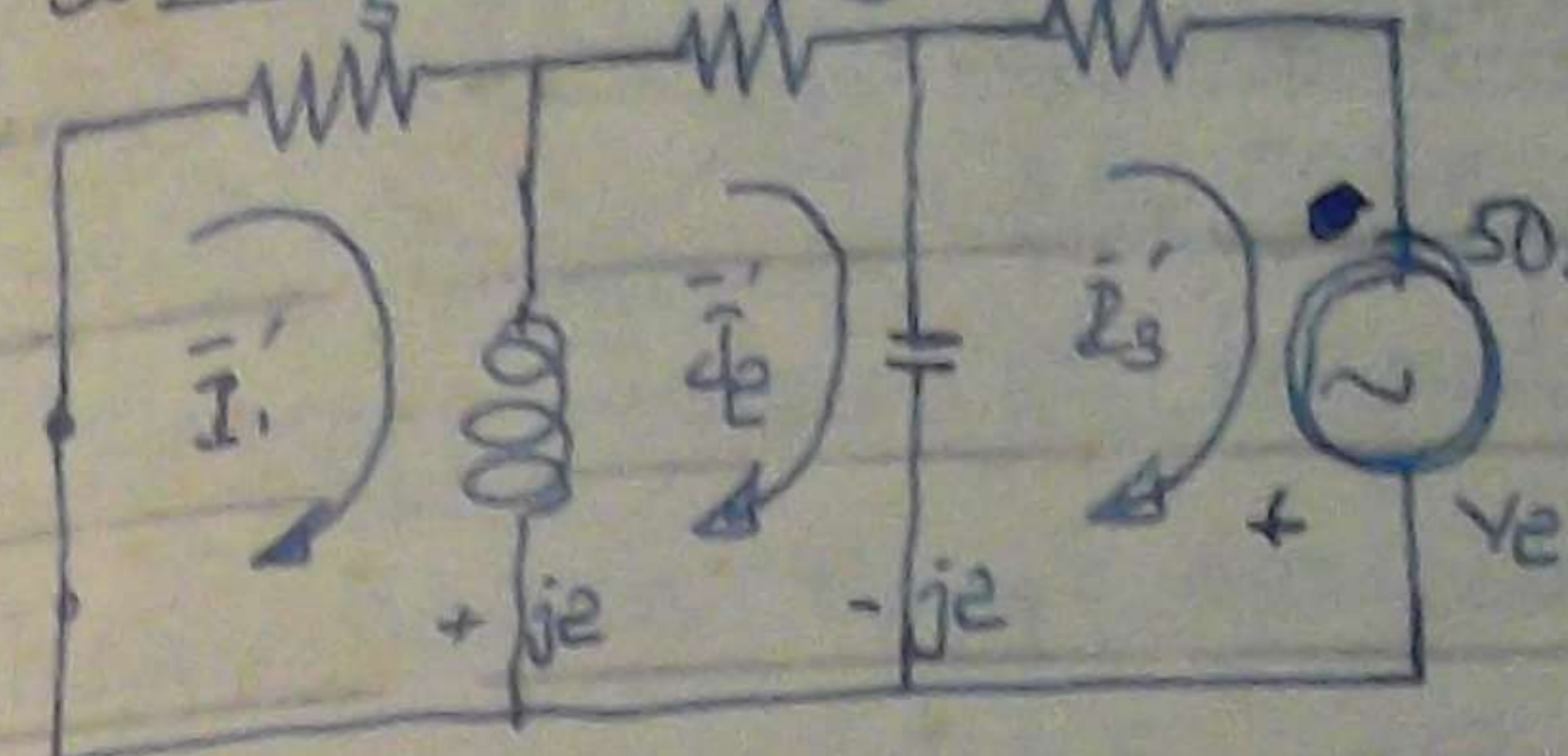
$$+j2 I_3 = 0 \quad (2)$$

$$0 + j2 I_2 + (3-j2)I_3 = 0 \quad (3)$$

$$D = \begin{vmatrix} 5+j2 & -j2 & 0 \\ -j2 & 0 & j2 \\ 0 & j2 & 3-j2 \end{vmatrix} = 4(19-j4) + 4(5+j2) + 4(3-j2) = 4(27-j4) = 108 - j16$$

$$N_1 = \begin{vmatrix} 50 & 0 & 0 \\ -j2 & 0 & j2 \\ 0 & 0 & 3-j2 \end{vmatrix} = 200 + j300$$

50/0° V Voltage source ဝင်တိုက်ကိုင်ဆောင်ထားသည်။



$$(5+j2)I_1 - j2 I_2 + 0 = 0 \quad (1)$$

$$-j2 I_1 + 0 I_2 + j2 I_3 = 0 \quad (2)$$

$$0 + j2 I_2 + (3-j2)I_3 = +j50 \angle 0^\circ$$

$$N_2' = \begin{vmatrix} 5+j2 & 0 & 0 \\ -j2 & 0 & j2 \\ 0 & +j50 & 3-j2 \end{vmatrix} = +500 + j200$$

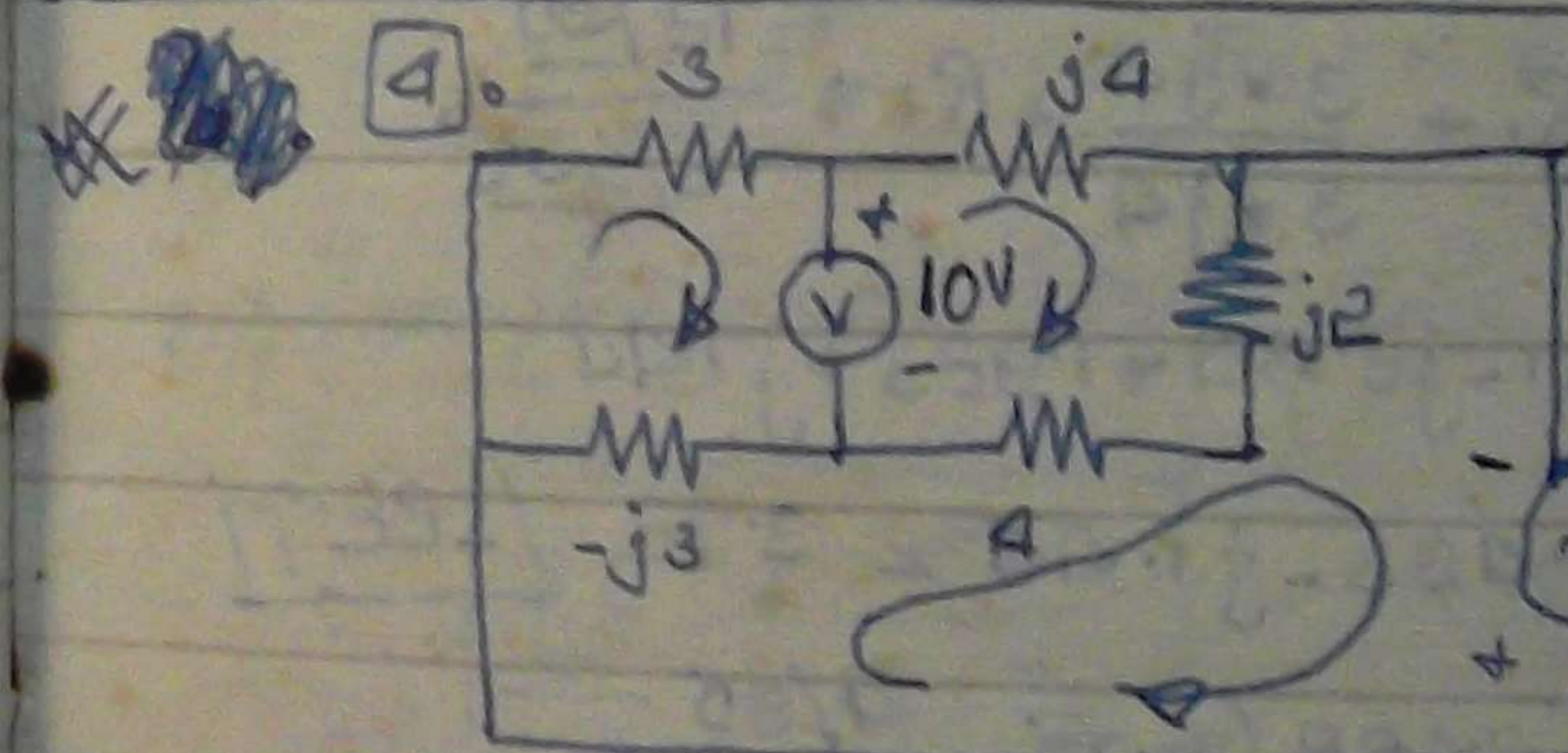
$$700 + j500 \angle 35.55^\circ$$

80 MTO'S ERROR?

$$\therefore I_{4n} = \frac{I_2'}{V_2=0} + \frac{I_2}{V_1=0} = \frac{N_2' + N_2}{D}$$

$$\frac{300 + j100}{108 - j16} = \frac{316.22 \angle 18.435^\circ}{109.1 \angle -8.425^\circ} = 2.897 \angle 26.86^\circ = 2.504 + j1.283 \text{ Amps.}$$

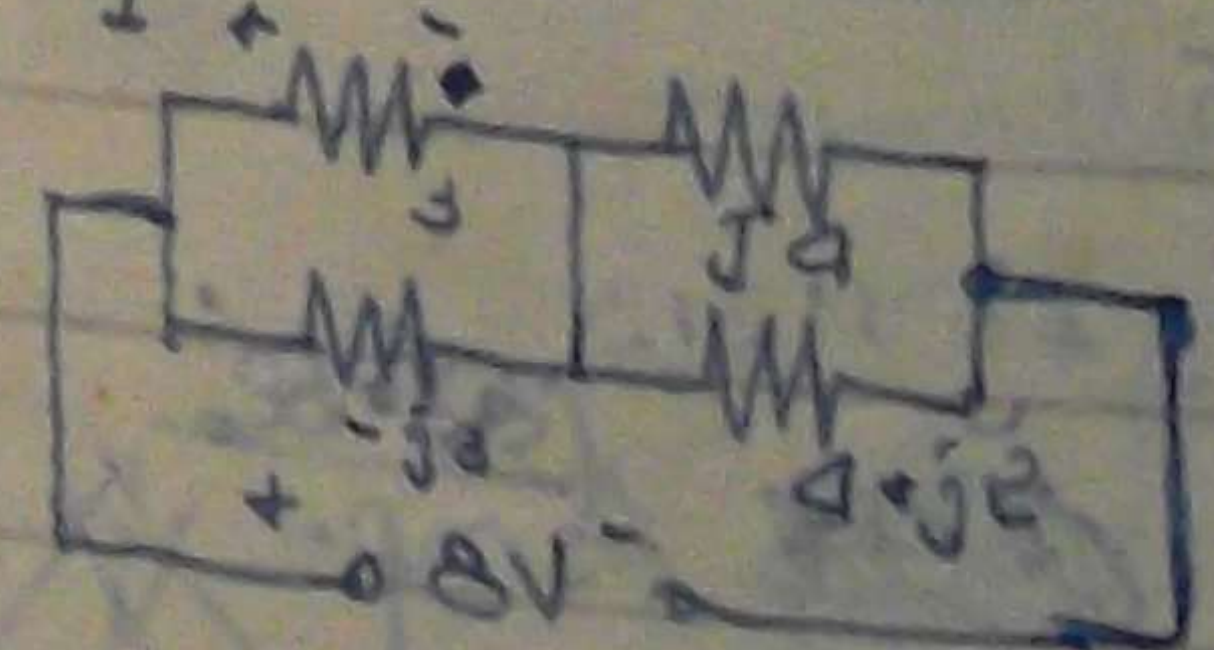
(လားရှာရန်လိုအပ်သည်။)



Find the current in the
3 ohm resistor by the method
of super-position theorem.

INSUFFICIENT DATA

8V → VOLTAGE ENERGY SOURCE ဝင်တိုက်ကိုင်ဆောင်ထားသည်။



$$Z_L = \frac{3 \times -j3}{3-j3} + \frac{4(1+j2)}{4+4+j2}$$

$$= \frac{9 \angle -90^\circ}{4.24 \angle -45^\circ} + \frac{17.9 \angle 26.57^\circ}{8.25 \angle 14.04^\circ} = 2.122 \angle -45^\circ + 2.17 \angle 12.53^\circ = 1.5 - j1.5 + 2.12 + j0.471 = 3.62 - j1.029 = 3.765 \angle -15.87^\circ$$

6

10V source တစ်ခုထည့်ပါ။ ကိုယ်တိုင် ဆွဲပါ။

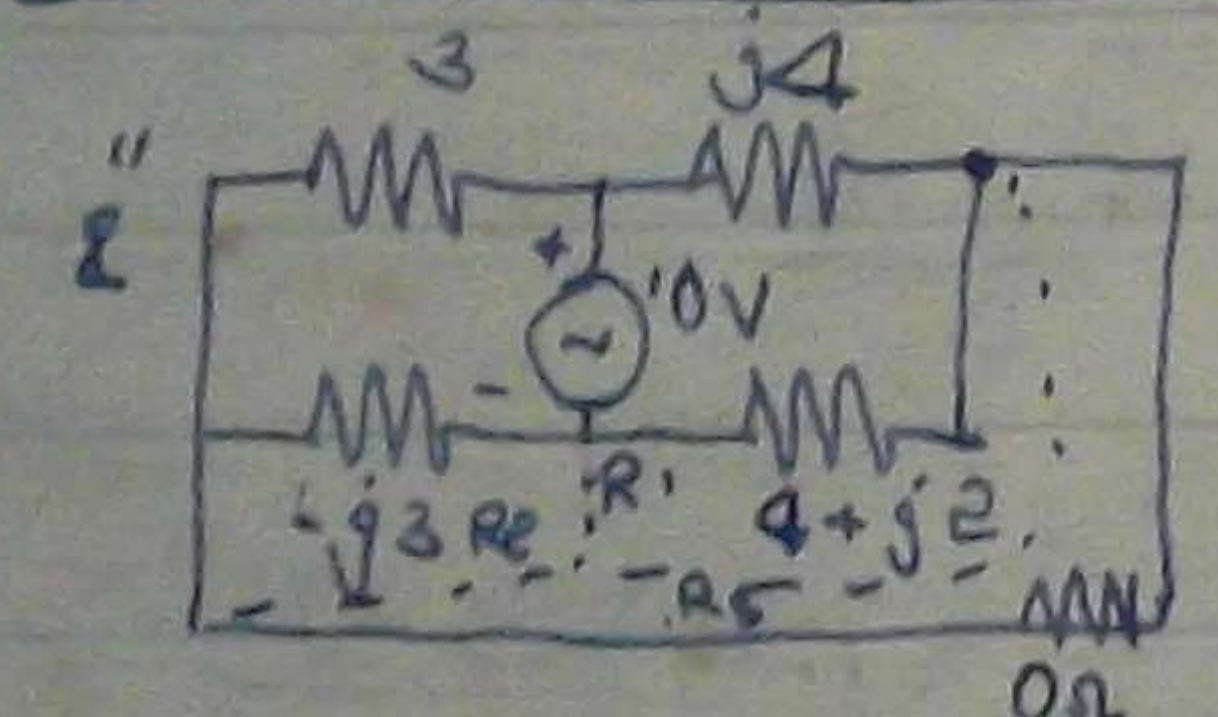
$$I_c = \frac{8}{3.765 \angle -15.87^\circ} = \frac{8}{3.765} \angle -15.87^\circ \text{ A}$$

$$I' = \frac{(-j3)}{3 + (-j3)} \cdot \frac{8}{3.765} \angle -15.87^\circ \text{ A}$$

$$= \frac{3 \angle -90^\circ}{4.24 \angle -45^\circ} \cdot \frac{8 \angle -15.87^\circ}{3.765}$$

$$= 1.501 \angle -60.87^\circ \text{ A} = 0.73 - j1.313 \text{ A}$$

10V source တစ်ခုထည့်ပါ။ ကိုယ်တိုင် ဆွဲပါ။



j3, 4+j2 နှင့် 0 Ω Δ ကို Y ခြုံပြောင်းသော်

$$R_1 = \frac{-j3(4+j2)}{-j3+4+j2+0} = \frac{6-j12}{4-j1}$$

$$= \frac{13.42 \angle -63.43^\circ}{4.13 \angle -14.03^\circ}$$

$$= 3.253 \angle -62.4^\circ = 1.507 - j2.884$$

$$R_2 = R_3 = 0$$

$$R_T = R_1 + \frac{3+j4}{3+j4} = R_1 + \frac{5 \angle 90^\circ}{5 \angle 53.2^\circ}$$

$$\therefore I'' = \frac{10}{3.72} = 2.688 \angle 22.77^\circ \text{ A}$$

$$\therefore I'' = 2.688 \angle 22.77^\circ \cdot \frac{j4}{3+j4} = 2.688 \angle 22.77^\circ \cdot \frac{4 \angle 90^\circ}{5 \angle 53.2^\circ}$$

$$= 2.1504 \angle 59.57^\circ = 1.09 + j1.855$$

$$\therefore I_{3\Omega} = I'' - I' = 1.09 + j1.855 - 0.73 + j1.313$$

$$= 0.36 + j3.168 = 3.19 \angle 83.8^\circ \text{ Amp.}$$

(right to left direction)

23.2.83

NOT SUFFICIENT DATA

(K: Law, နှိုင်းညှိခြင်းဖြင့် ရှာနိုင်ပါသည်။) မှန်ကန်စွာ ဖြေဆိုပါ။ 3.2.83 4U

80 78

THEVENIN'S THEOREM

(VOLTAGE SOURCE EQUIVALENT CIRCUIT)

Energy Source နှင့် Impedance ပြုငါးသော ရှိသည့် network ကို Voltage source E_0 နှင့် series တွင်ဆက်သွယ်သည့် Z_0 နှင့် Equivalent circuit တစ်ခုအဖြစ် စားသုံးဆွဲဆွဲနိုင်သည်။ E_0 နှင့် Z_0 ကို ဆွဲဆွဲ component ကို ဖြတ်၍ ဖြတ်ရာတွင် ဖြစ်ပေါ်လာသော open circuit voltage နှင့် Z_0 နှင့် ဆွဲဆွဲရာတွင် Z_0 ကို ဖြတ်၍ ဖြတ်ရာတွင် ရှိသည့် Impedance ဖြစ်သည်။ Z_0 ကို Z_0 နှင့် ဆွဲဆွဲရာတွင် Z_0 ကို ဖြတ်၍ ဖြတ်ရာတွင် ရှိသည့် Impedance ဖြစ်သည်။ Z_0 ကို Z_0 နှင့် ဆွဲဆွဲရာတွင် Z_0 ကို ဖြတ်၍ ဖြတ်ရာတွင် ရှိသည့် Impedance ဖြစ်သည်။



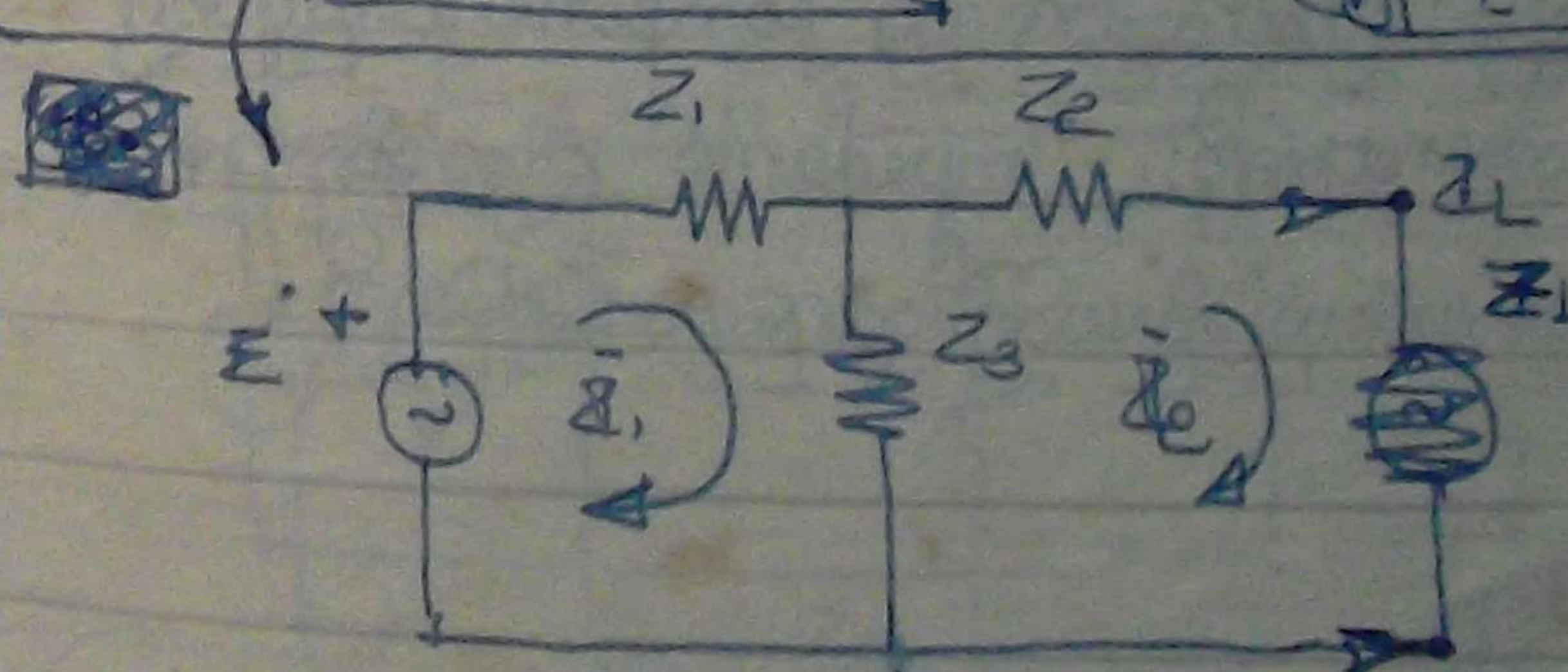
$$I = \frac{E}{Z_1 + Z_3}$$

$$E_3 = Z_3 I \quad \left\{ E_0 = E_3 + 0V = I Z_3 = \frac{E Z_3}{Z_1 + Z_3} \right\}$$

$$E_0 \text{ ဖြစ်ပေါ်လာခြင်း} - \left\{ Z_0 = Z_2 + \frac{Z_1 Z_3}{Z_1 + Z_3} \right\}$$

$$I_L = \frac{E_0}{Z_0 + Z_L}$$

(Z_L ဖြစ်ပေါ်လာခြင်းကို ဖြတ်၍ ဖြတ်ရာတွင်)



(AC generator နှင့် impedance ပြုငါးသော n/w. alternator)

$$\begin{aligned}
 I_1 &= I_2 \\
 (Z_1 + Z_3) I_1 - Z_3 I_2 &= E \\
 -Z_3 I_1 + (Z_2 + Z_3 + Z_4) I_2 &= 0
 \end{aligned}$$

$$\therefore \vec{I}_2 = \frac{\begin{vmatrix} Z_1 + Z_3 & E \\ -Z_3 & 0 \end{vmatrix}}{\begin{vmatrix} Z_1 + Z_3 & -Z_3 \\ -Z_3 & Z_2 + Z_3 + Z_4 \end{vmatrix}} = \frac{EZ_3}{(Z_1 + Z_3)(Z_2 + Z_3 + Z_4) - Z_3^2}$$

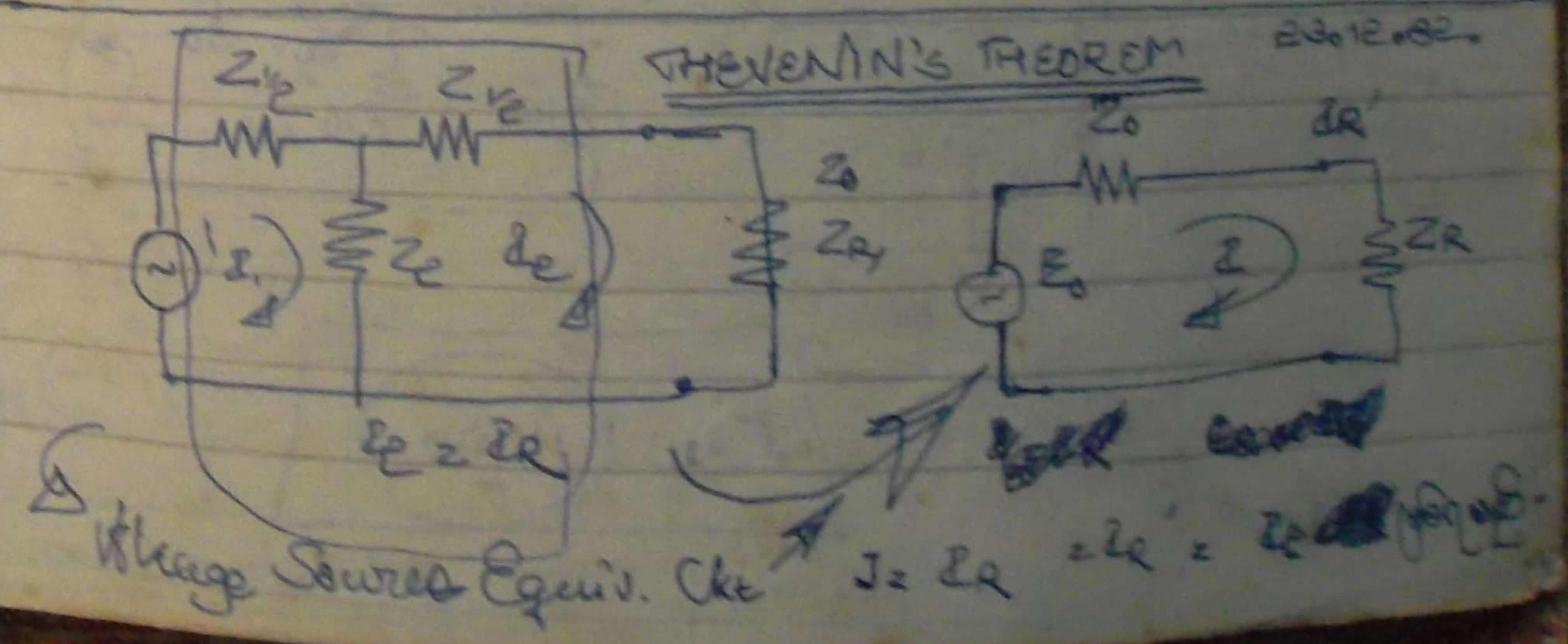
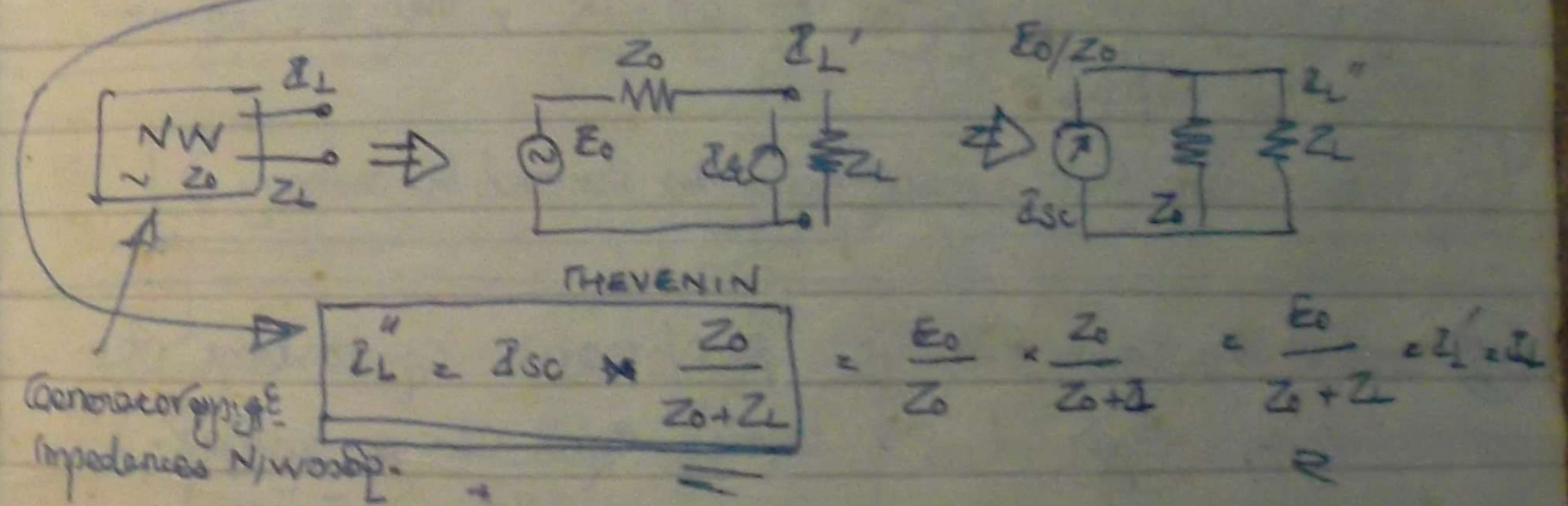
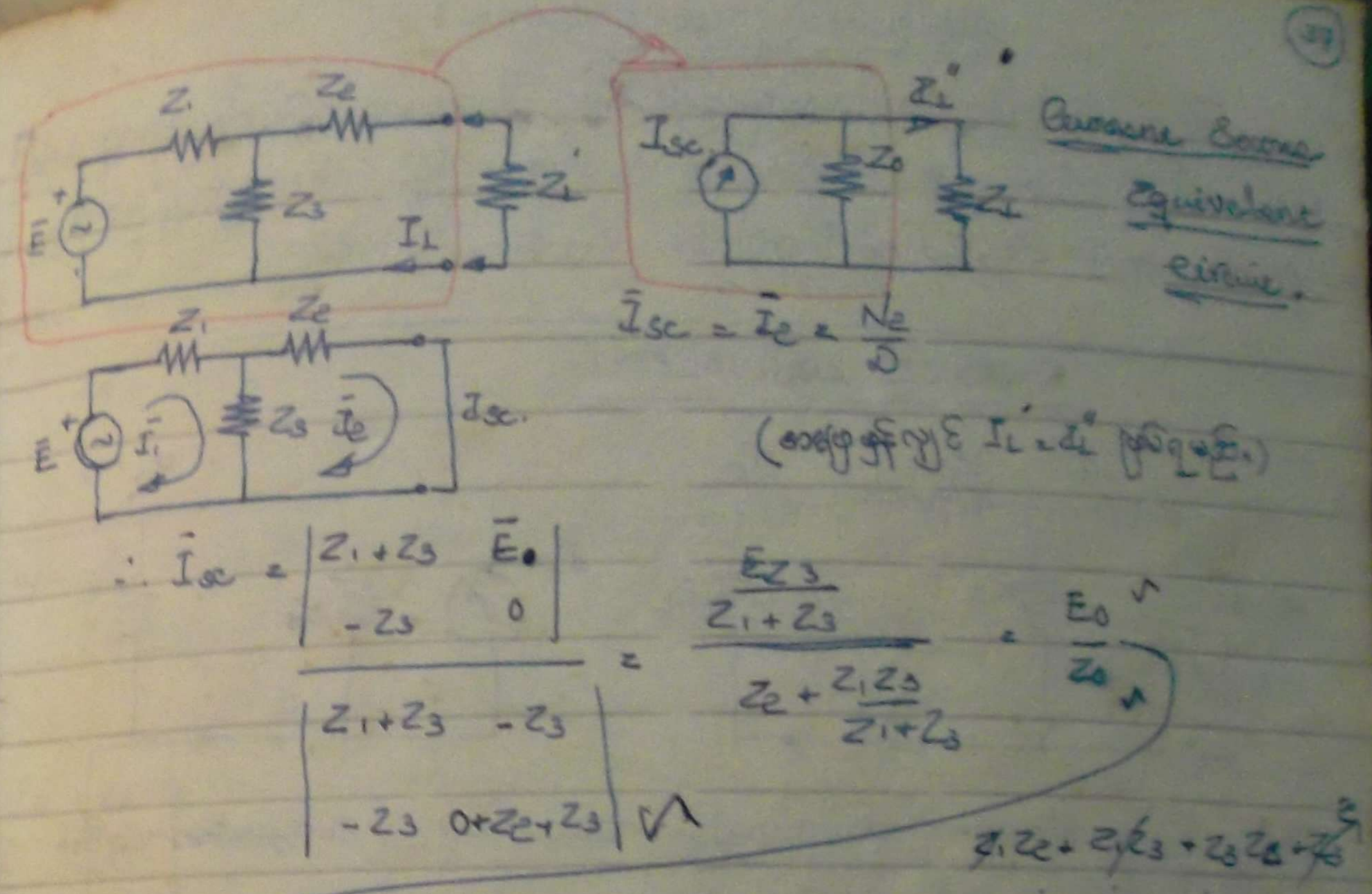
$$= \frac{\frac{EZ_3}{Z_1 + Z_3}}{Z_2 + Z_3 + Z_4 - \frac{Z_3^2}{Z_1 + Z_3}} = \frac{\frac{EZ_3}{Z_1 + Z_3}}{Z_2 + \frac{Z_1 Z_3 + Z_3^2 - Z_3^2}{Z_1 + Z_3} + Z_4} = \frac{E_0}{Z_0 + Z_L}$$

$I_L = \frac{E_0}{Z_0 + Z_L}$

{ I_L နှင့် I_L တူညီသောကြောင့် $\therefore$ Equivalent ပုံစံ. }

78 (20) NORTON'S THEOREM. CHAPTER VII.
CURRENT SOURCE EQUIVALENT CIRCUIT.

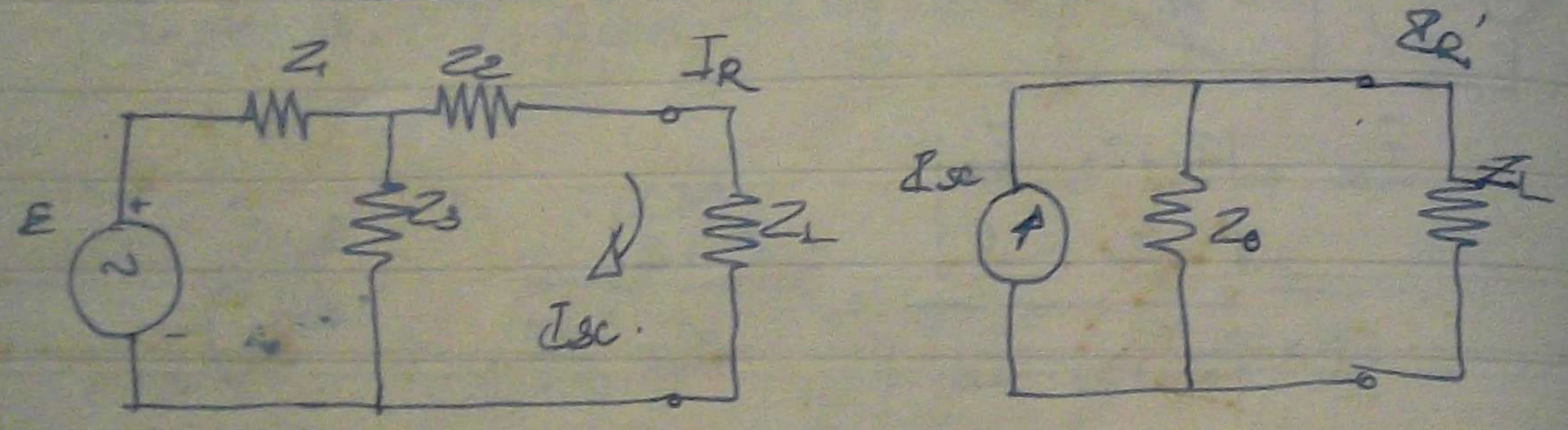
Frequency independent energy source နှင့် impedance ပုံစံပါသော
 မြေသွင်း network ကို ဆက်သွယ်ထားသော source နှင့် impedance တို့ကို parallel
 ဆက်သွယ်ထားသော equivalent circuit တွေကို ဆက်သွယ်ထားသောကြောင့်
 Common source I_{sc} နှင့် Z_0 တို့သည် components ကိုယ်တိုင်
 မှတိုက်ရိုက်ဆက်သွယ်ထားသောကြောင့် $\therefore$ Impedance Z_0 တို့သည်
 network ကိုယ်တိုင် energy source ဆက်သွယ်ထားသောကြောင့် Z_0 ပုံစံသည်



THEVENIN'S THEOREM (Cont.)

For any circuit, we can find the Thevenin voltage E_0 and Thevenin impedance Z_0 across the load terminals. The net work done by the source is $V \cdot I$ where V is the voltage across the load and I is the current through the load. For a load impedance Z_L , the current is $I = \frac{E_0}{Z_0 + Z_L}$. The power is $P = I^2 Z_L$.

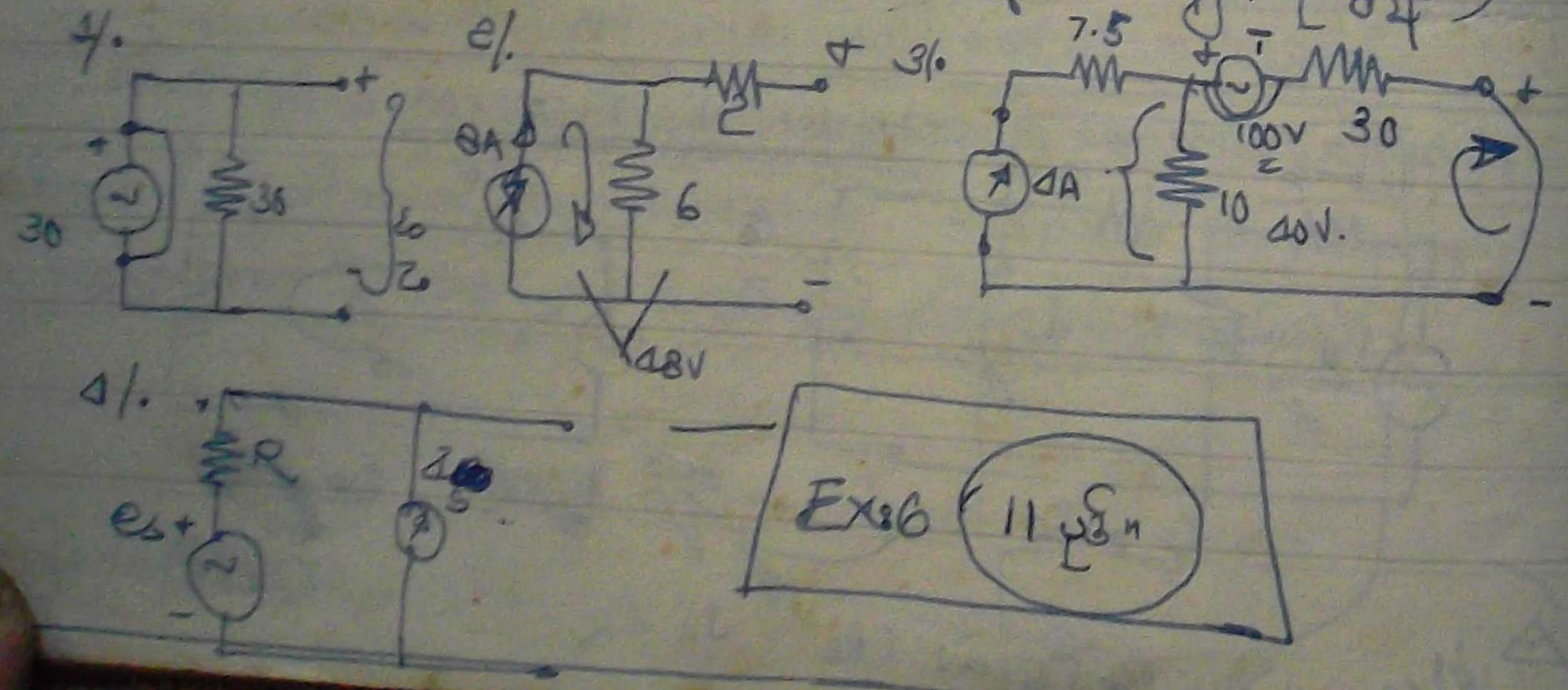
NORTON'S EQUIVALENT.



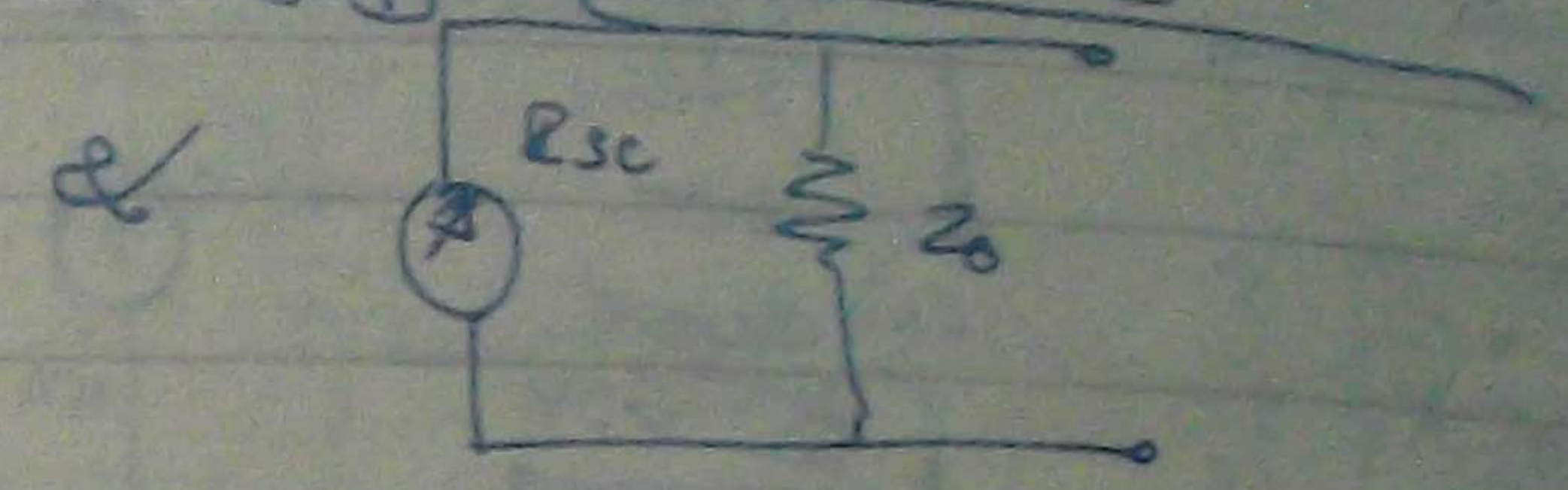
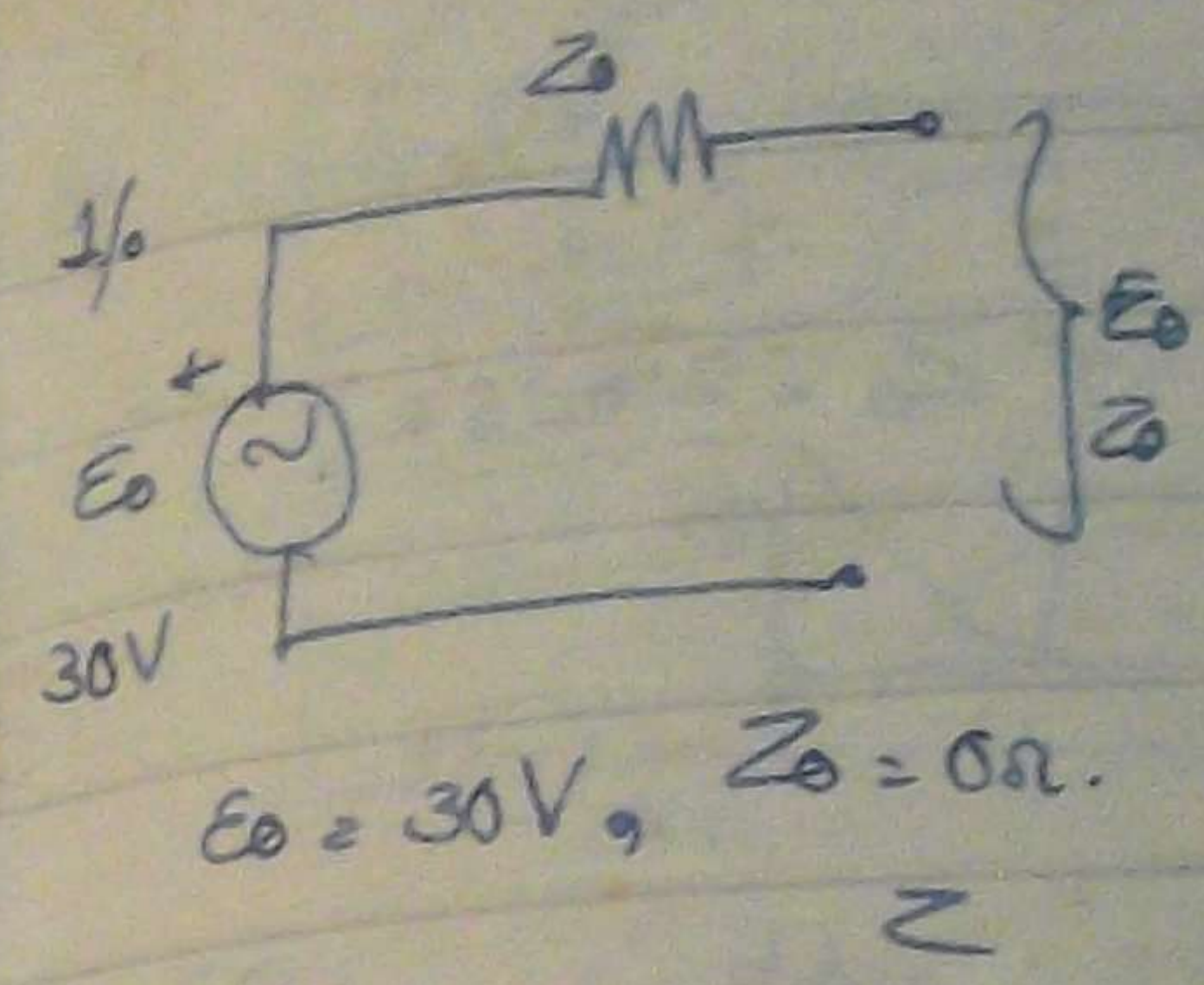
For any circuit, we can find the Norton current I_{sc} and Norton impedance Z_0 across the load terminals. If $Z_L = Z_0$, the power is maximum. If $Z_L = Z_0$, they are equivalent. Norton is right.

(Thevenin and Norton are equivalent circuits.)

Example 1: Find the Thevenin voltage E_0 and Thevenin impedance Z_0 across the load terminals. The circuit consists of a 30V source, a 30Ω resistor, and a 6Ω resistor in parallel with the load.

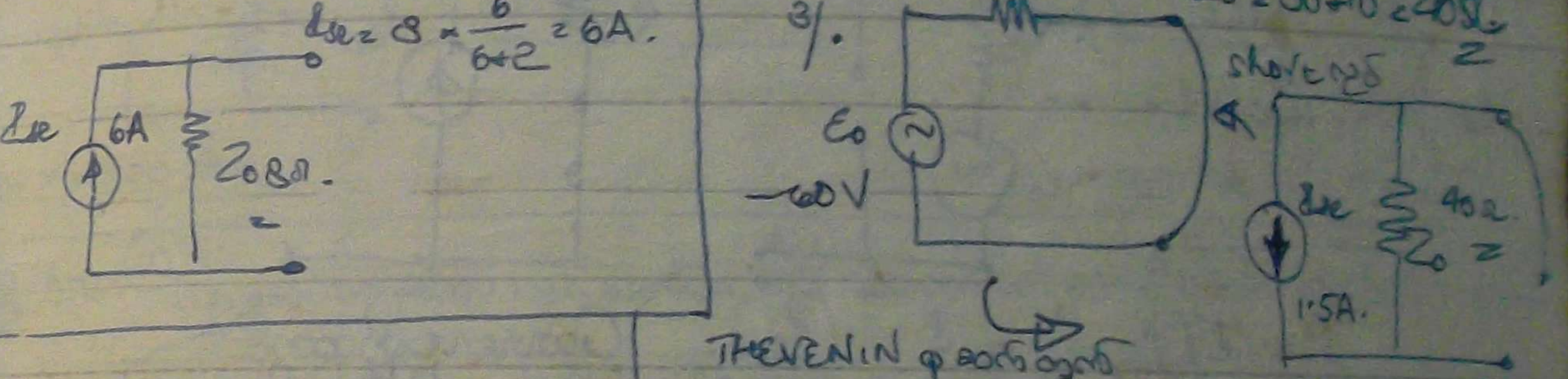


THEVENIN'S THEOREM

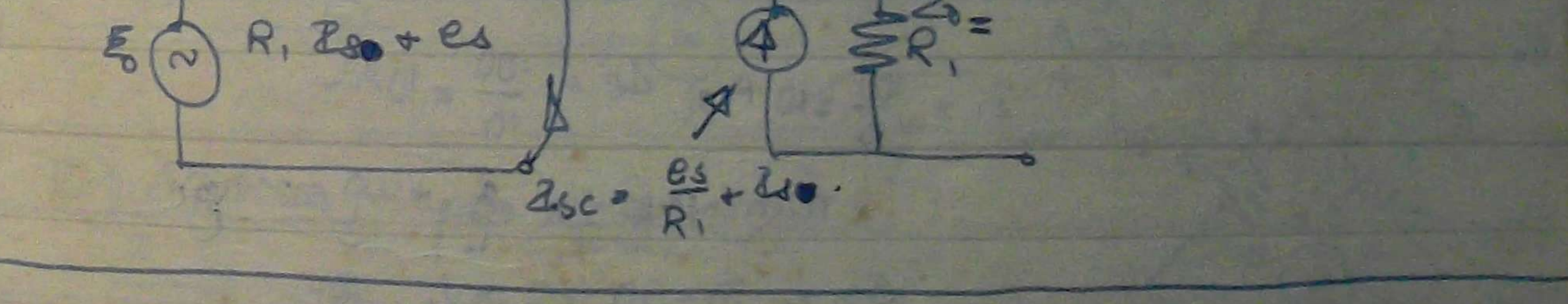


$E_0 = 30V$, $Z_0 = 0\Omega$. The current through the load is $I = \frac{E_0}{Z_0 + Z_L}$. The power is $P = I^2 Z_L$.

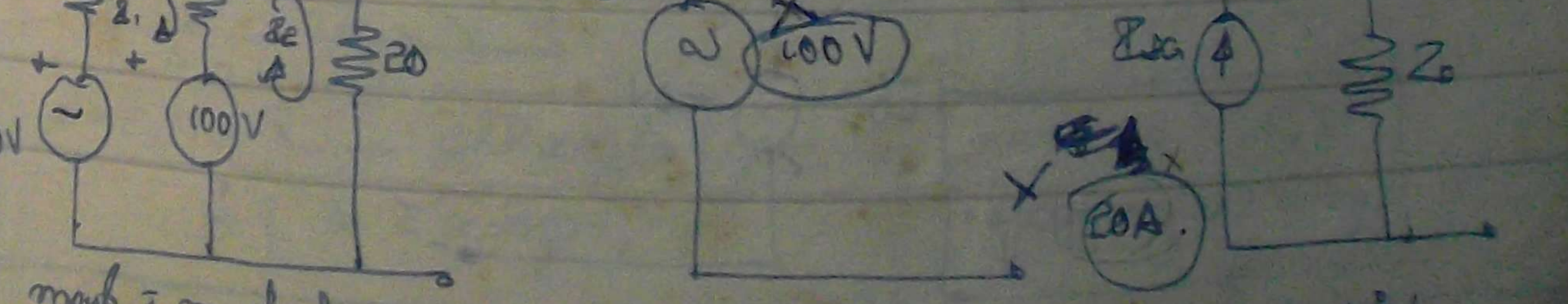
Example 2: Find the Thevenin voltage E_0 and Thevenin impedance Z_0 across the load terminals. The circuit consists of a 48V source, a 30Ω resistor, and a 6Ω resistor in parallel with the load.



Example 3: Find the Thevenin voltage E_0 and Thevenin impedance Z_0 across the load terminals. The circuit consists of a 100V source, a 10Ω resistor, and a 20Ω resistor in parallel with the load.

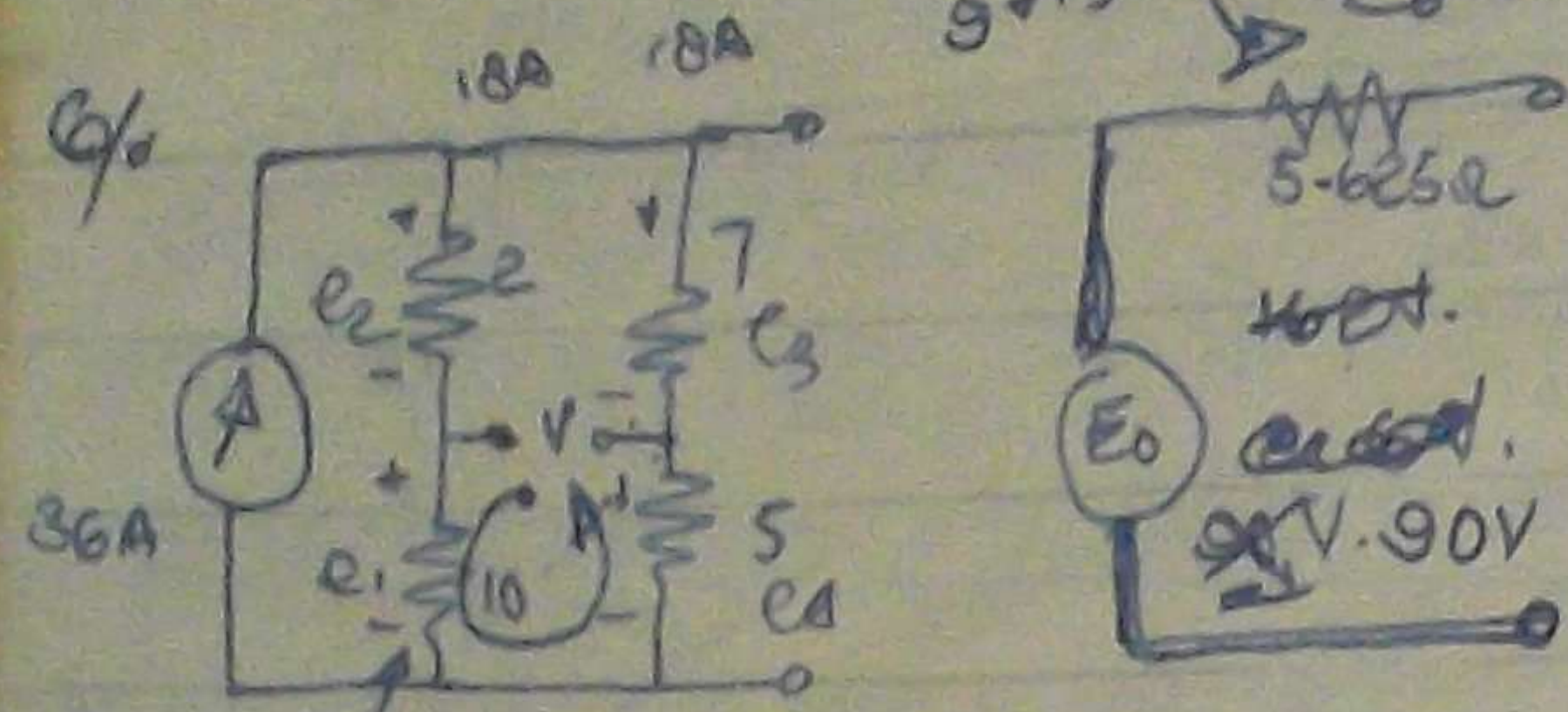


Example 4: Find the Thevenin voltage E_0 and Thevenin impedance Z_0 across the load terminals. The circuit consists of a 100V source, a 10Ω resistor, and a 20Ω resistor in parallel with the load.



mesh & method of superposition etc. $Z_0 = Z_1 \parallel Z_2 \parallel \dots$

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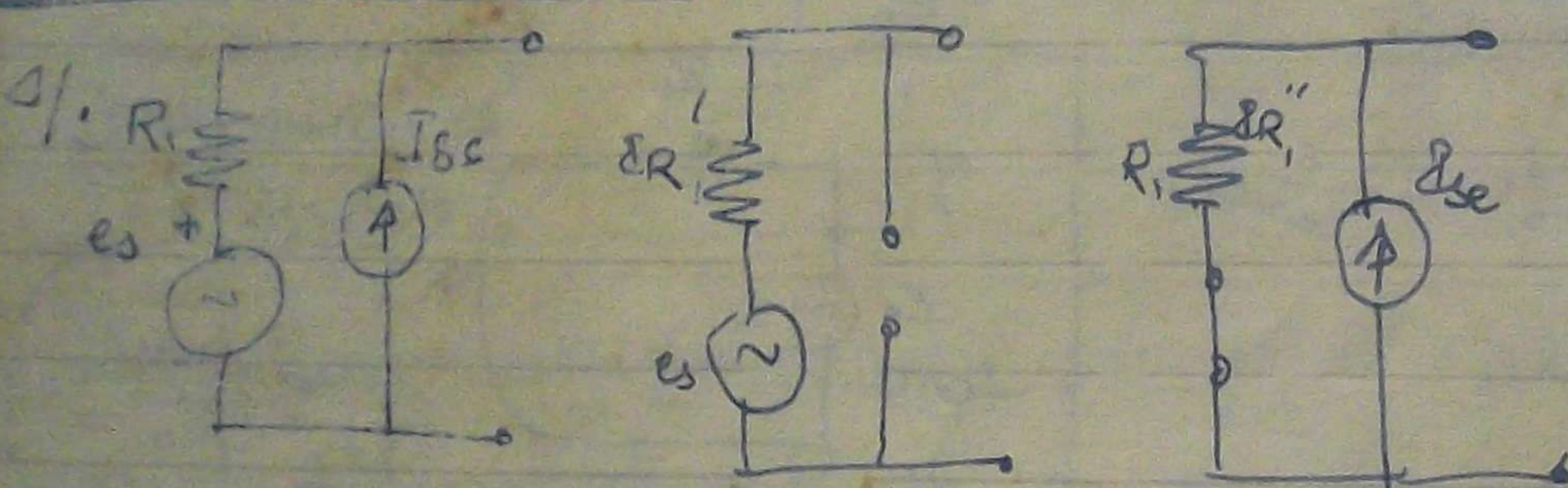
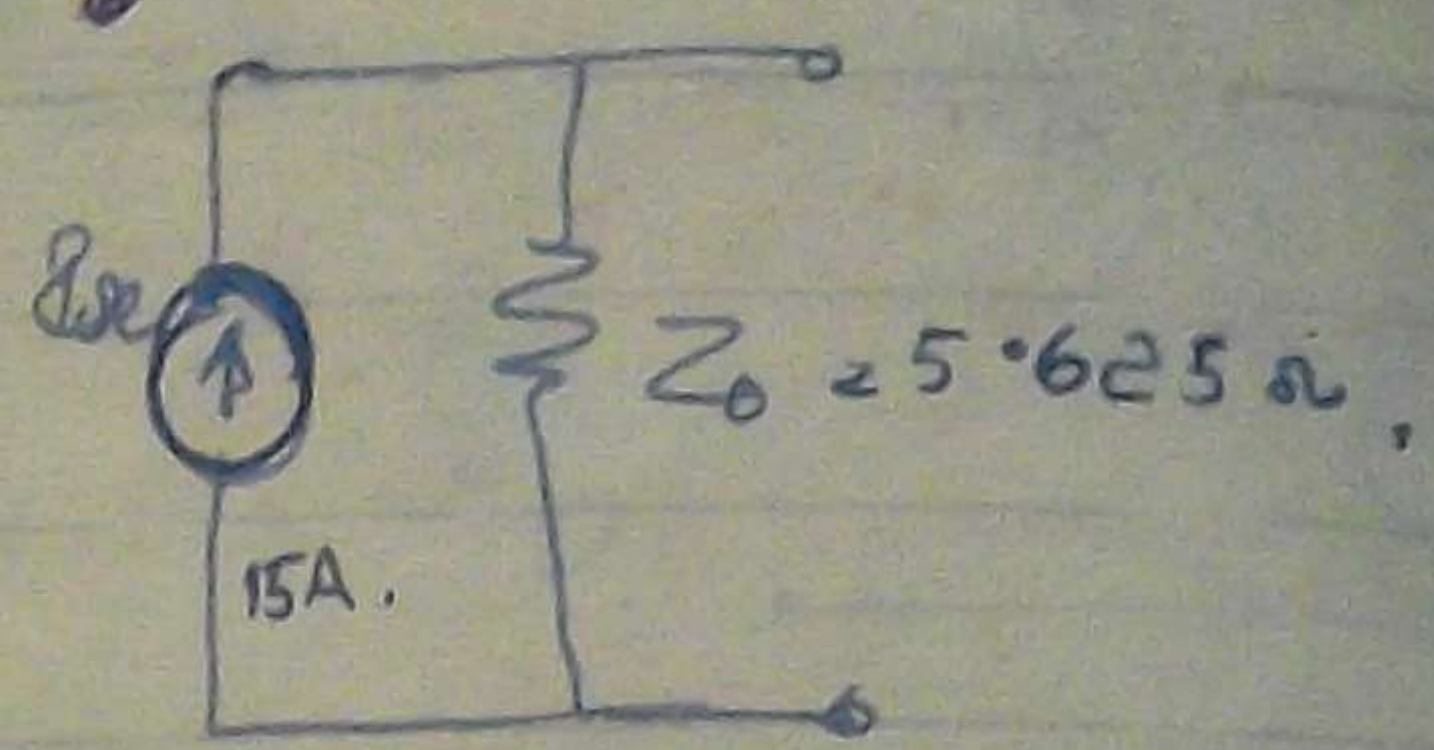


$$10 \times 18 - 18 \times 5 = E_0$$

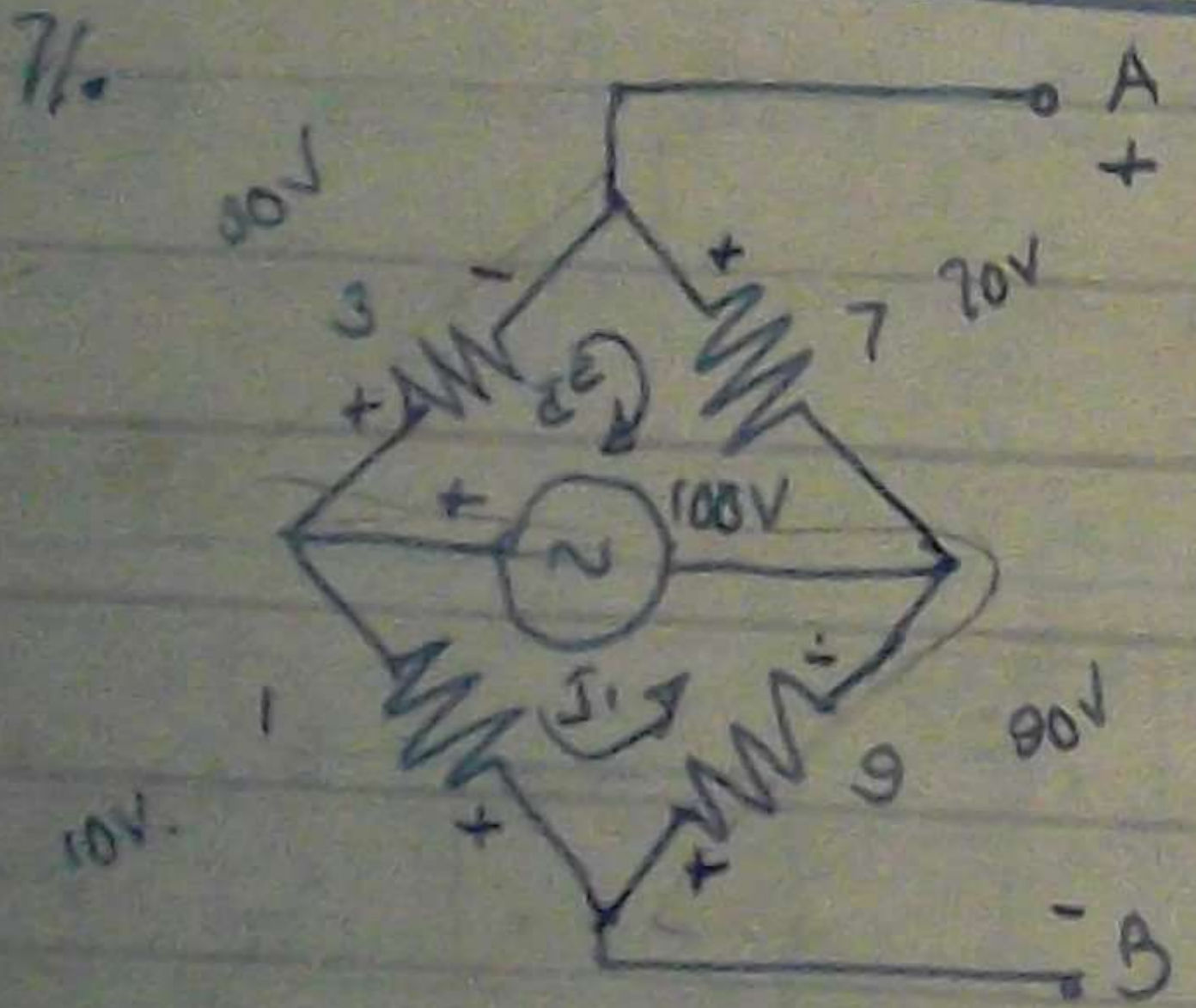
$$e_1 - e_2 = E_0$$

$$e_3 - e_2 = E_0$$

$$18(7-2)$$



$I = I' / I_{sc=0} + I'' / E_s=0$. Currents are found using Super-Position method. $ER + ES = E_0$ is the result.



$$I_1 = \frac{100}{10} = 10A, I_2 = \frac{100}{10} = 10A$$

TERMINAL A is the positive terminal.

$$E_0 = 70 - 90 = -20V$$

$$Z_0 = 3\Omega$$

$$E_0 = -20V$$

Z, E
Equiv. Ckt. Diagram

8.

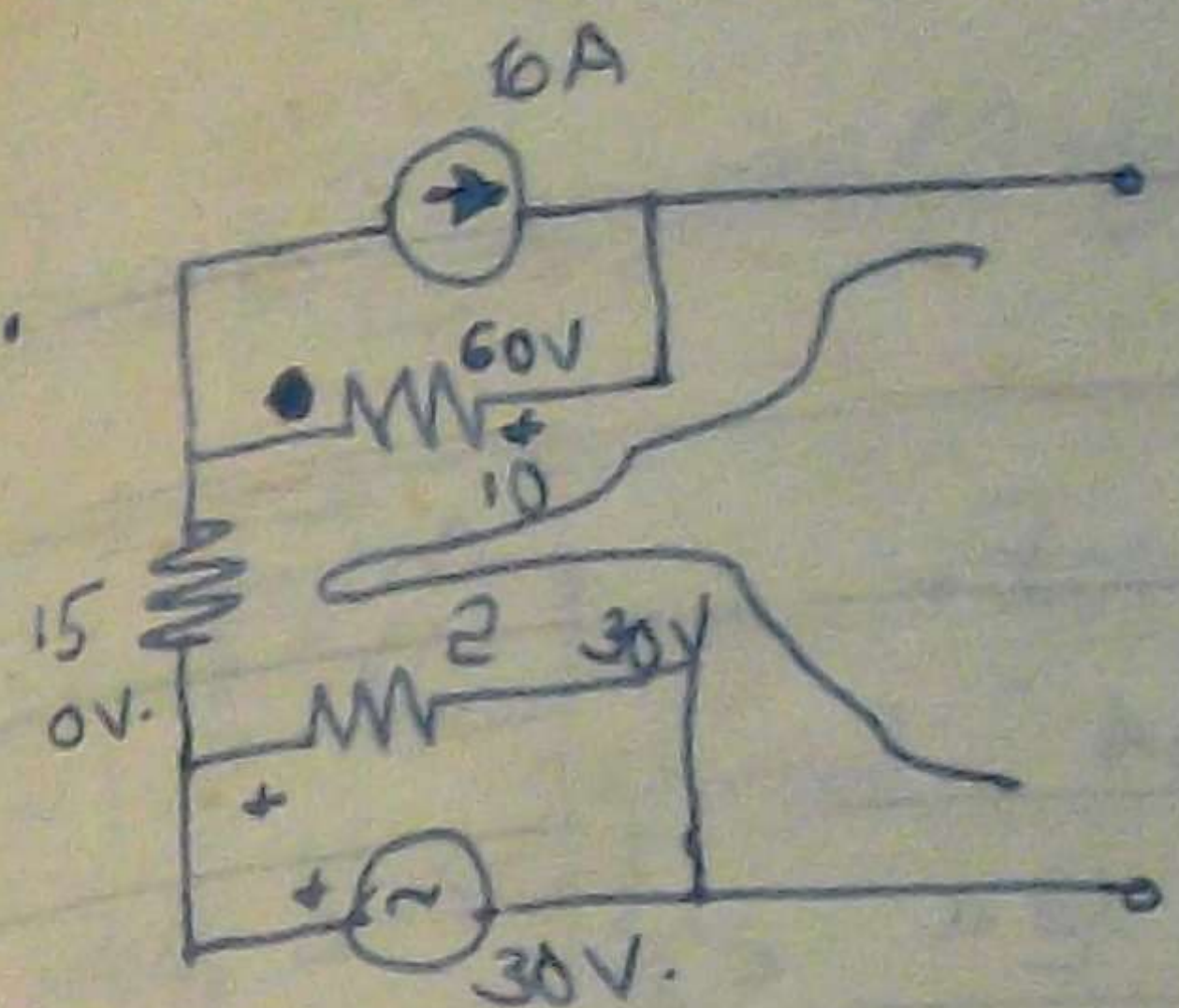


FIG. 1

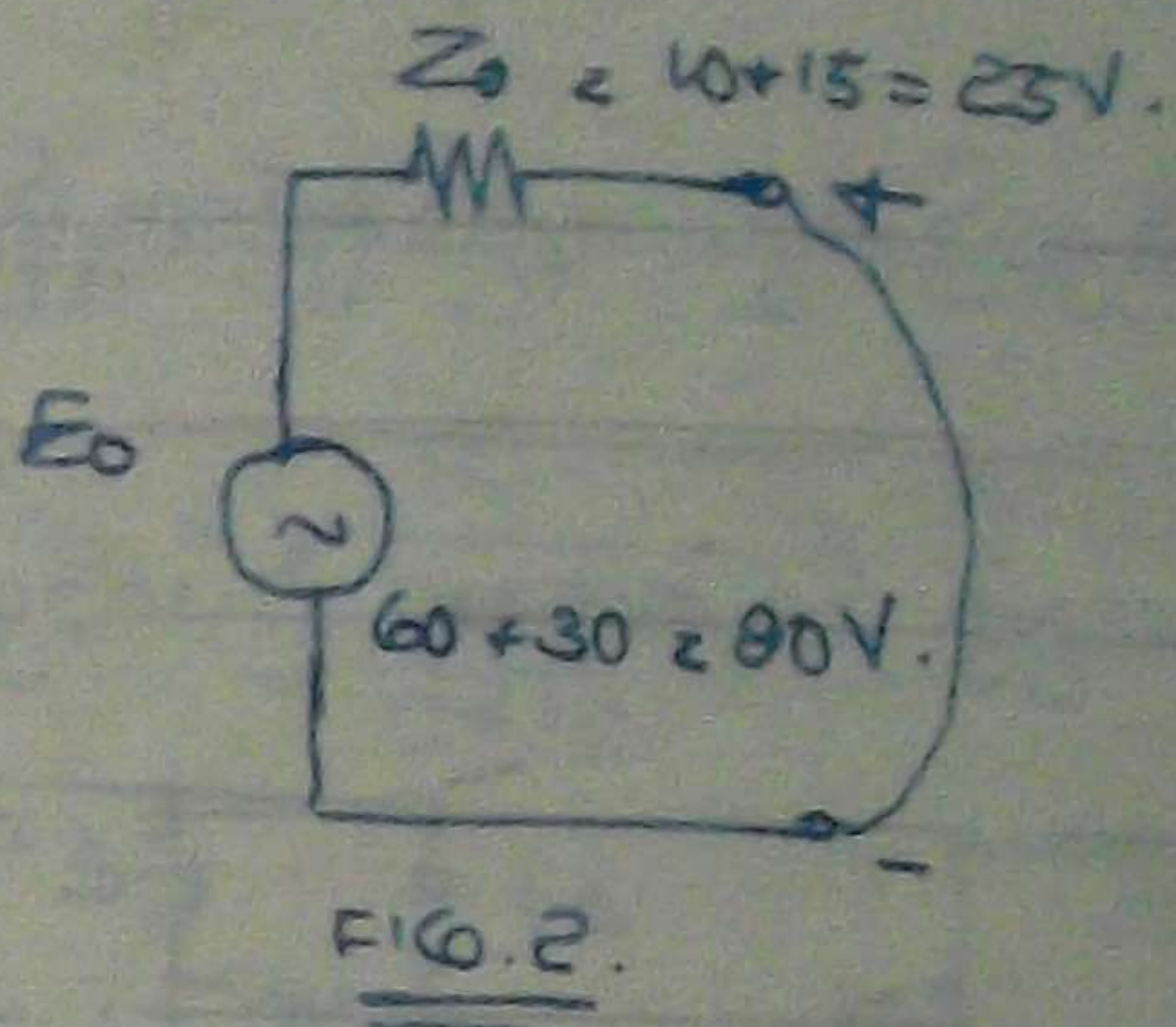
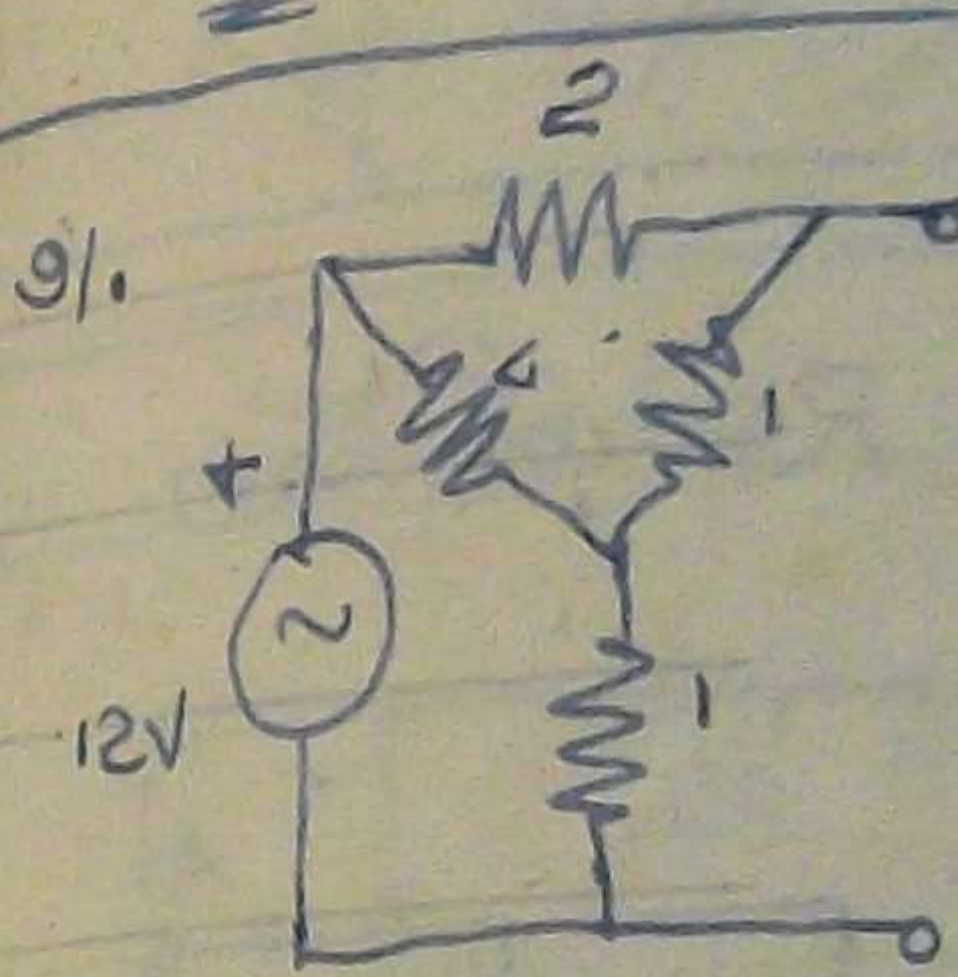
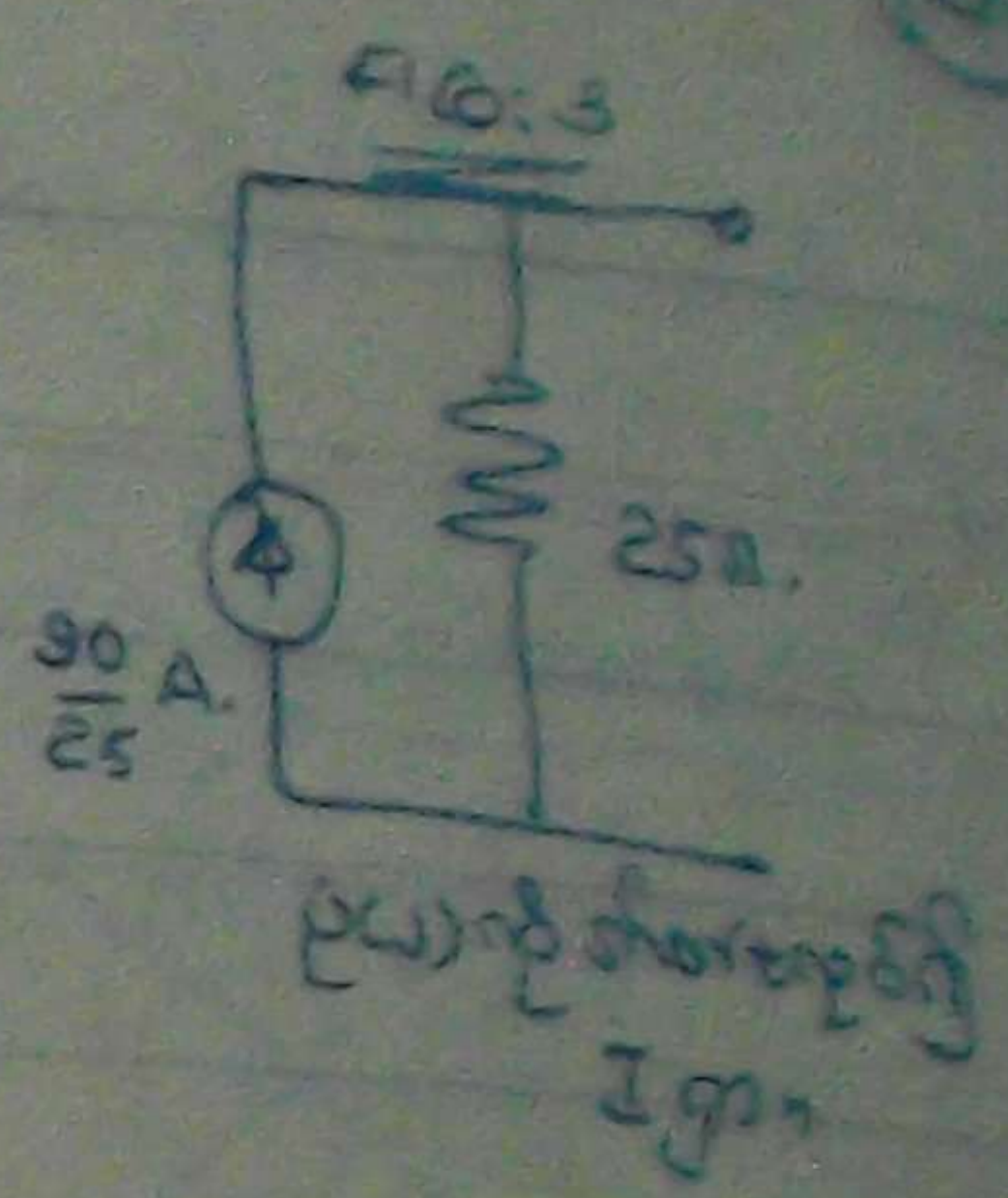
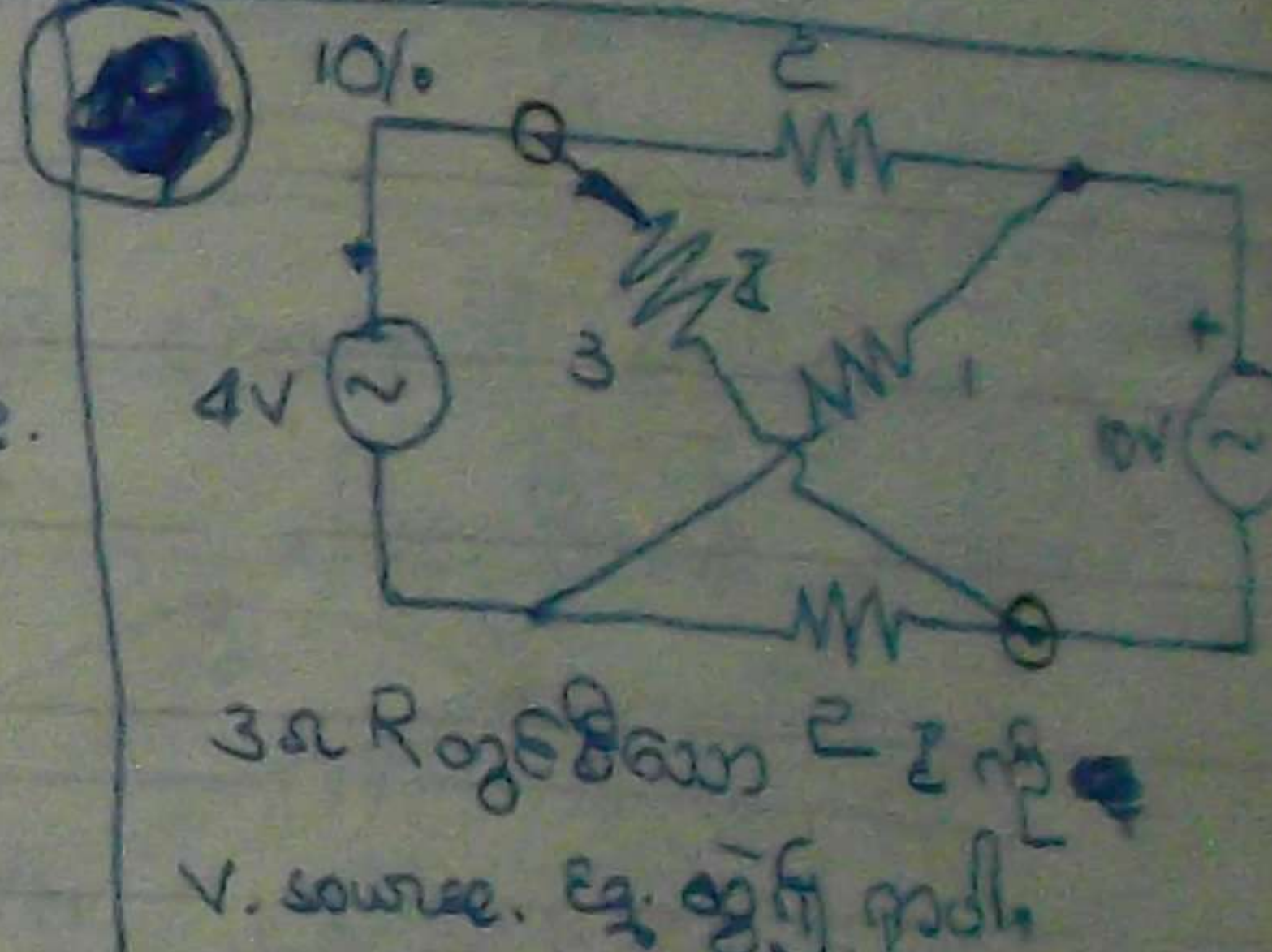
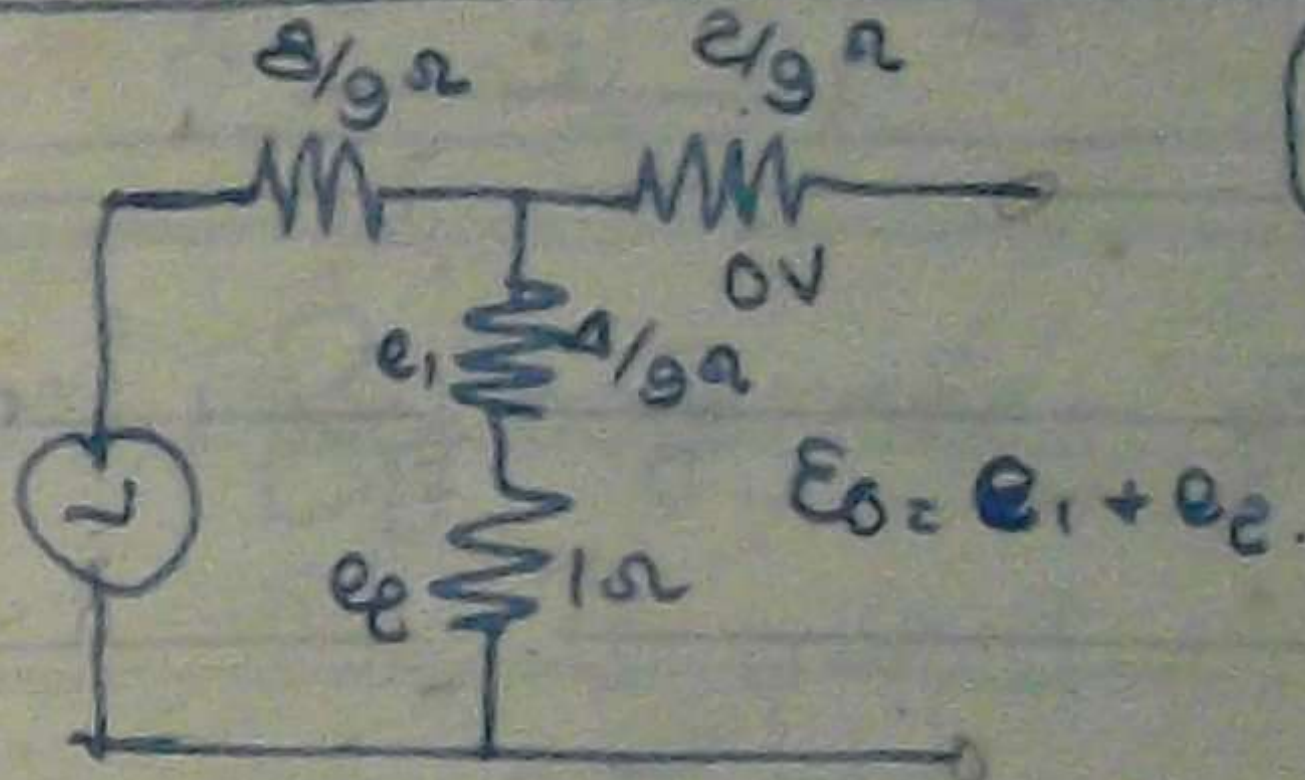


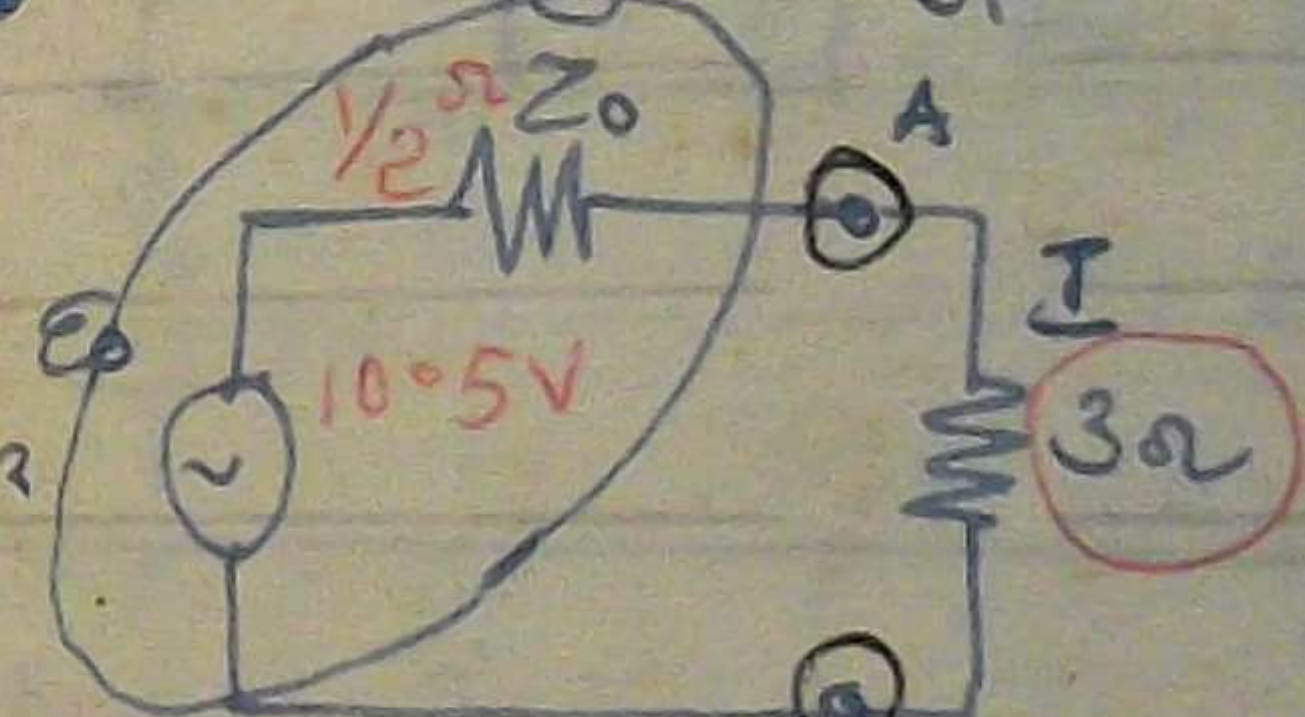
FIG. 2



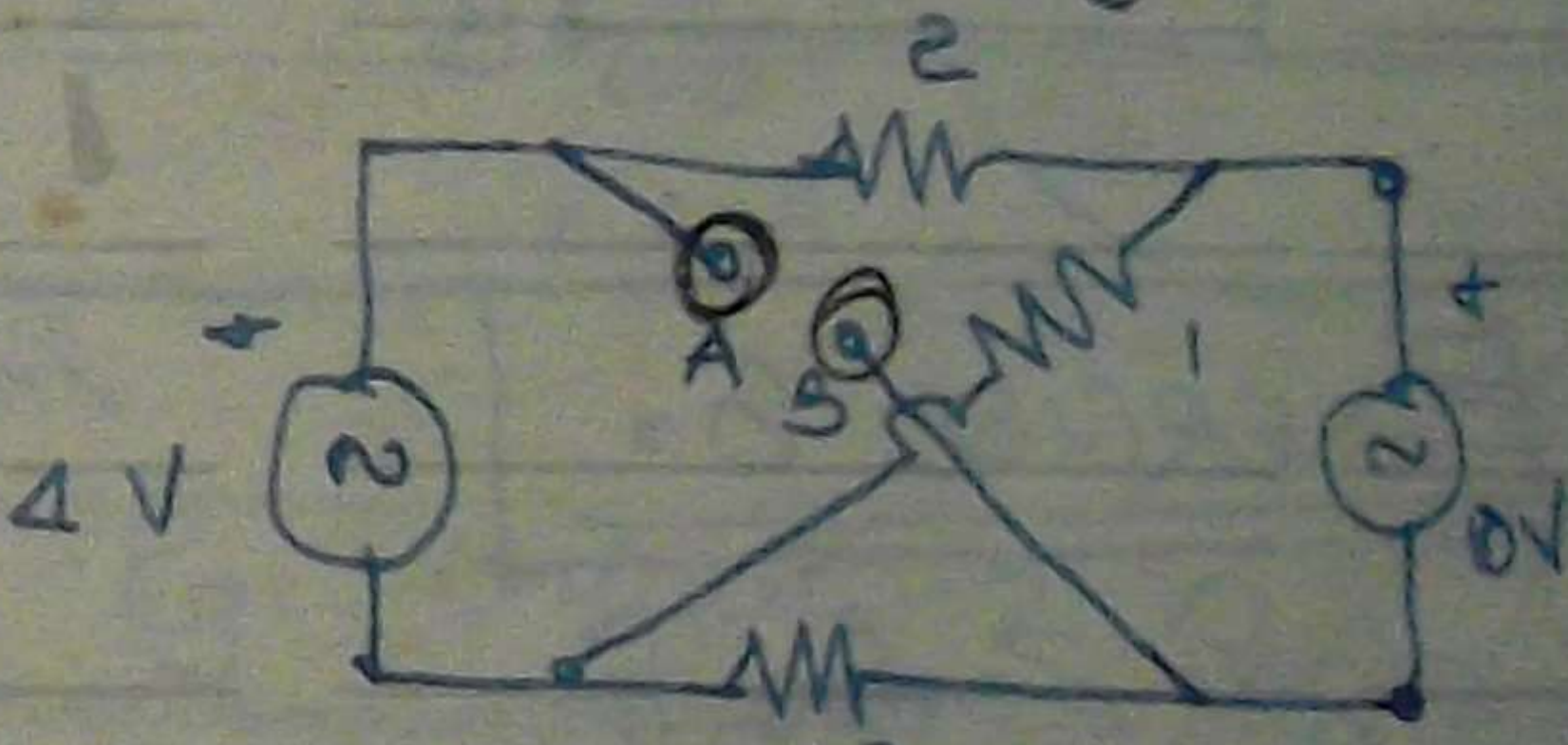
Δ-Y transformation



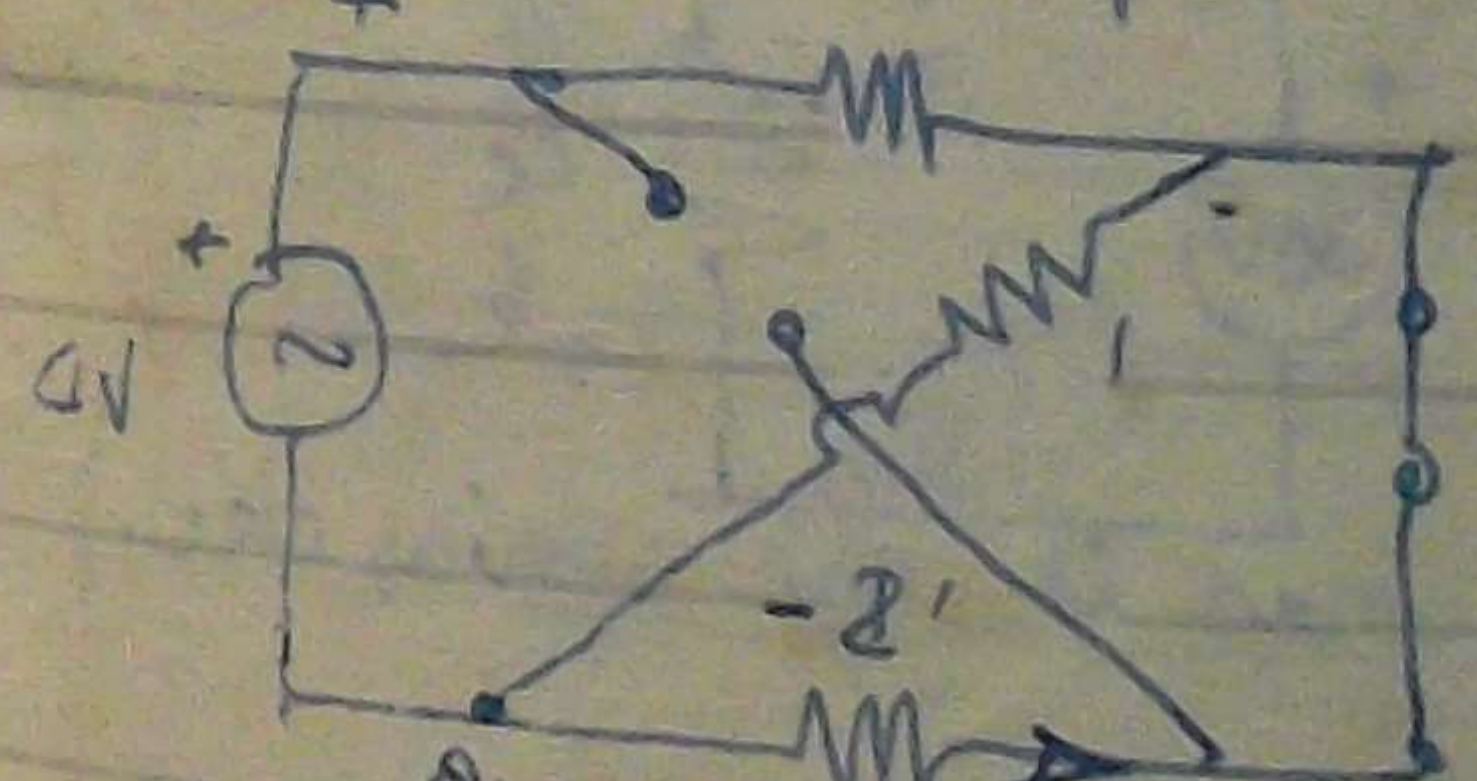
Ans: (10) 3 ohm resistor has net work done. Thevenin voltage is 10V. Thevenin resistance is 3 ohms. The current through the 3 ohm resistor is 3A.



Ans: -3A



Super position method

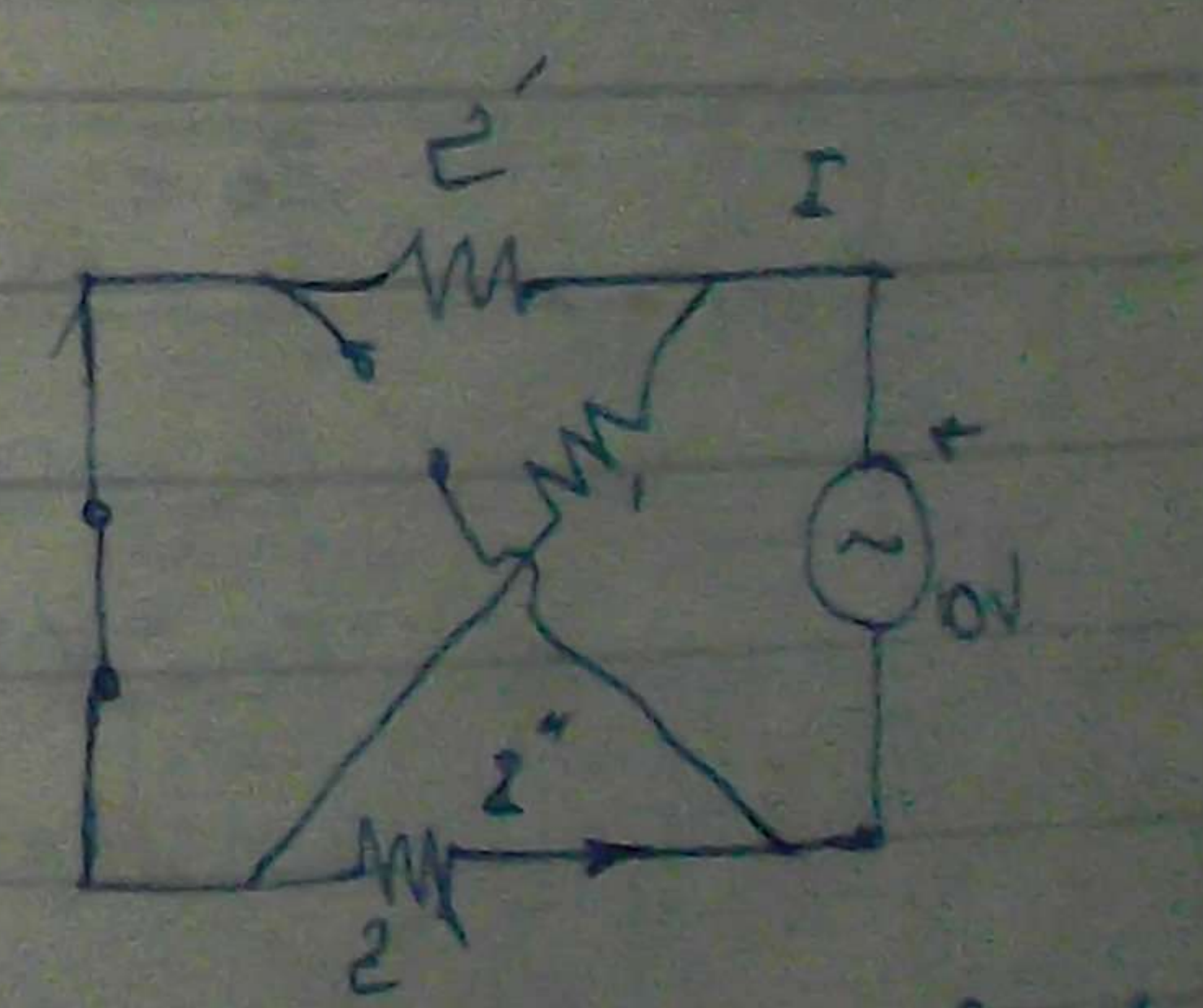


$$E_0 = 1 + 2e_2$$

$$e' + 2/1 = R \rightarrow 2R \text{ across } R$$

$$I \rightarrow I' \text{ across } R$$

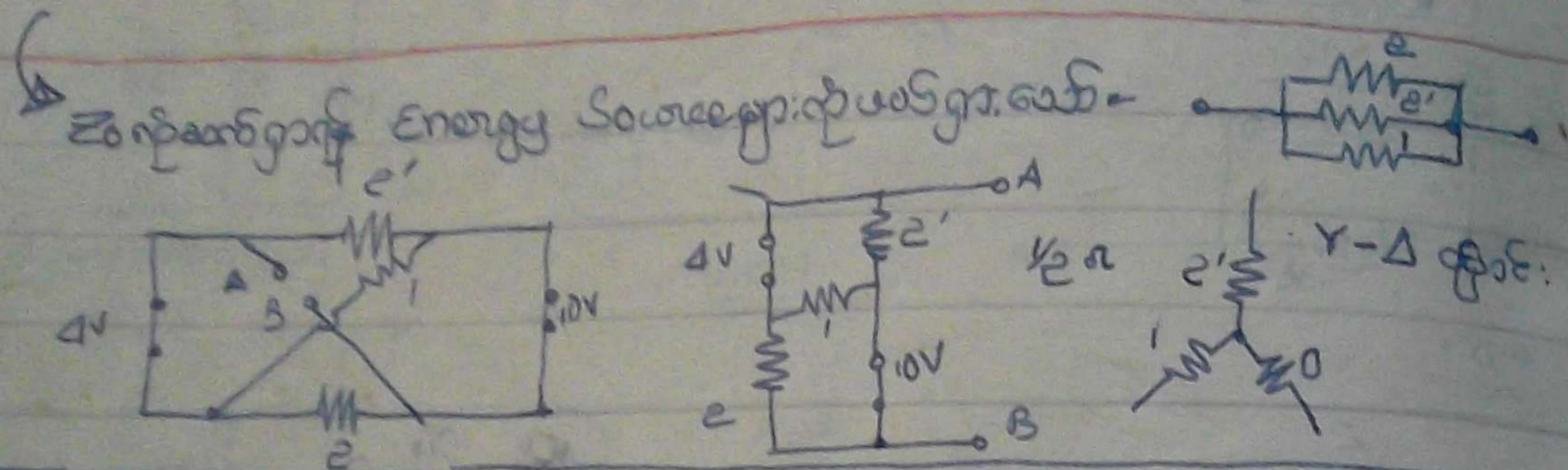
$$I = (-I') + (+I'')$$



$$e + e' / 1 = R = 3 \text{ ohms}$$

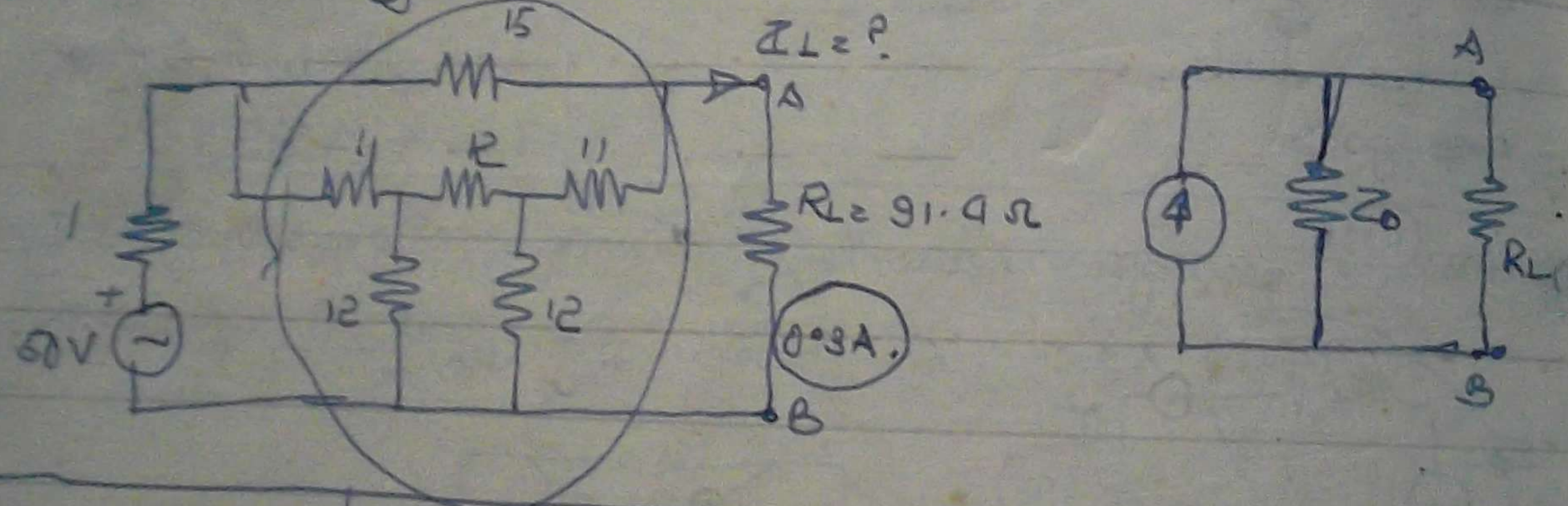
42

Resistor 2' ရှိ 2 နှစ်တွင် အခြားတူညီသော လျှပ်စီးကြောင်းများ သည် 10V



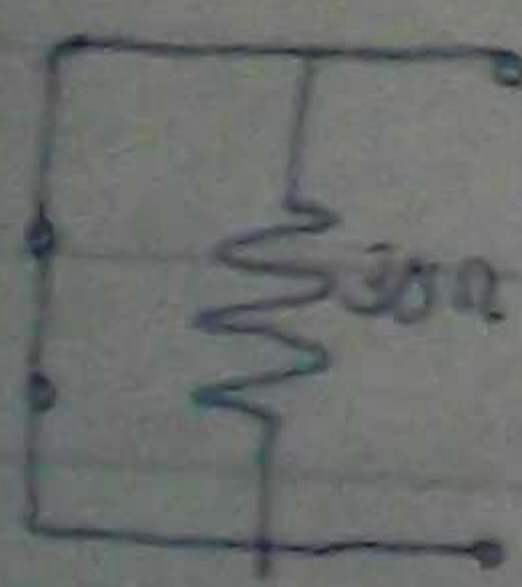
11.

ဆက်လက် Norton's Eq. ပြုလုပ်ဆောင်ရွက်ပါ။ Load R_L နှင့် R_L သို့မဟုတ် current I_L ကိုရှာပါ။



EXERCISE 6.

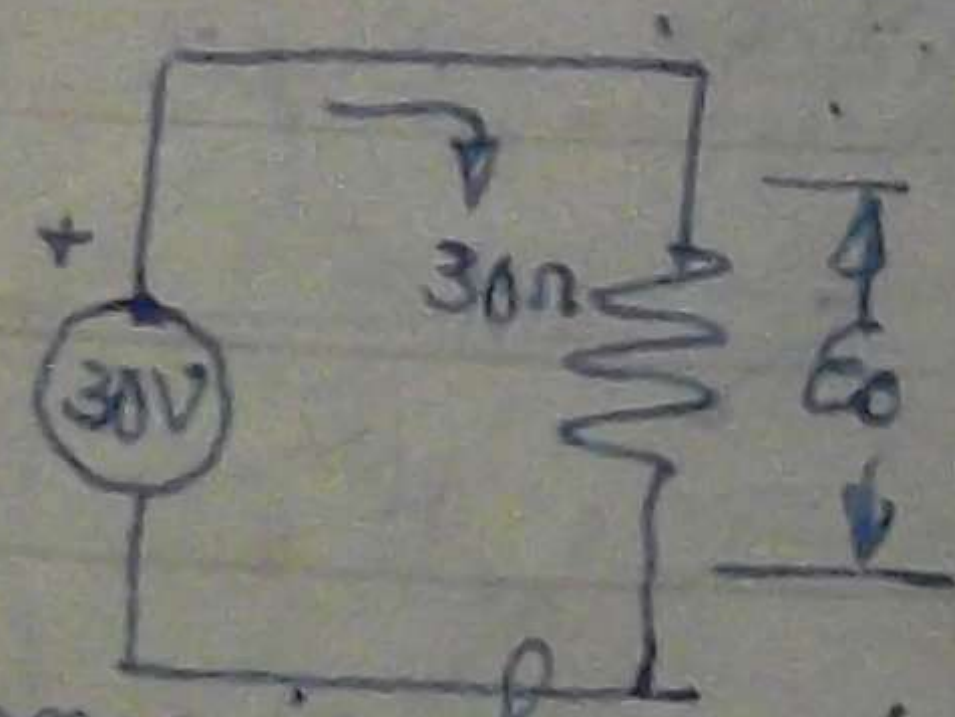
No. 1. လျှပ်စီးကြောင်းကို Z_0 ကိုရှာပါ။



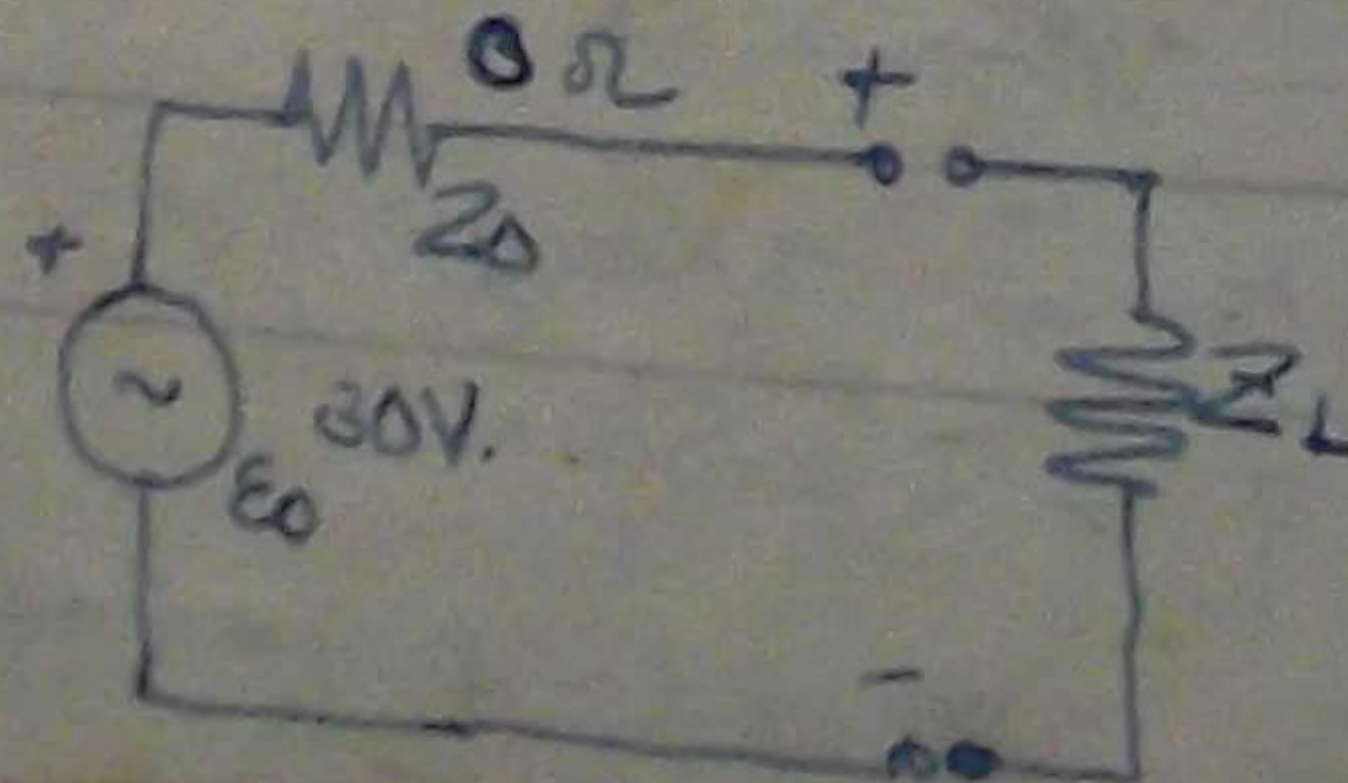
$$Z_0 = \frac{0 \times 30}{0 + 30} = 0 \Omega$$

E_0 ကိုရှာပါ။

$E_0 = 30V$ (only 1 resistance in the series ckt.)



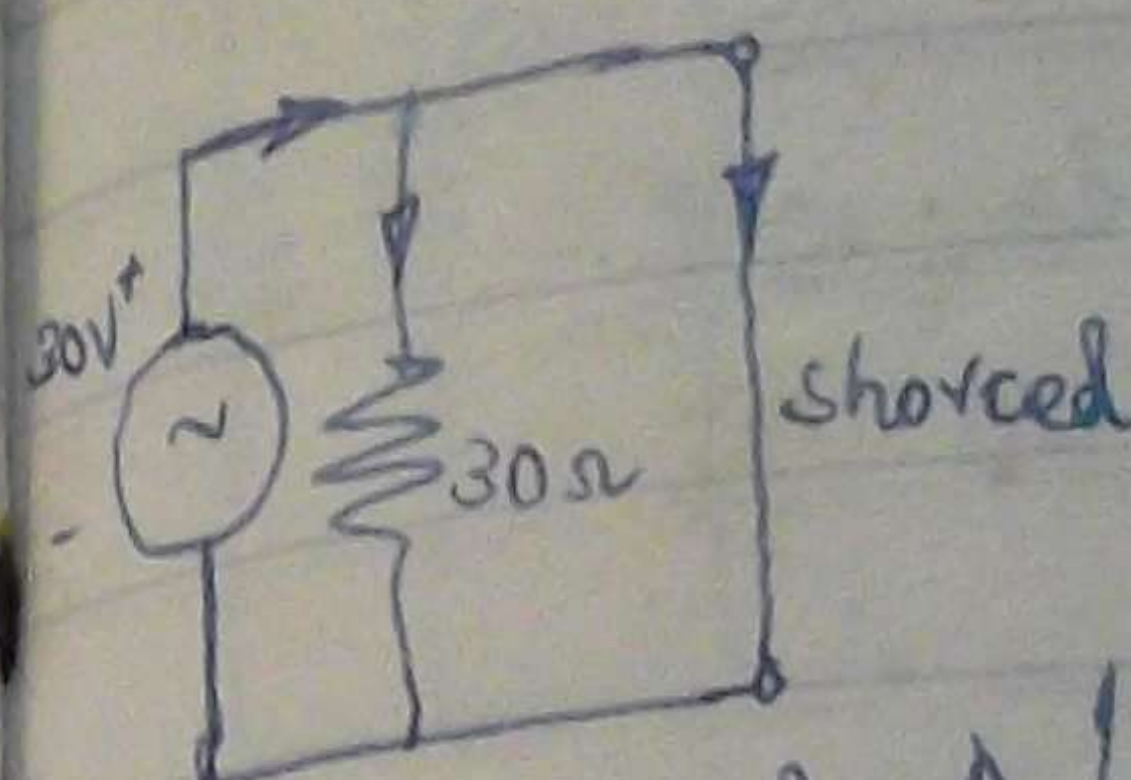
$\therefore$ Thevenin's Equivalent Circuit $\Rightarrow$



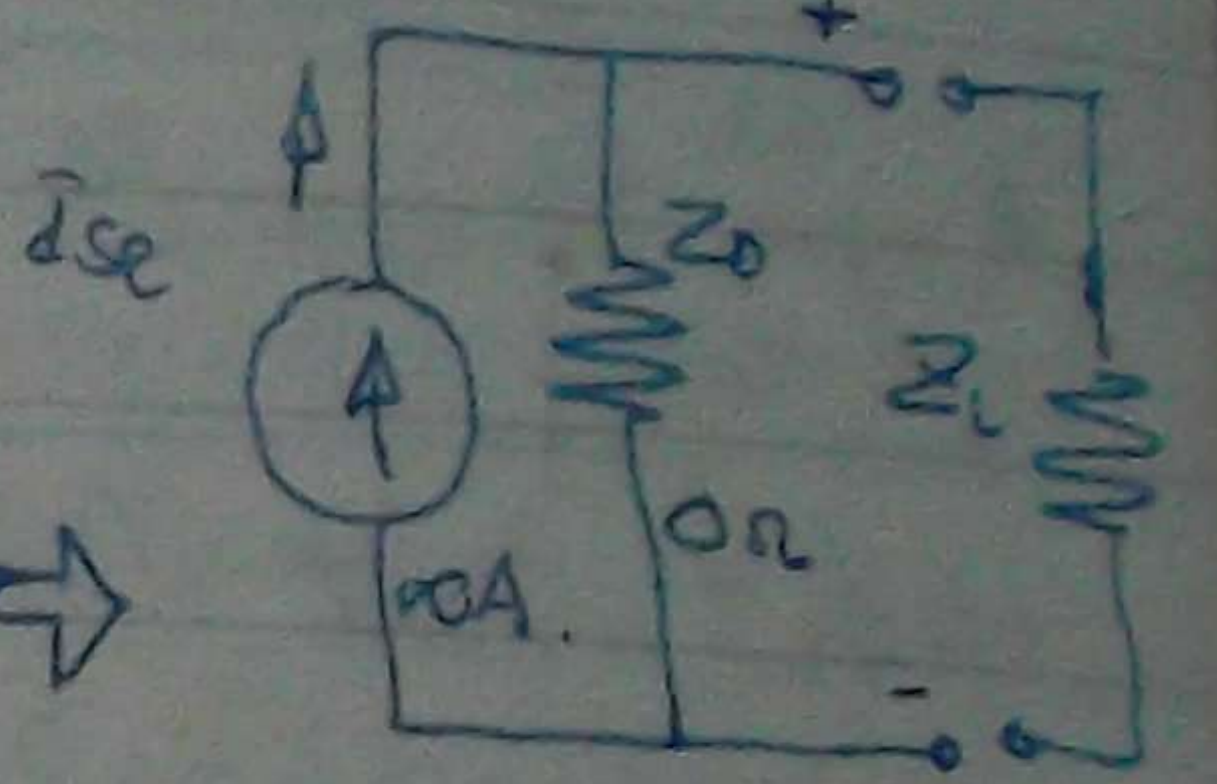
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Norton's Theorem:- လျှပ်စီးကြောင်း

$$I_{sc} = \frac{30}{\frac{0 \times 30}{0 + 30}} = \frac{30}{0} = \infty A$$



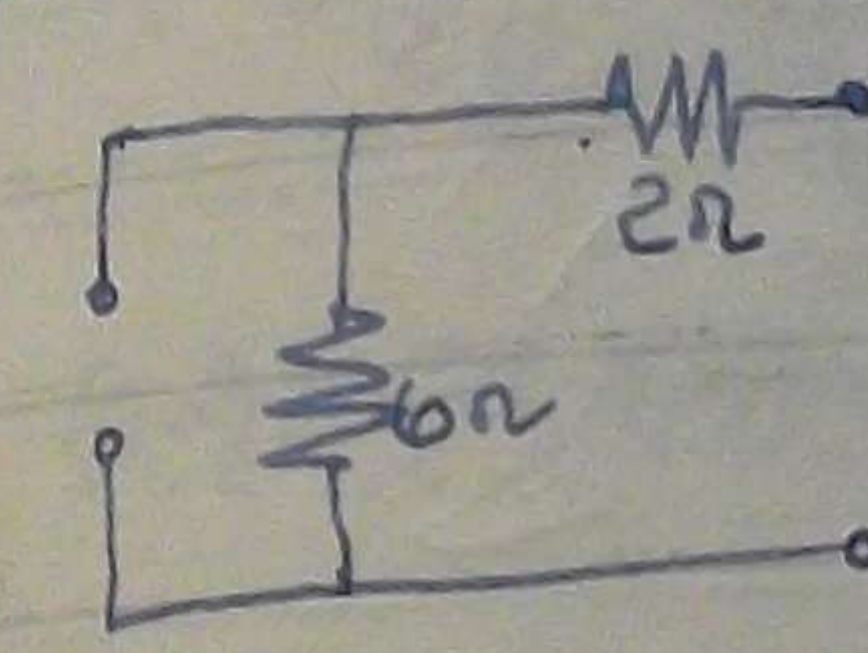
Requested Norton's Equivalent Ckt $\Rightarrow$



2/ Z_0 ကိုရှာပါ။

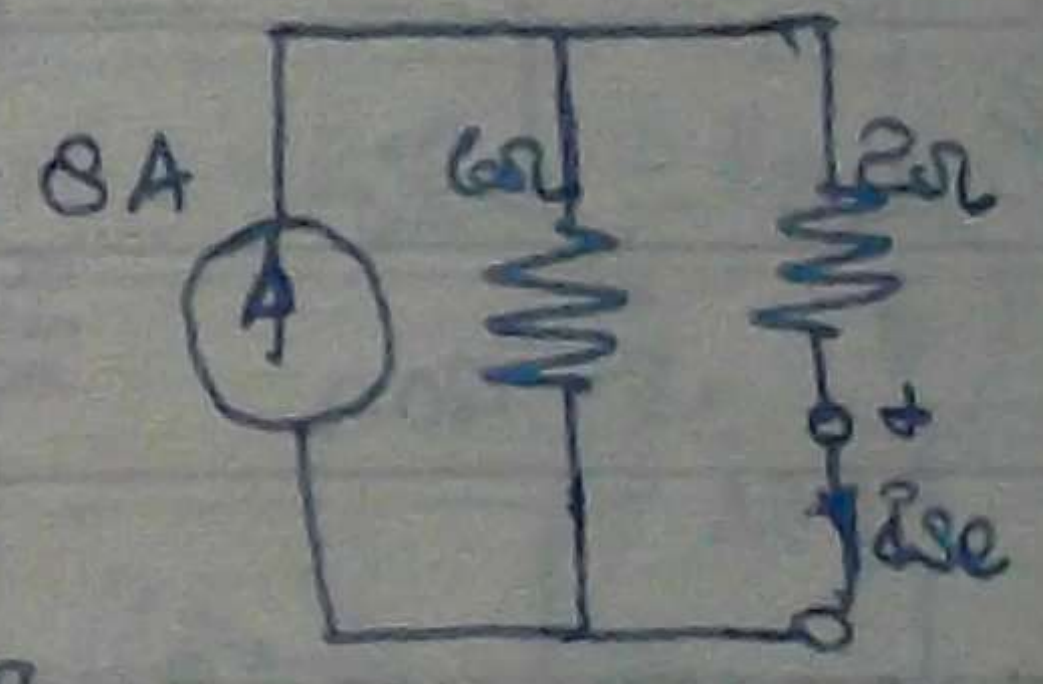
$$Z_0 = 6 + 2 = 8 \Omega$$

I_{sc} ကိုရှာပါ။



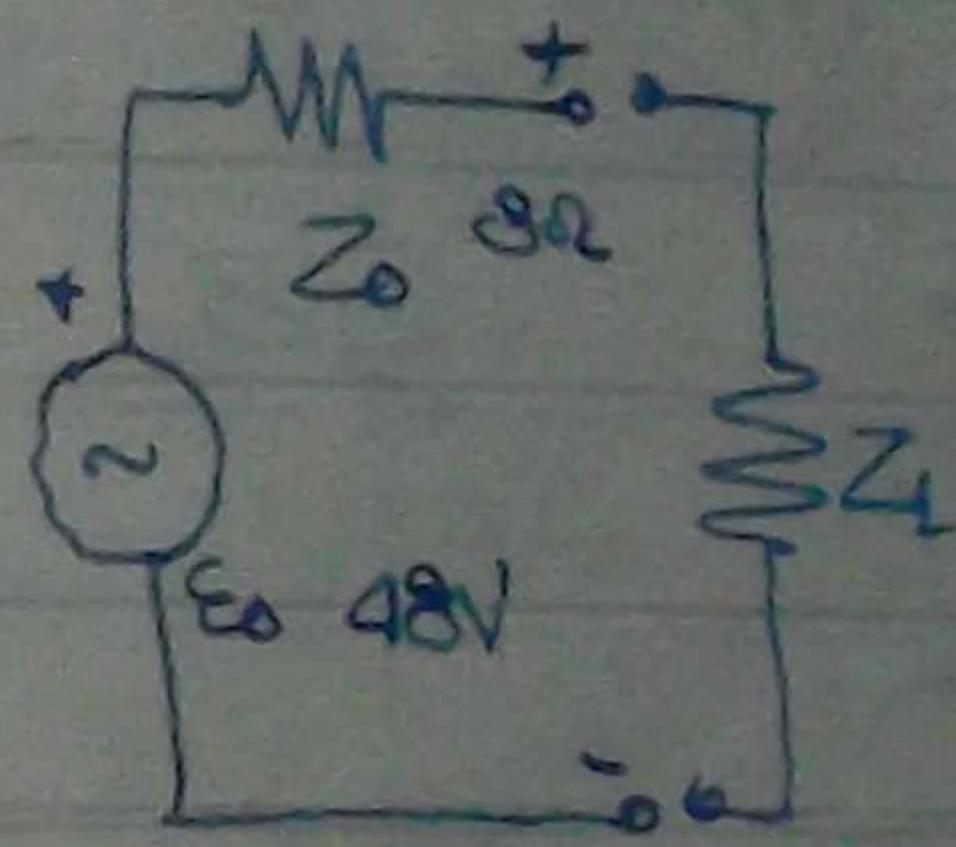
E_0 ကိုရှာပါ။

$$\begin{aligned} E_0 &= E_{6\Omega} + E_{2\Omega} \\ &= 0 + 6 \times 8 \\ &= 48V \end{aligned}$$

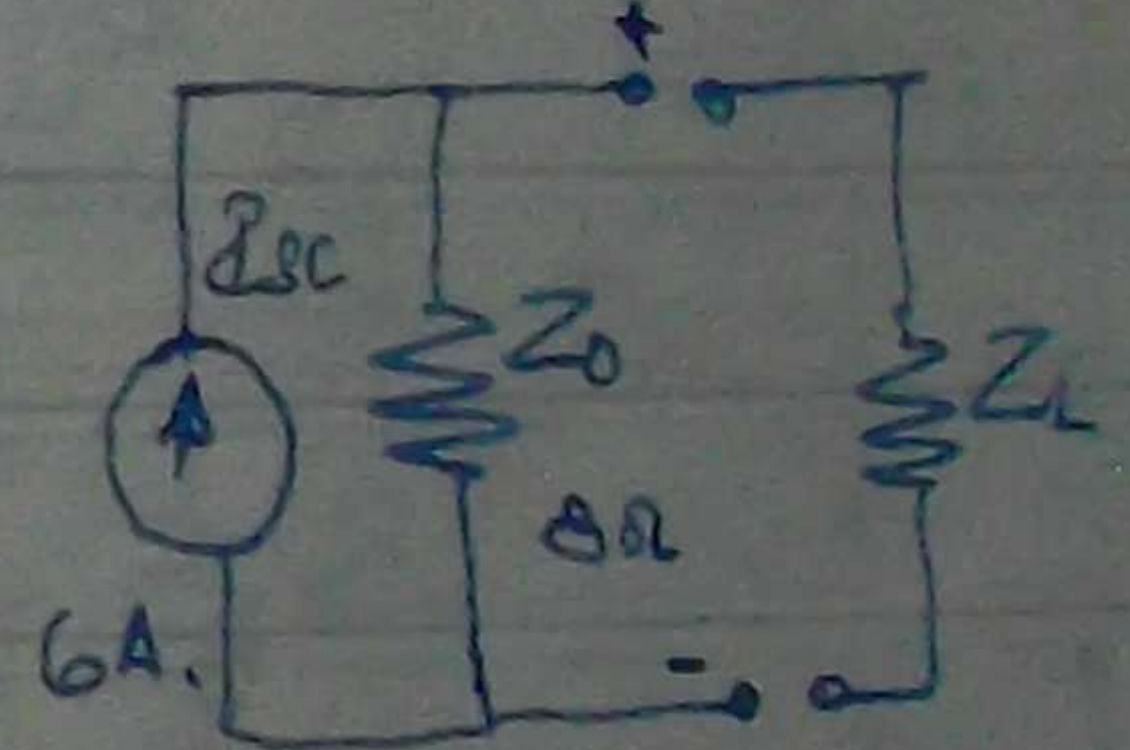


$$\begin{aligned} I_{sc} &= \frac{6 \times 8}{6 + 2} \\ &= 6A \end{aligned}$$

$\therefore$ Thevenin Equi. Ckt



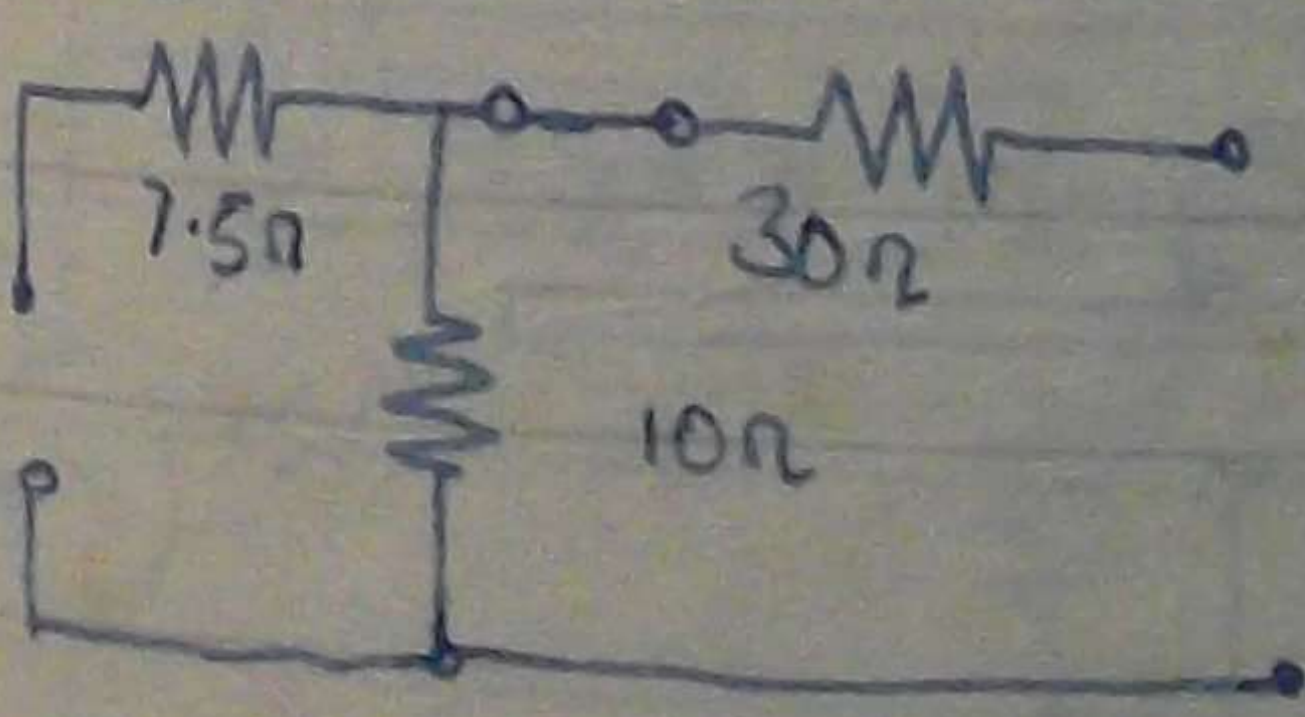
Norton's Eq. Circuit $\Rightarrow$



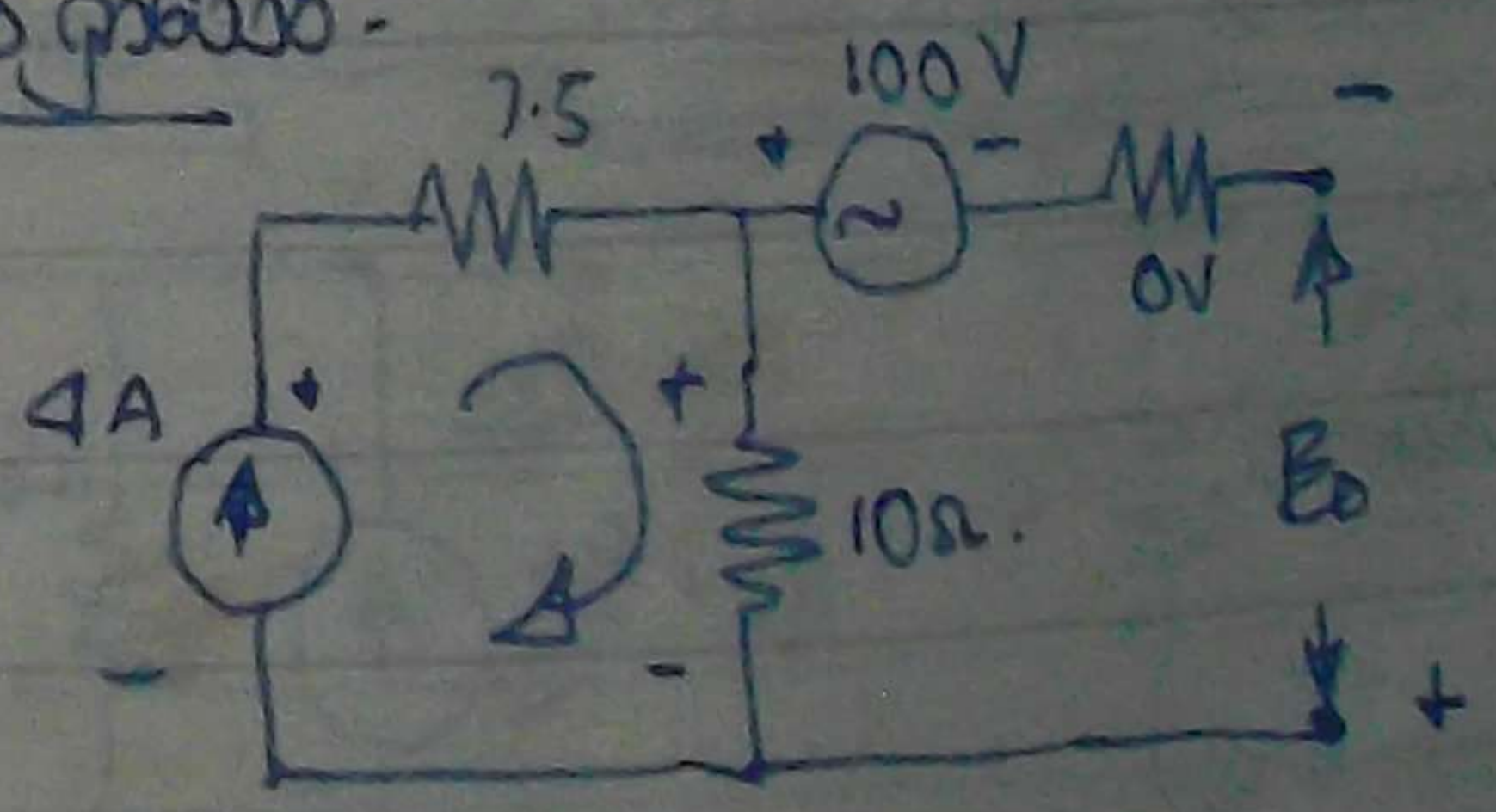
3/ Z_0 ကိုရှာပါ။

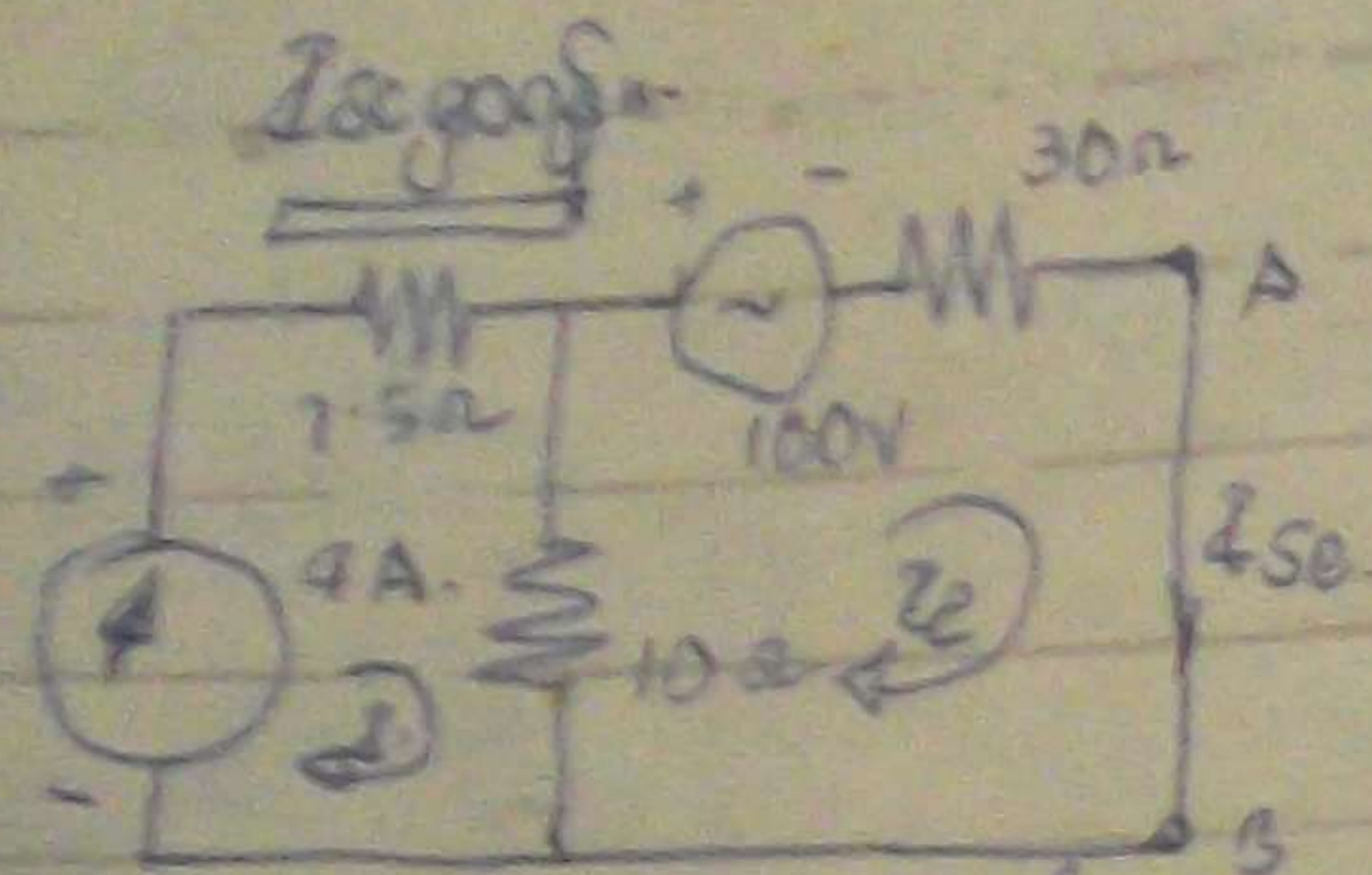
$$Z_0 = 30 + 10 = 40 \Omega$$

E_0 ကိုရှာပါ။



$$E_0 = 100 - 4 \times 10 = 60V$$





Mesh Current Method

$$I_1 = 4A$$

$$E_0 =$$

$$-100 = (30 + 10)I_2 = 10I_2$$

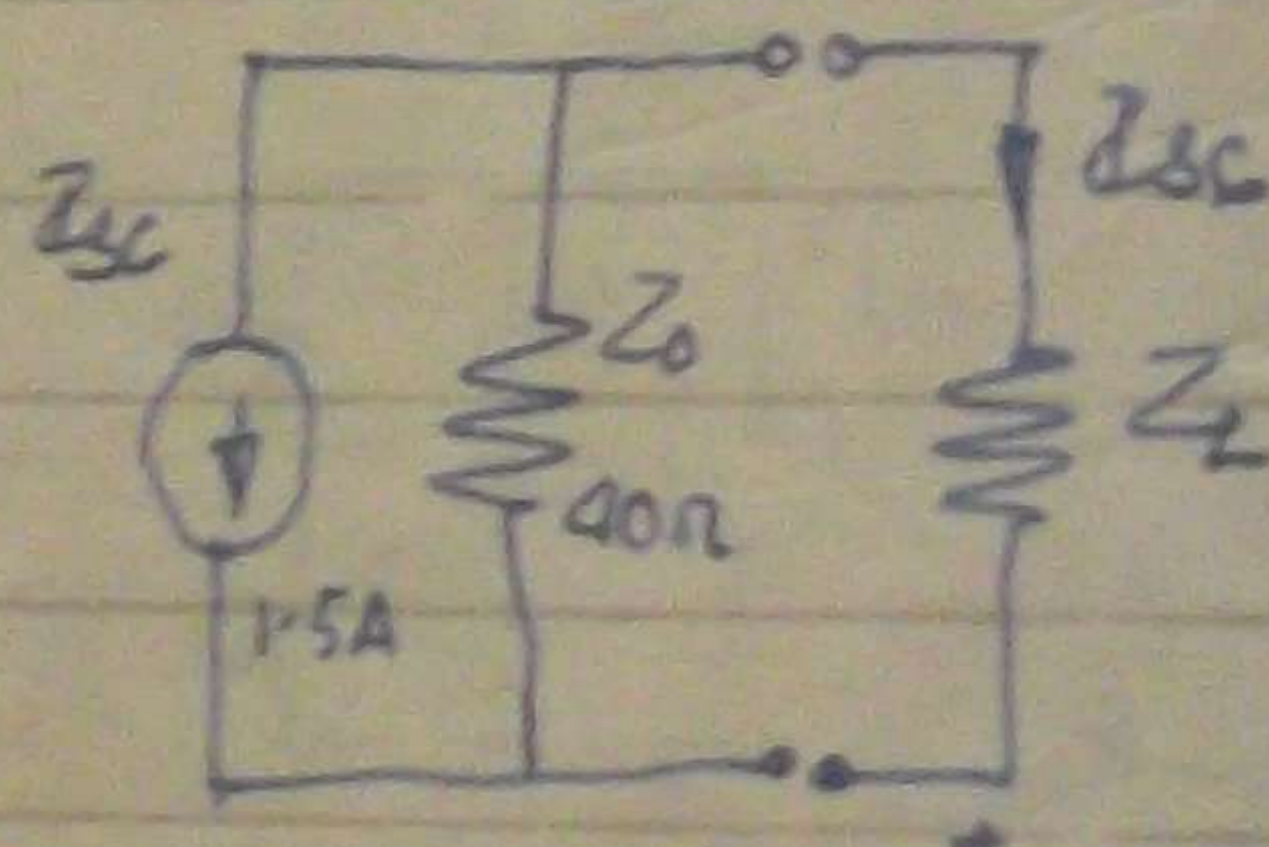
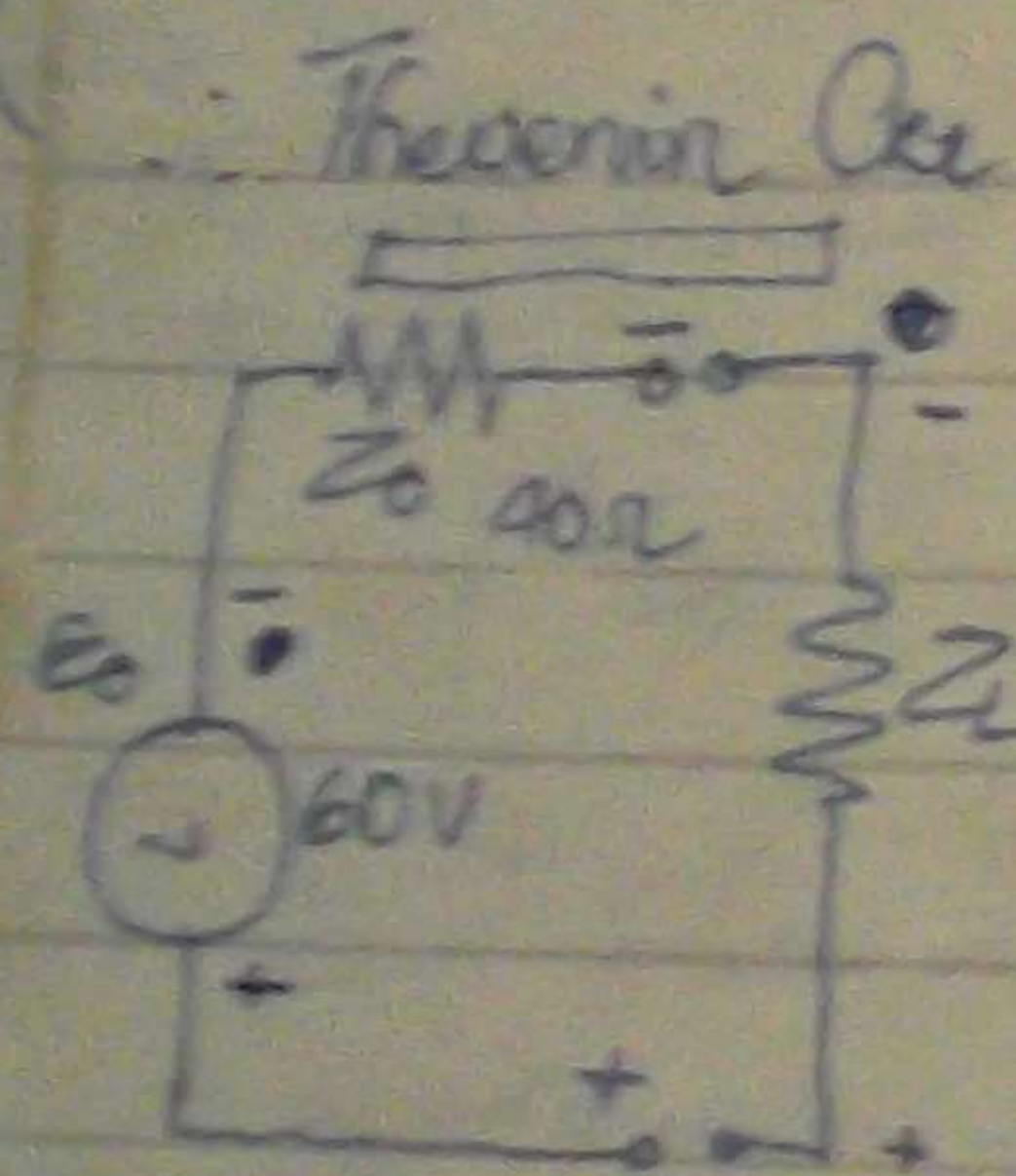
$$-100 = 40I_2 - 40$$

$$-60 = 40I_2$$

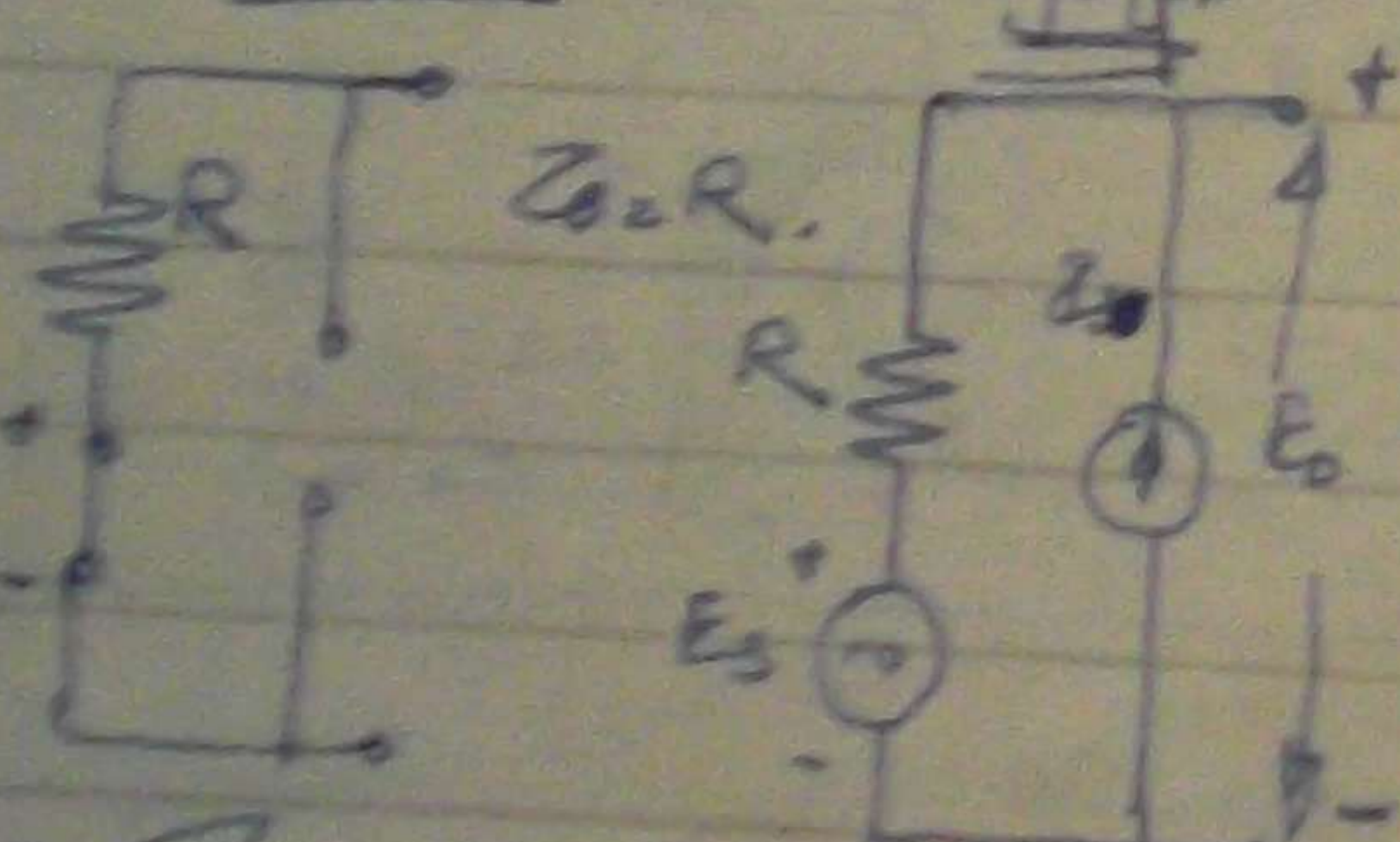
$$I_2 = -1.5A$$

$$I_{sc} = 1.5A \text{ (point B to A.)}$$

Norton's Ckt.



4. Z_0 gnd.

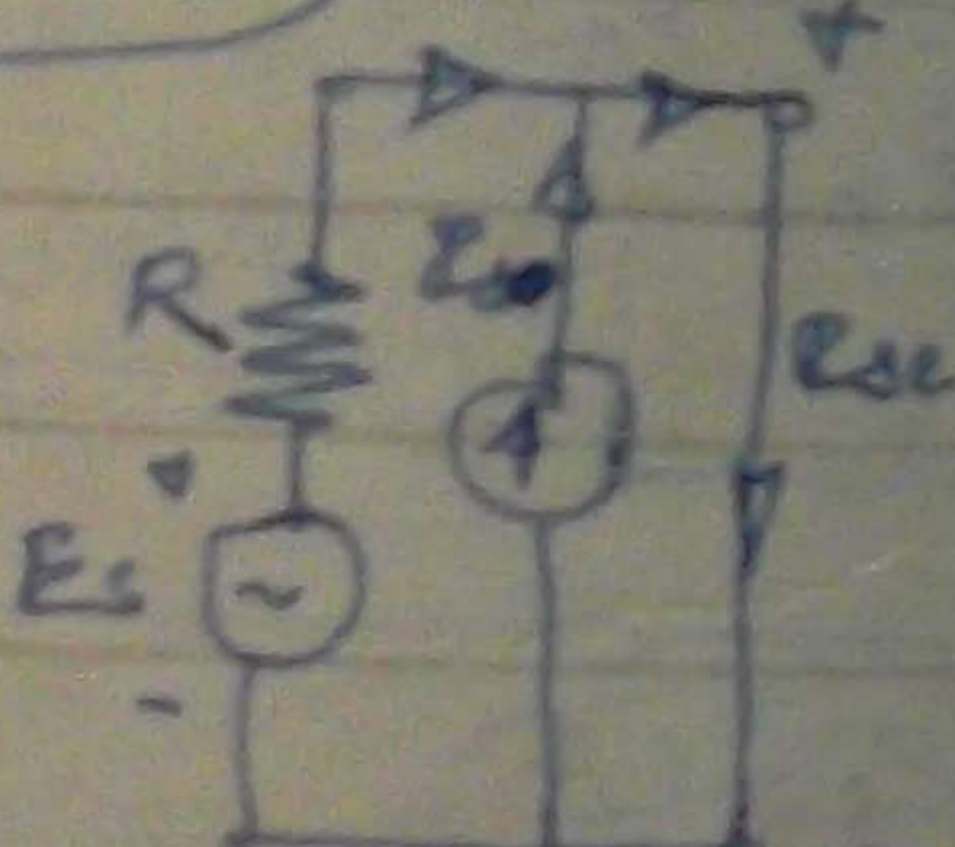


E_0 gnd.

$$E_0 = R \cdot I_{sc} + E_s$$

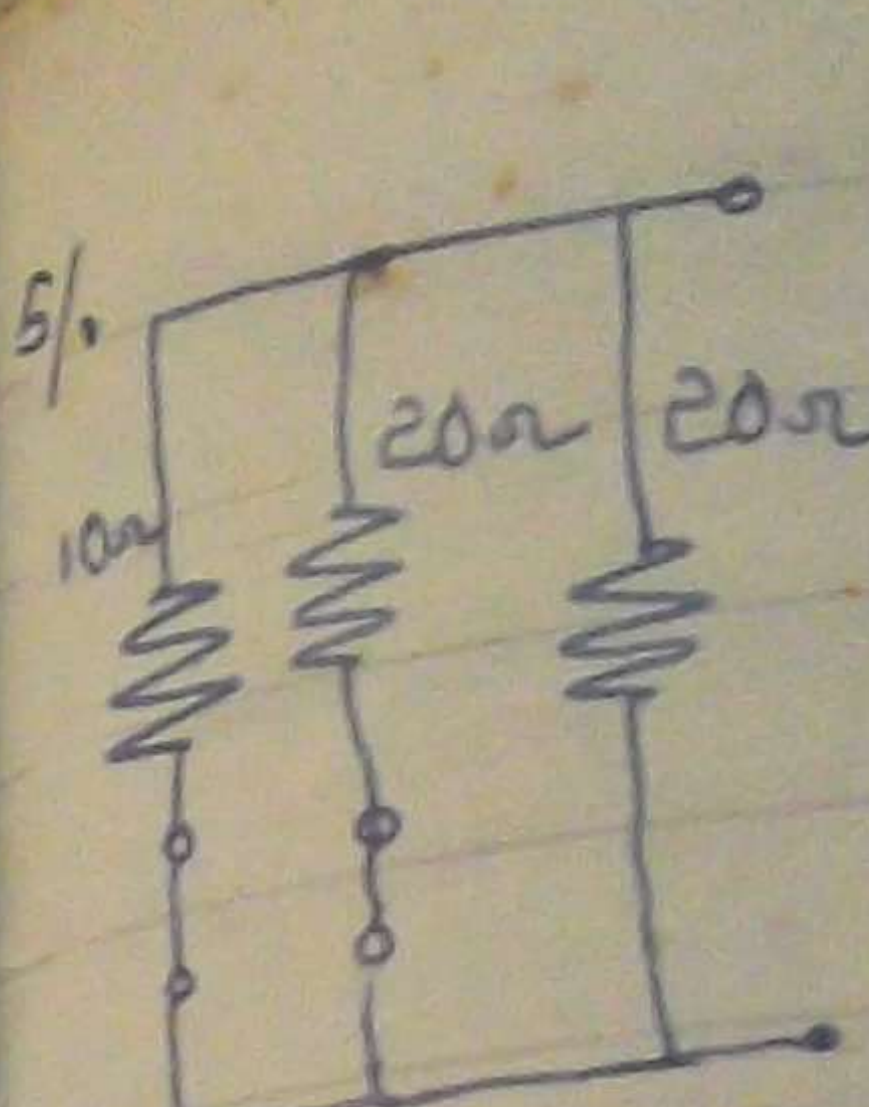
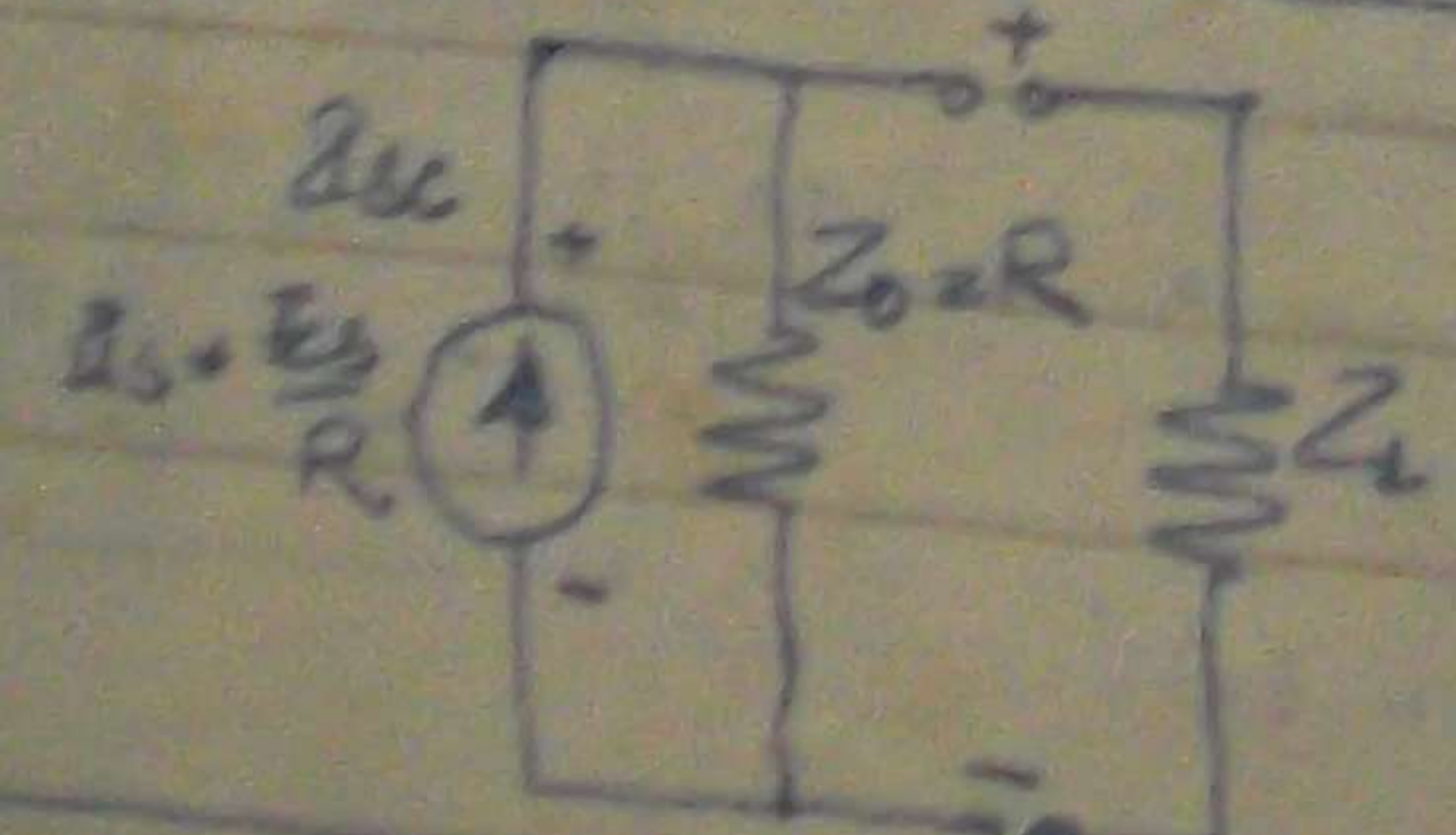
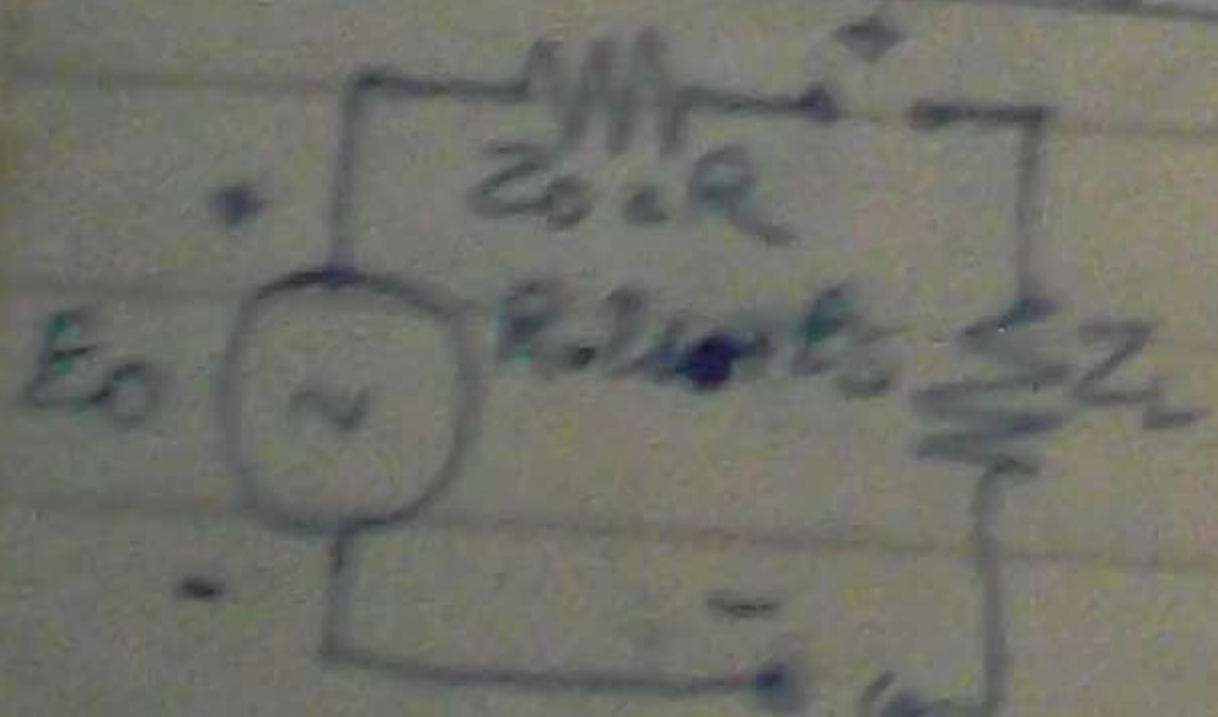
I_{sc} gnd.

$$I_{sc} = I_{sc} + \frac{E_s}{R}$$



Thevenin's Equiv. Ckt

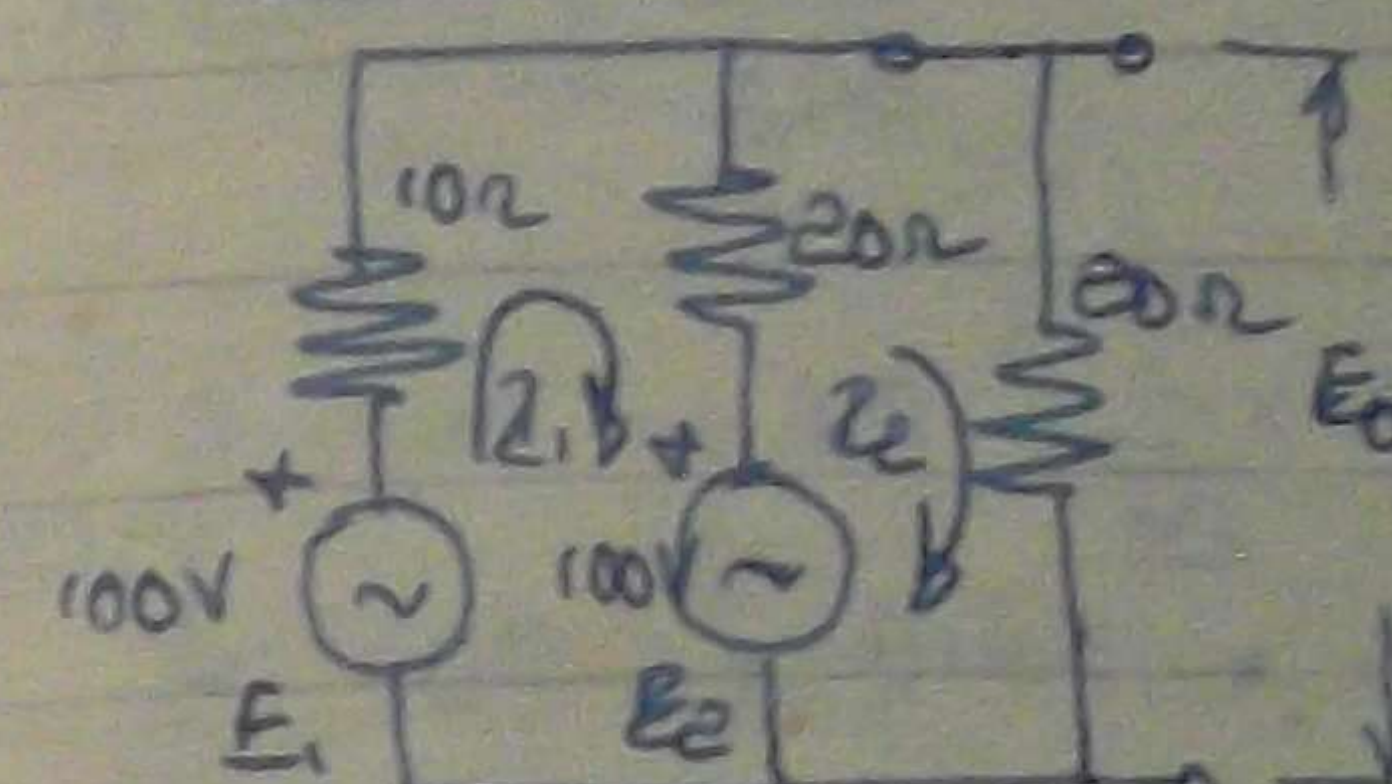
Norton's Equiv. Ckt



Z_0 gnd.

$$Z_0 = \frac{10 \times \frac{20}{2}}{10 + \frac{20}{2}} = 5\Omega$$

E_0 gnd.



Mesh Currents Method

$$100 - 100 = 30I_1 - 20I_2$$

$$100 = -30I_1 + 40I_2$$

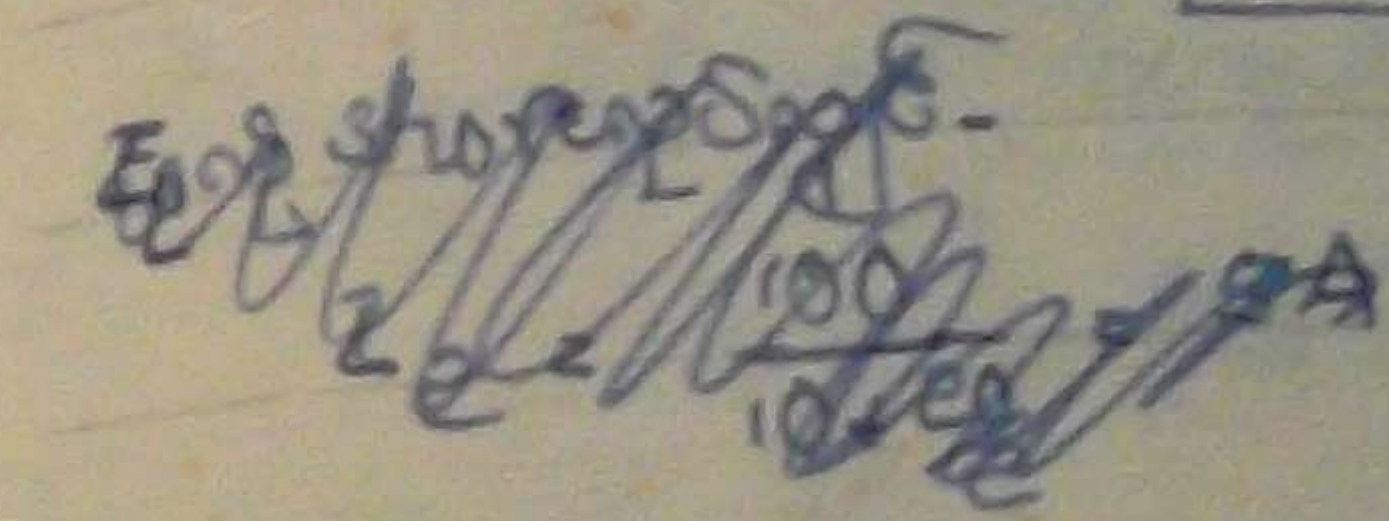
$$0 = 3I_1 - 2I_2 \quad (1)$$

$$5 = -I_1 + 2I_2 \quad (2)$$

$$(+)$$

$$5 = 2I_1$$

$$\therefore I_1 = 2.5A$$



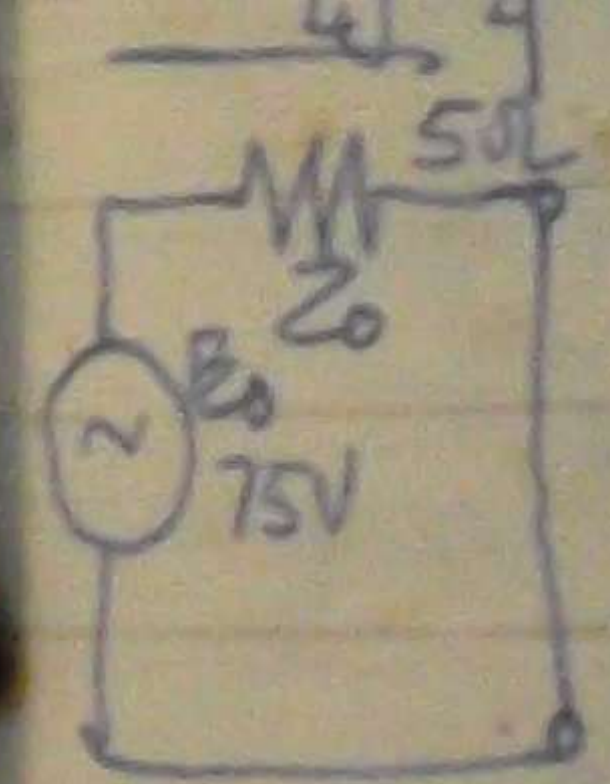
E_0 gnd.

$$(Eq 1) \rightarrow 3 \times 2.5 - 2I_2 = 0$$

$$\therefore I_2 = \frac{7.5}{2} = 3.75A$$

$$E_0 = 20 \times 3.75 = 75V$$

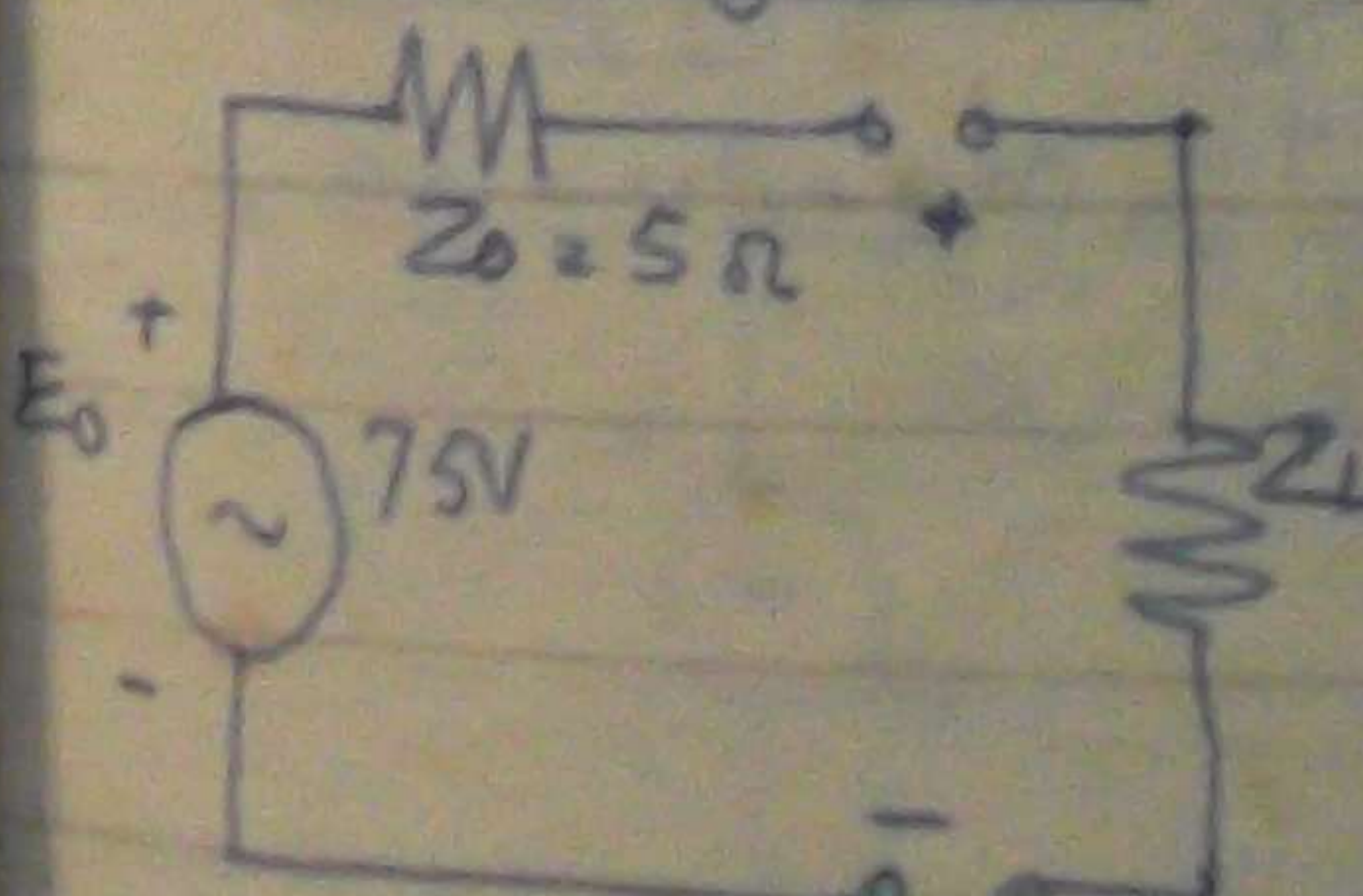
I_{sc} gnd.



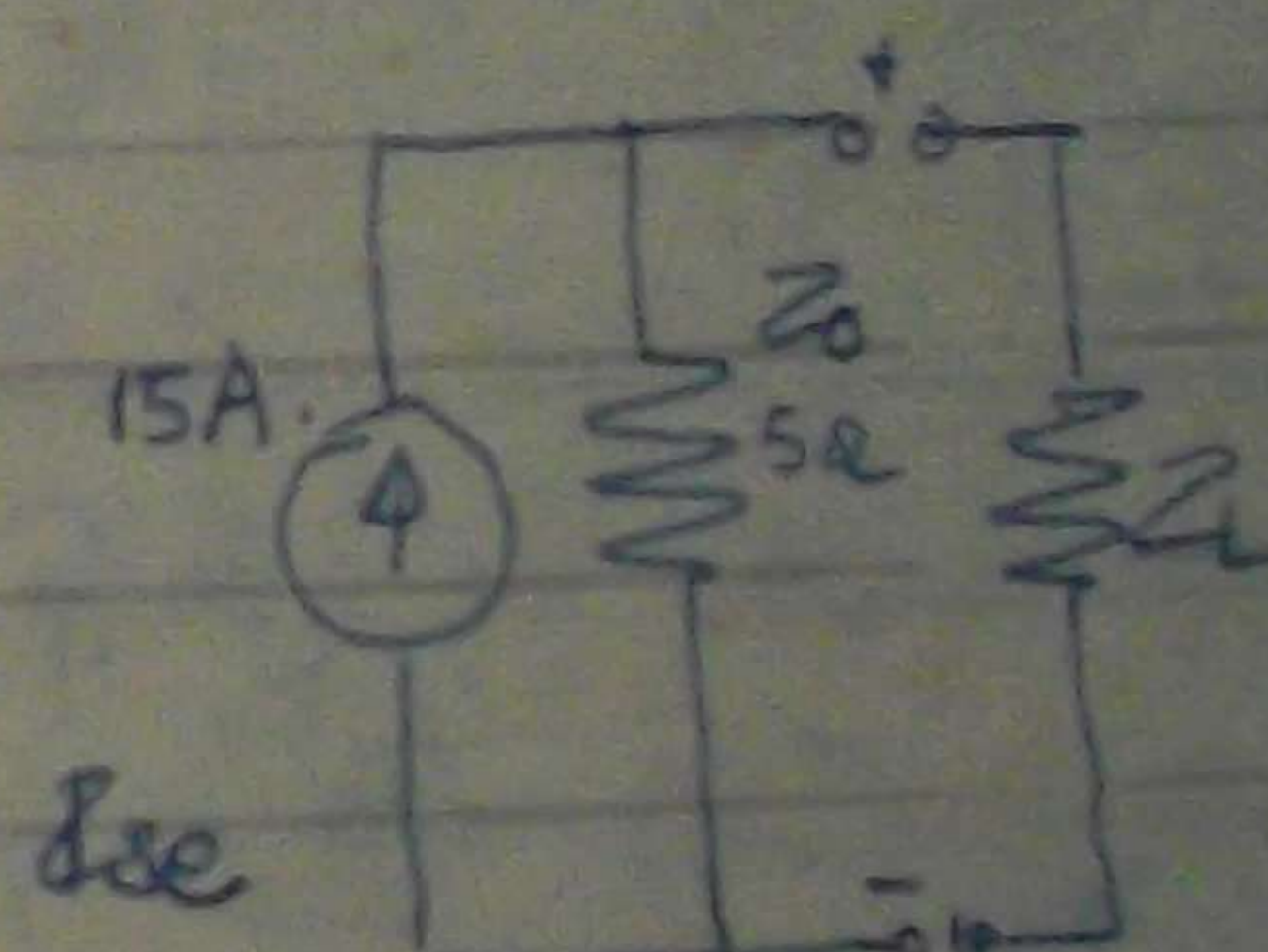
$$I_{sc} = \frac{75}{5} = 15A$$

Ans.

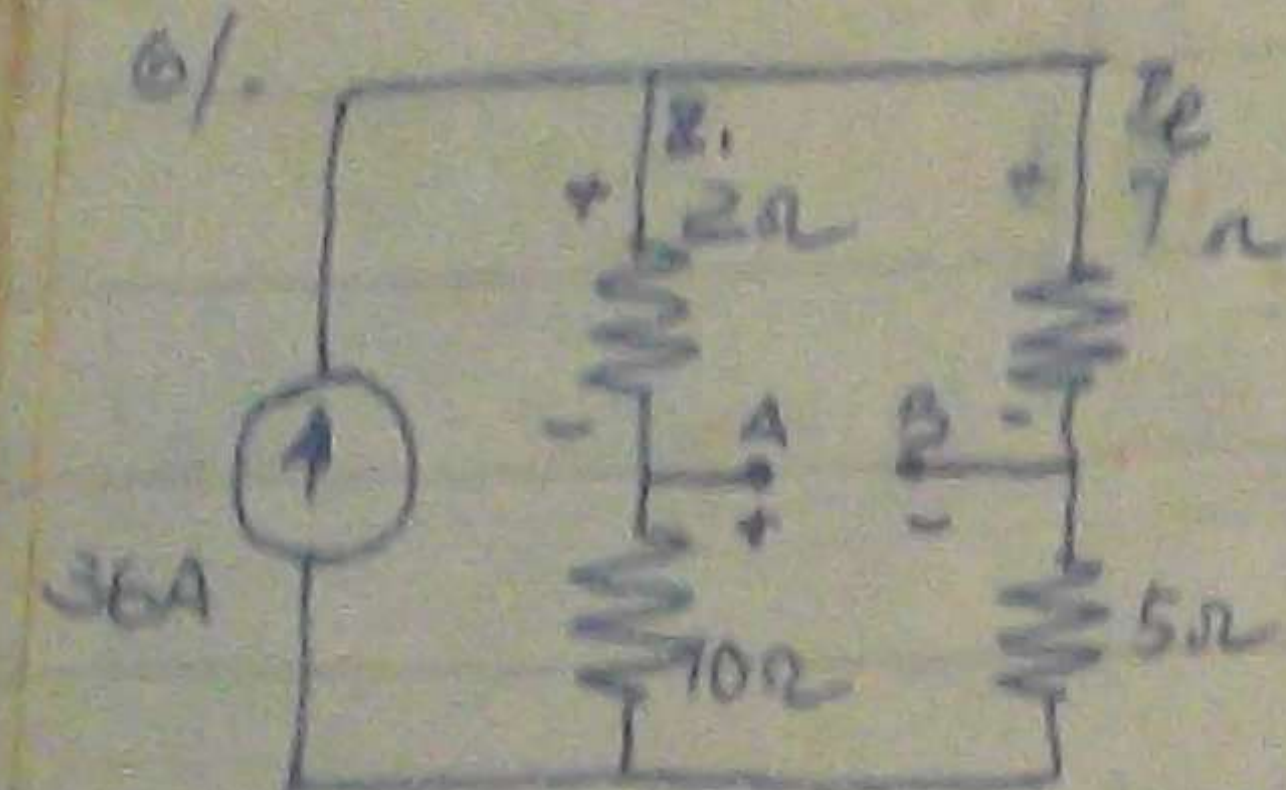
Thevenin's Eq. Ckt



Norton's Eq. Ckt



6/



Z_0 တွင် I SOURCE OPEN ဖြစ်သည်။

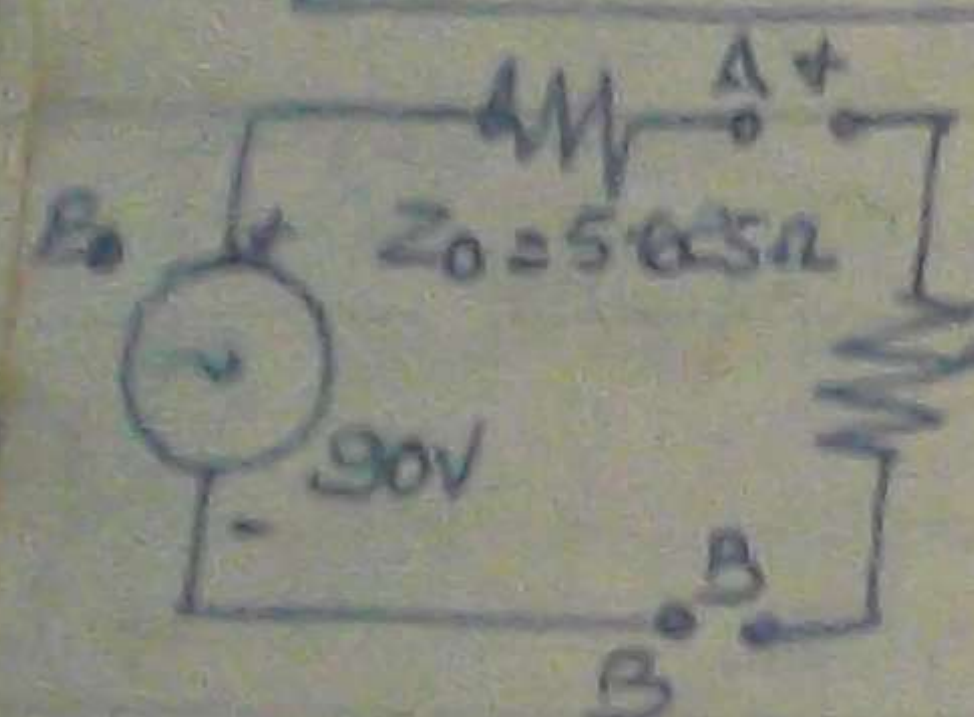
$$Z_0 = \frac{(2+7)(10+5)}{(2+7)+(10+5)}$$

$$= \frac{39 \times 15}{39} = 15 \Omega$$

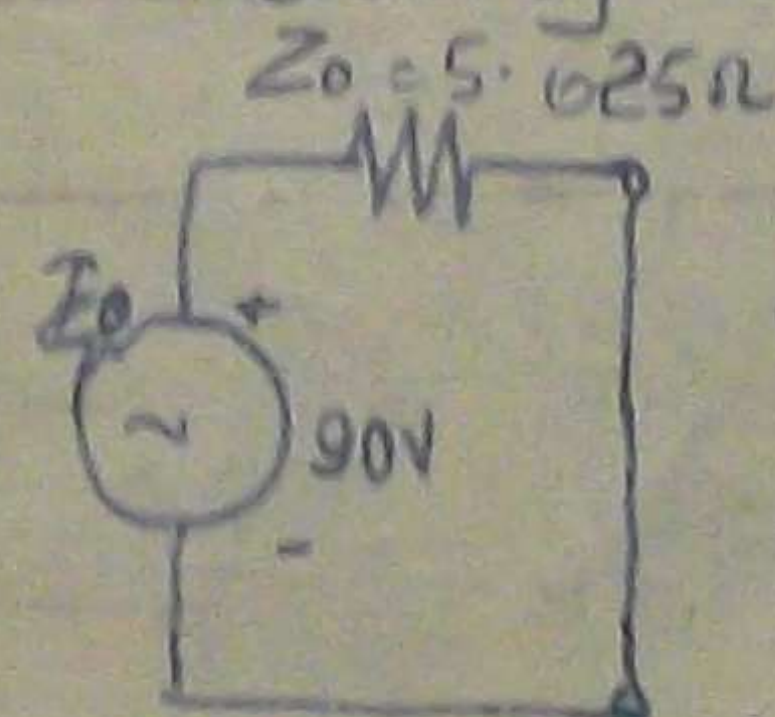
စတုရန်း $I_1 = I_2 = \frac{36 \times 12}{20} = 18A$

$E_0 = -2 \times 18 + 7 \times 18 = 5 \times 18 = 90V$ } UPPER OROPS.

$\therefore$ Thevenin's Eq. Ckt. (ဆက်လက် 10Ω နှင့် 5Ω ရှိသည်။ E_0 ကို ဖြေဆိုရမည်။)

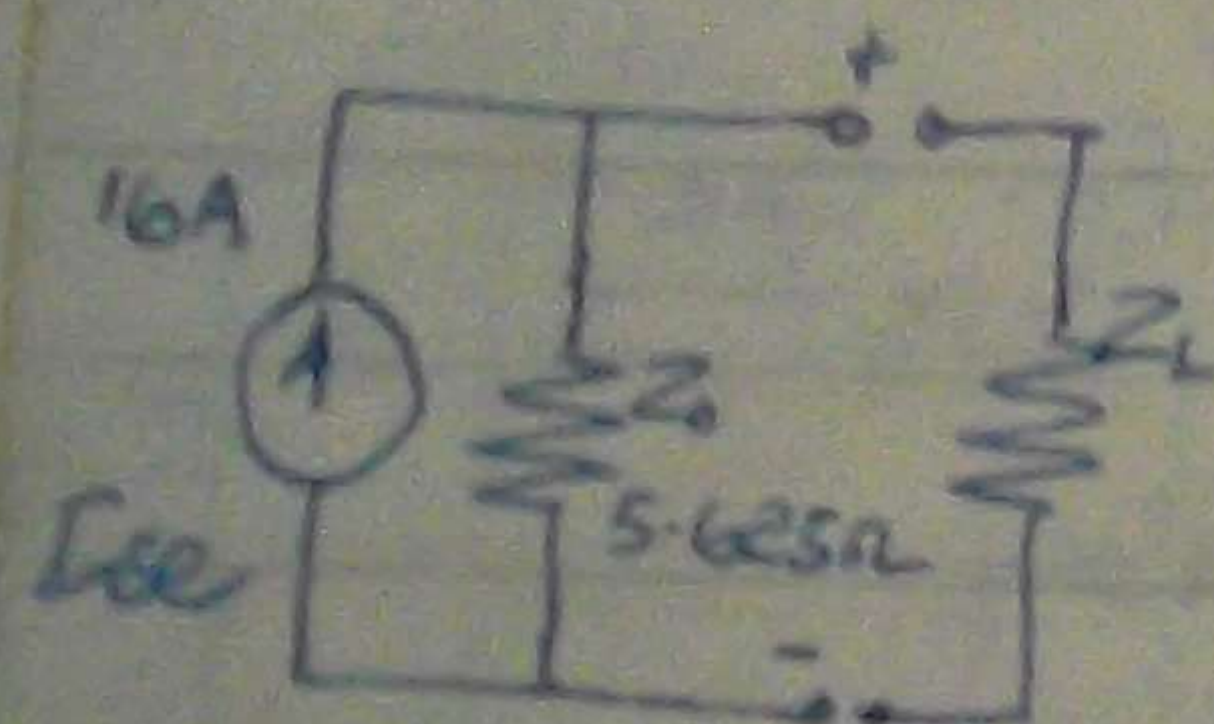


Thevening Norton Ckt တွင် ရှိသည်။

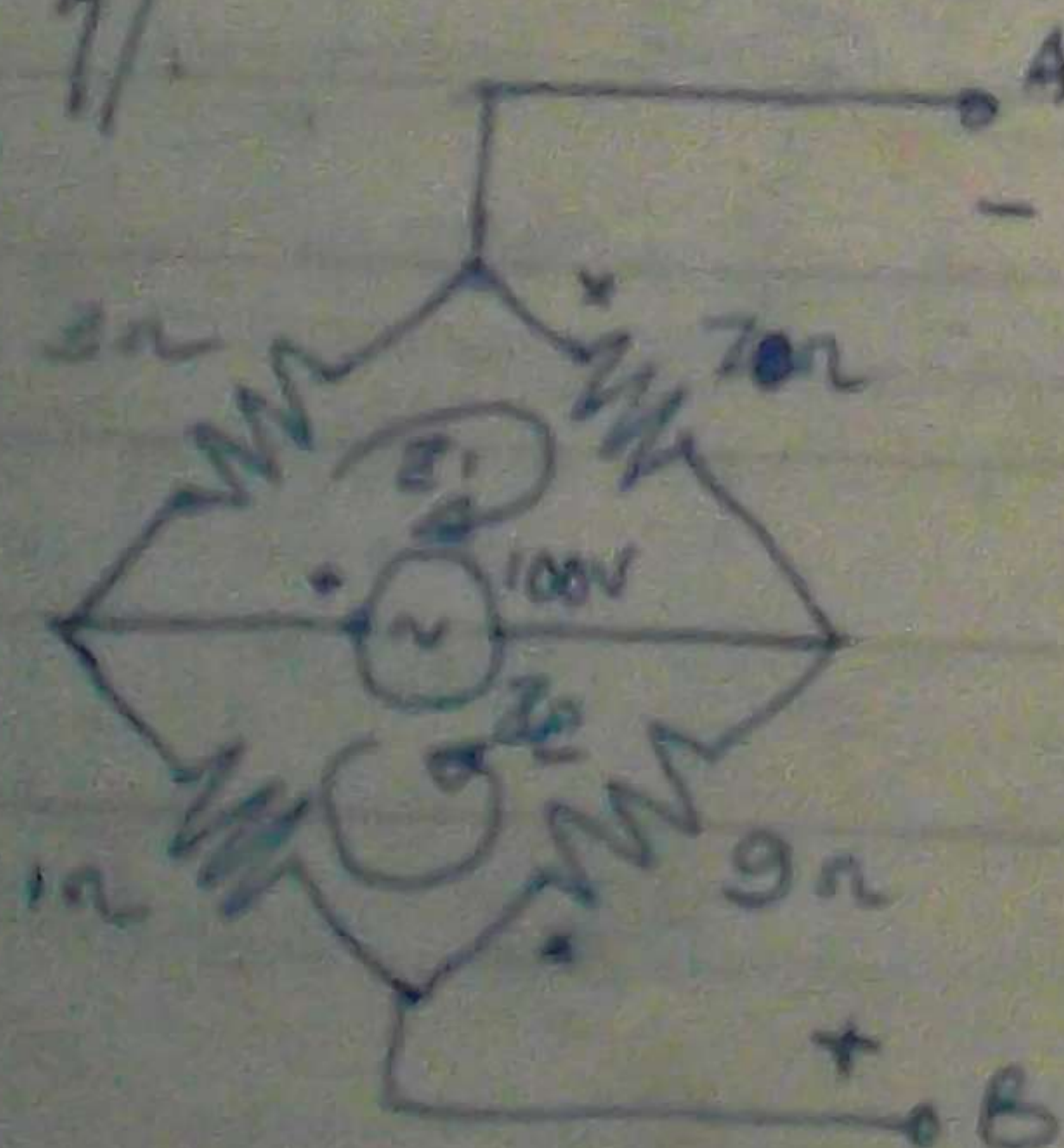


$$\therefore I_{sc} = \frac{90 \times 8}{45} = 16A$$

$\therefore$ Norton's Eq. Ckt.



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Z_0 တွင် V SOURCE ကို SHORT ဖြစ်သည်။

$$Z_0 = \frac{1 \times 9}{1+9} + \frac{3 \times 7}{3+7} = 0.9 + 2.1 = 3\Omega$$

$$I_1 = \frac{100}{3+7} = 10A$$

$$I_2 = \frac{100}{1+9} = 10A$$

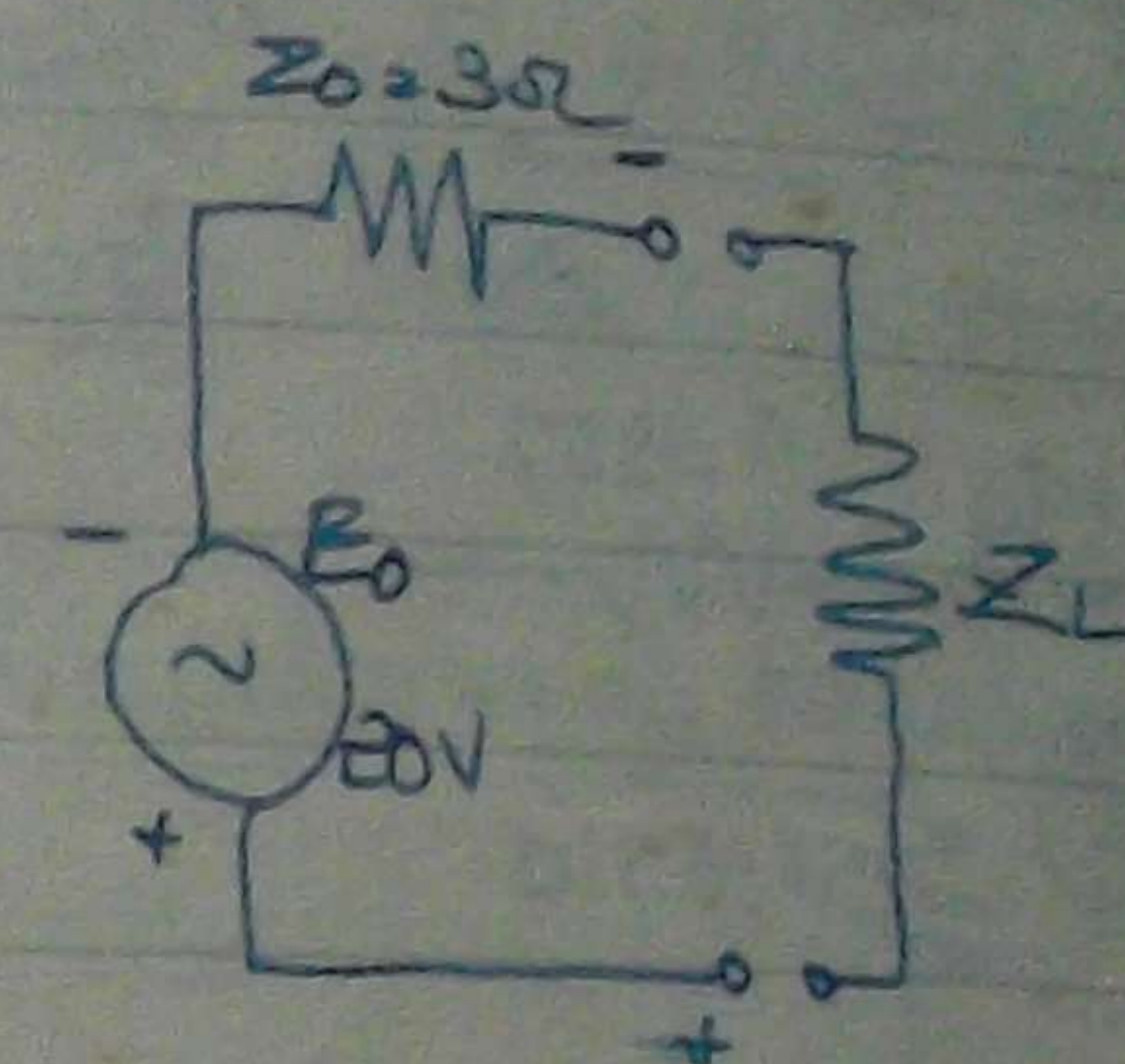
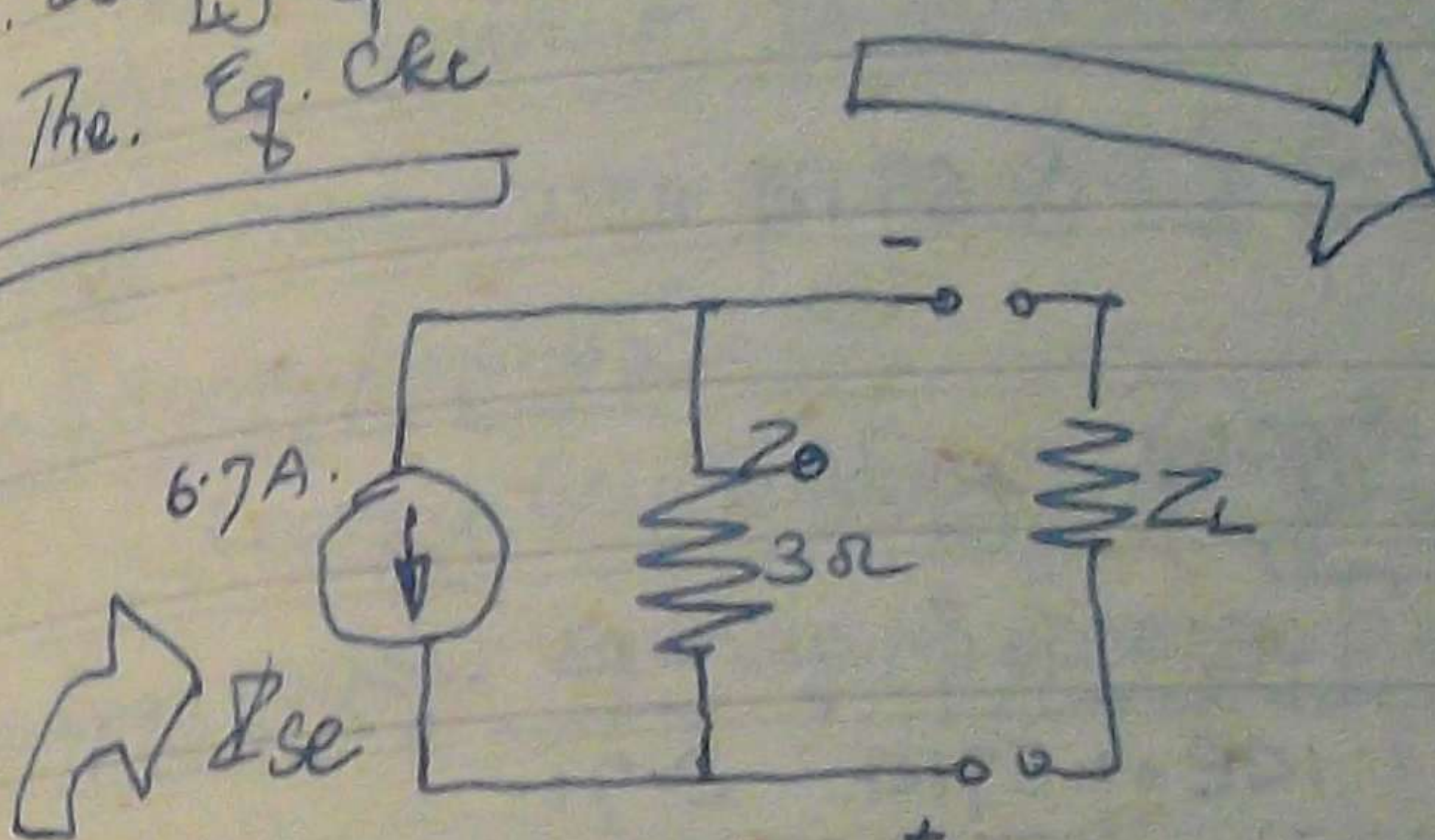
စတုရန်း $pt. B$ ကို + ဖြစ်စေ

$$E_0 = 9 \times 10 - 7 \times 10 = 20V$$

$$I_{sc} = \frac{20}{3} = 6.67A$$

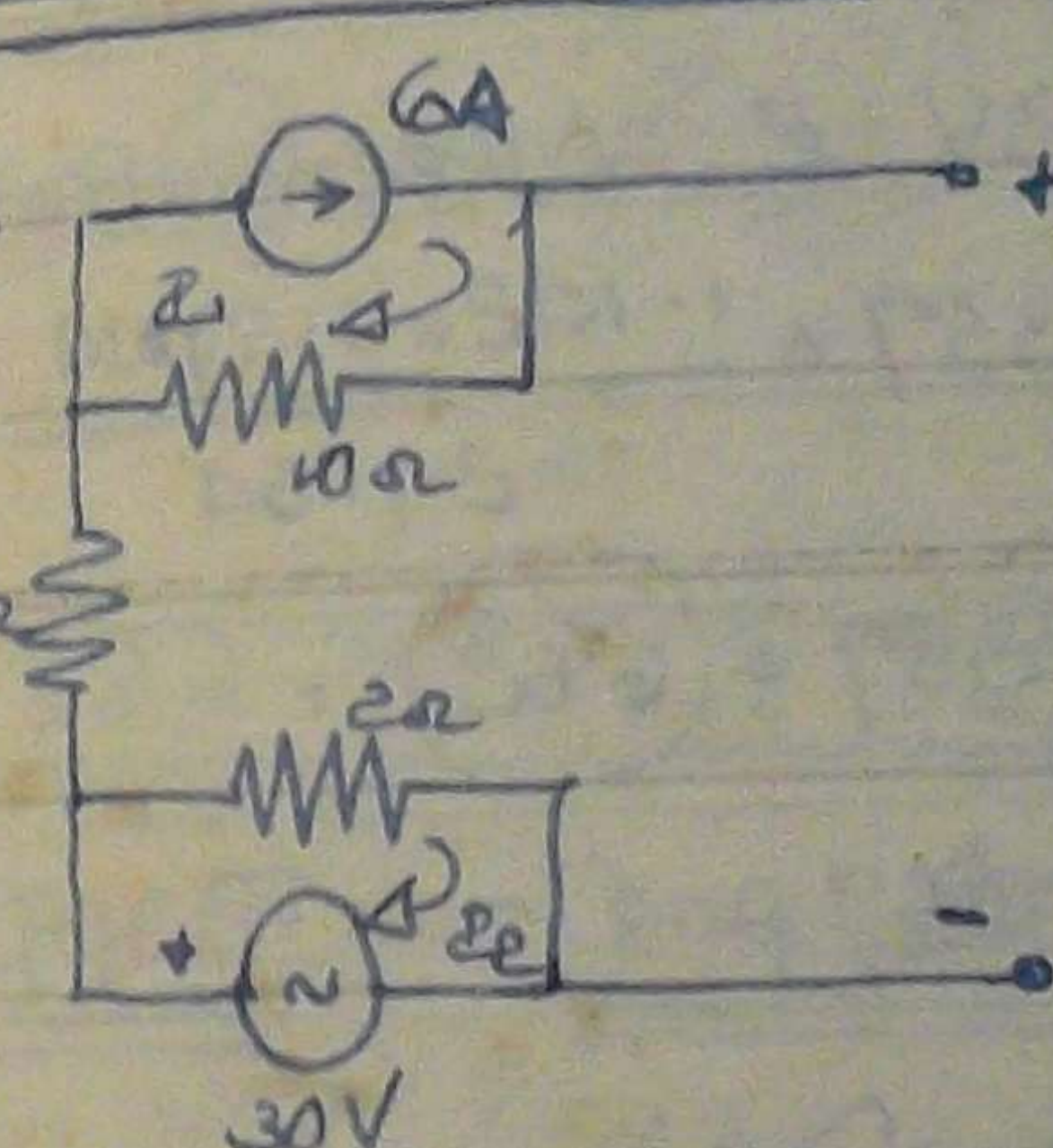
စတုရန်း

The. Eq. Ckt

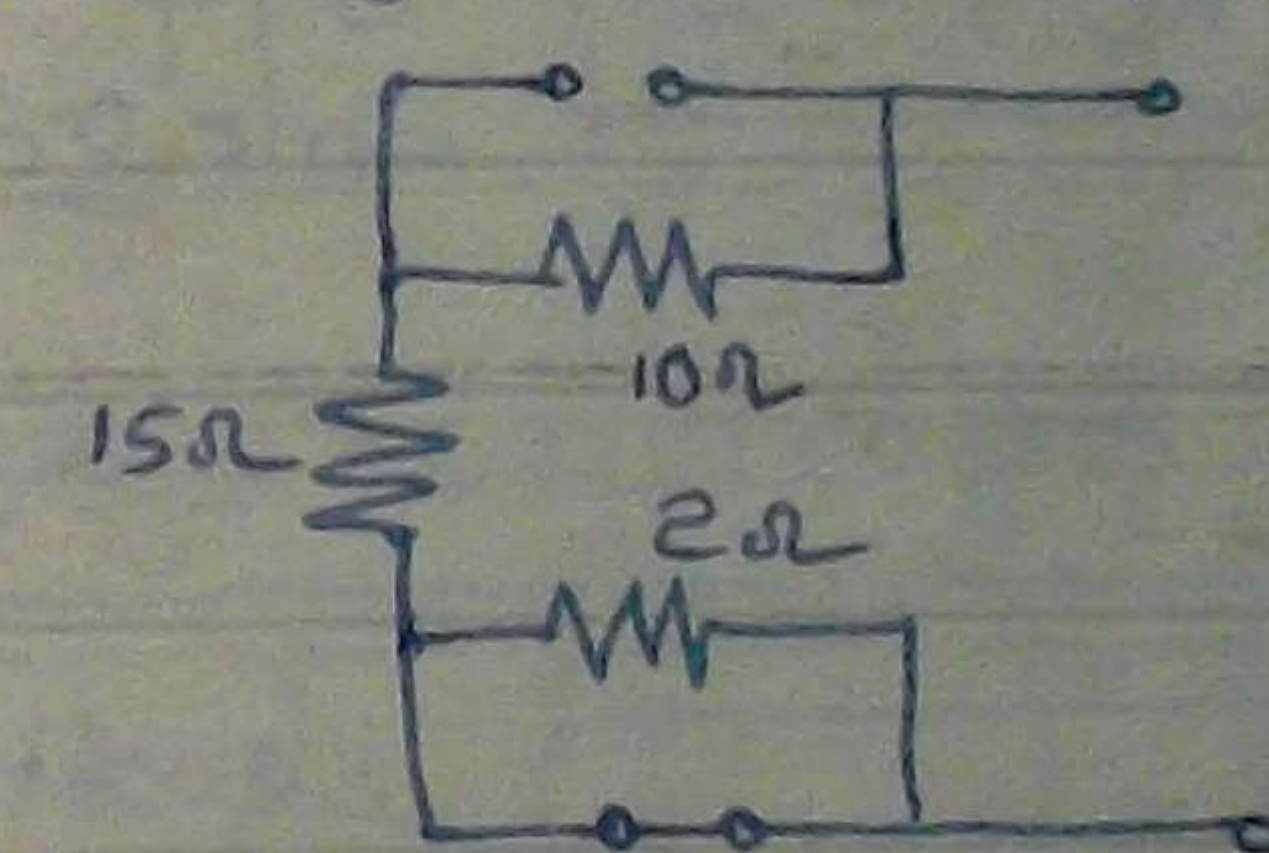


Norton's Eq. Ckt.

8/



Z_0 တွင်



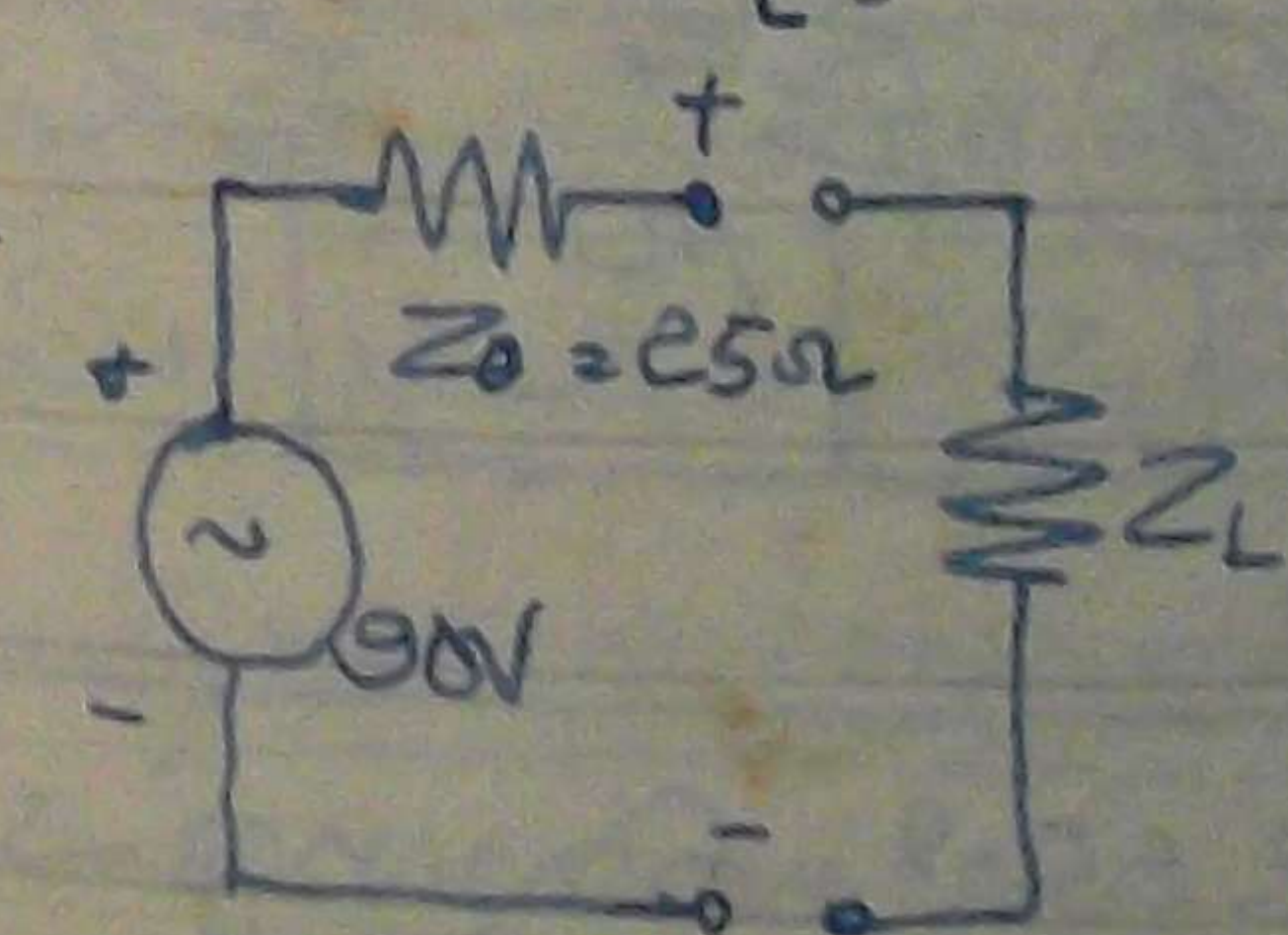
$$Z_0 = 10 + 15 + \frac{0 \times 2}{0+2} = 25\Omega$$

စတုရန်း $I_1 = 6A, I_2 = \frac{30}{2} = 15A$

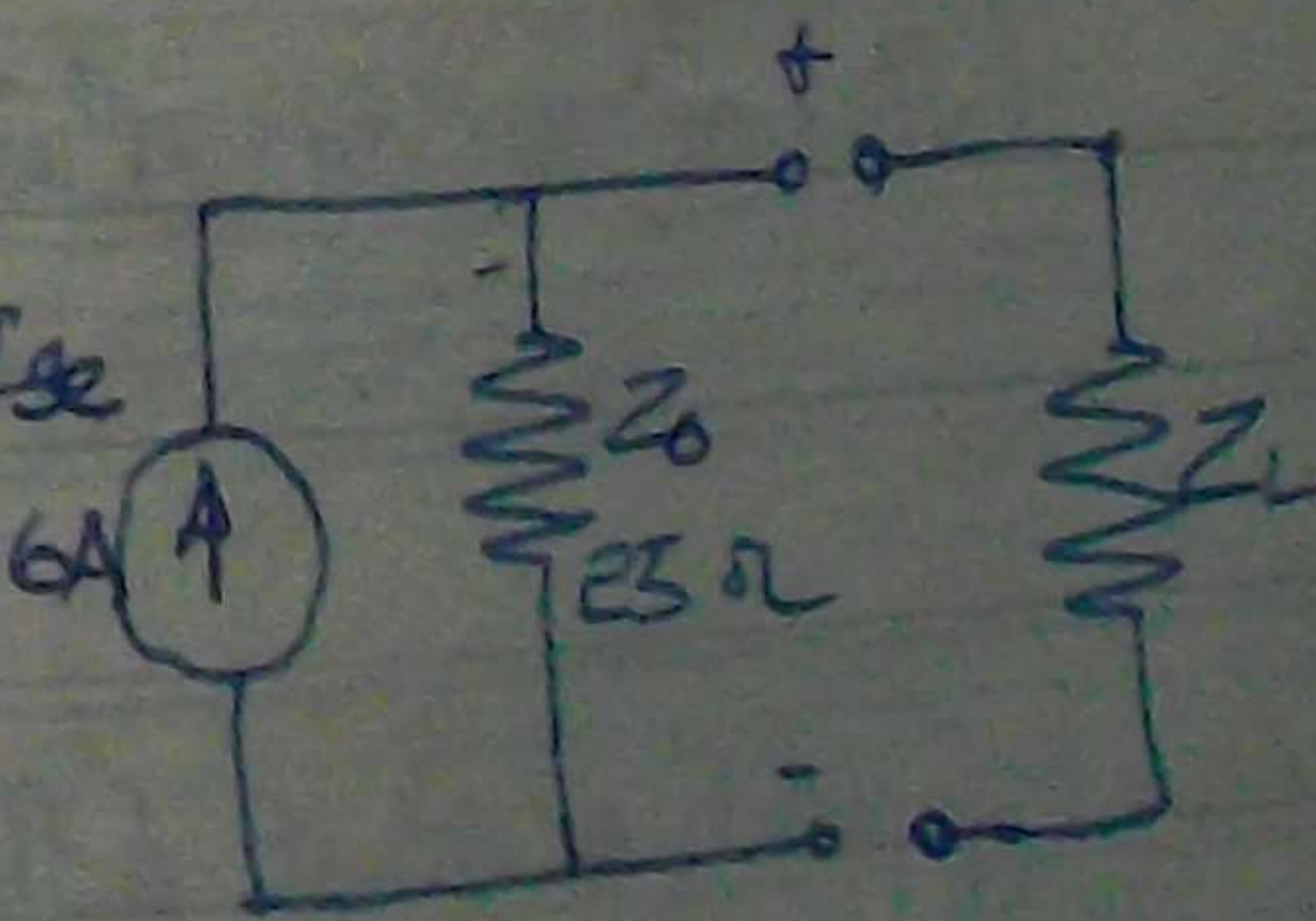
$$\therefore E_0 = 6 \times 10 + 0 + 2 \times 15 = 90V$$

$$\therefore I_{sc} = \frac{90}{25} = 3.6A$$

The

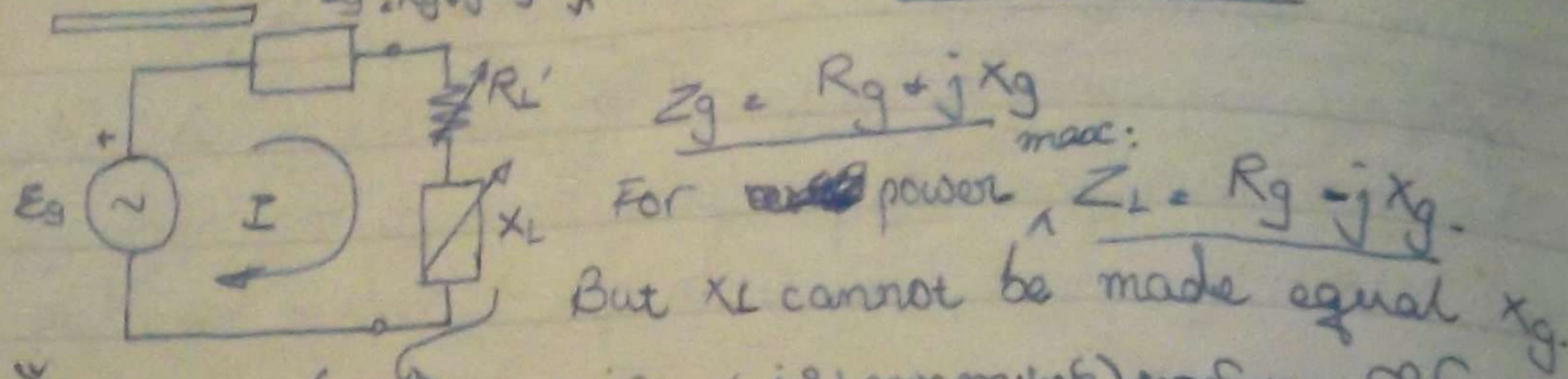


Nor



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CASE III VARIABLE IMPEDANCE LOAD WITH LIMITED CAPACITANCE OR INDUCTANCE.



For max power $Z_L = R_g - jX_g$.
But X_L cannot be made equal X_g .
($\therefore X_L$ can be $-j2$ to $-j8$ ohms) $\therefore$ $Z_L = R_L - jX_L$ (where $R_L = R_g$ and $X_L = X_g$ is not possible).
range of X_L is from $-j2$ to $-j8$ ohms.

For $R_L = R_g + jX_g + jX_L$ is not possible.

$Z_g = R_g + j1$ ohms. X_L can be $-j2$ to $-j8$ ohms.

$X_L = -j2$ ohms. Z_g is $10 + j20$ ohms. $\therefore$ $Z_L = 10 - j20$ ohms.

X_L is constant. $\therefore$ $Z_L = R_L - jX_L$ where $R_L = \sqrt{R_g^2 + (X_g - X_L)^2}$.

$$Z_L = R_L - jX_L \text{ where } R_L = \sqrt{R_g^2 + (X_g - X_L)^2}$$

NO. 1

EXERCISE VII

4 problems

Network voltage source equiv. circuit is $E_g = 50 \angle 0^\circ$ V, $Z_g = 10 + j20$ ohms. maximum power is transferred to load impedance Z_L . $\therefore$ $Z_L = 10 - j20$ ohms. $\therefore$ max. power is transferred to Z_L .

Dissipated Power is pure resistance. $\therefore$ X_L is constant.

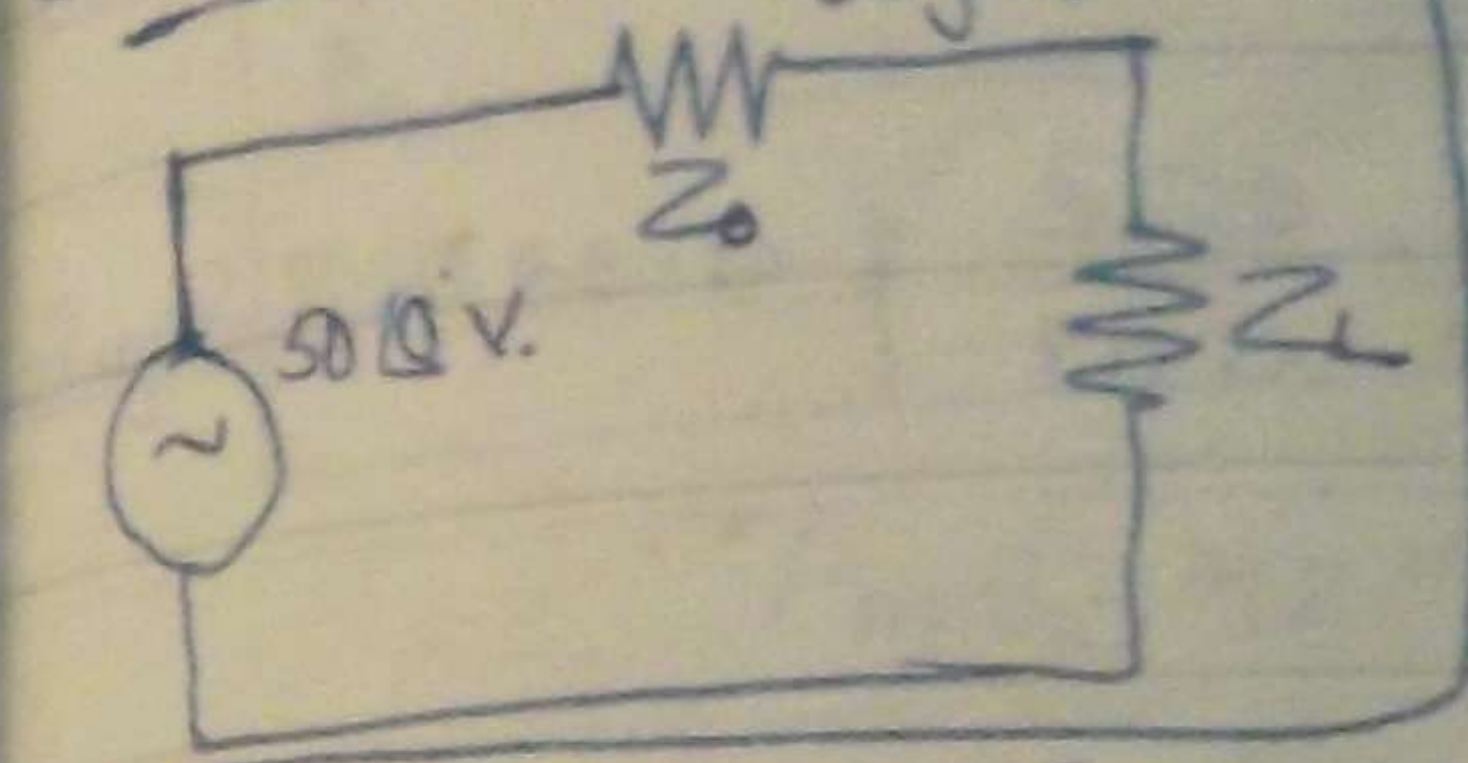
For max power $Z_L = R_g - jX_g$. $\therefore$ $Z_L = 10 - j20$ ohms.

PURE RESISTANCE LOAD.

$$Z_L = Z_g = 10 + j20 = 22.36 \angle 63.4^\circ$$

$$I_{max} = \frac{50 \angle 0^\circ}{22.36 \angle 63.4^\circ} = 2.236 \angle -63.4^\circ$$

$$\therefore \text{Max. Power} = (2.236)^2 \times 10 = 50 \text{ W}$$



$$Z_L = Z_g^* = 10 - j20$$

$$\therefore I_L = \frac{50 \angle 0^\circ}{10 + j20 + 10 - j20} = \frac{50}{20} = 2.5 \text{ A}$$

$$\therefore P_{max} = 2.5^2 \times 10 = 62.5 \text{ W}$$

(a) For max power $Z_L = Z_g^* = 10 - j20$ ohms.

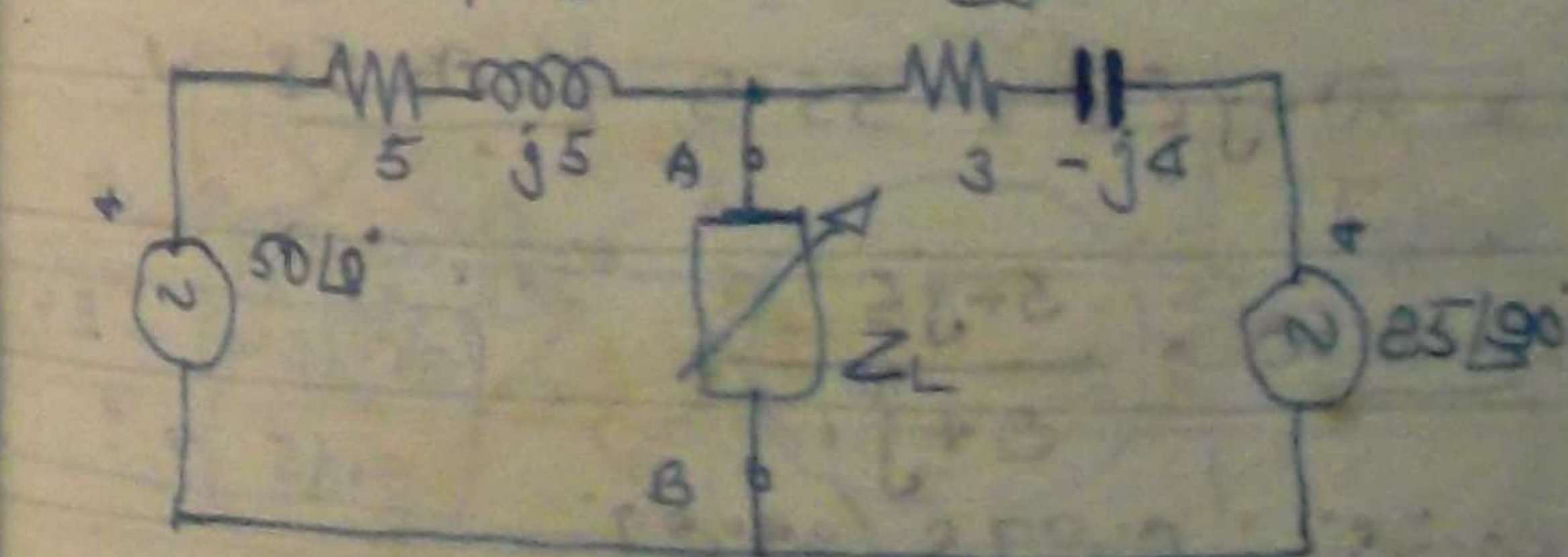
$$Z_L = Z_g = 10 + j20 = 22.36 \angle 63.4^\circ$$

$$\therefore I_L = \frac{50 \angle 0^\circ}{10 + j20 + 22.36 \angle 63.4^\circ} = \frac{50}{32.36 \angle 63.4^\circ} = 1.545 \angle -63.4^\circ$$

$$\therefore \text{Max. Power} = (1.545)^2 \times 10 = 23.85 \text{ W}$$

Ans.

NO: 2//. For max power $Z_L = Z_g^* = 10 - j20$ ohms.



$$Z_L = 10 \angle 0^\circ$$

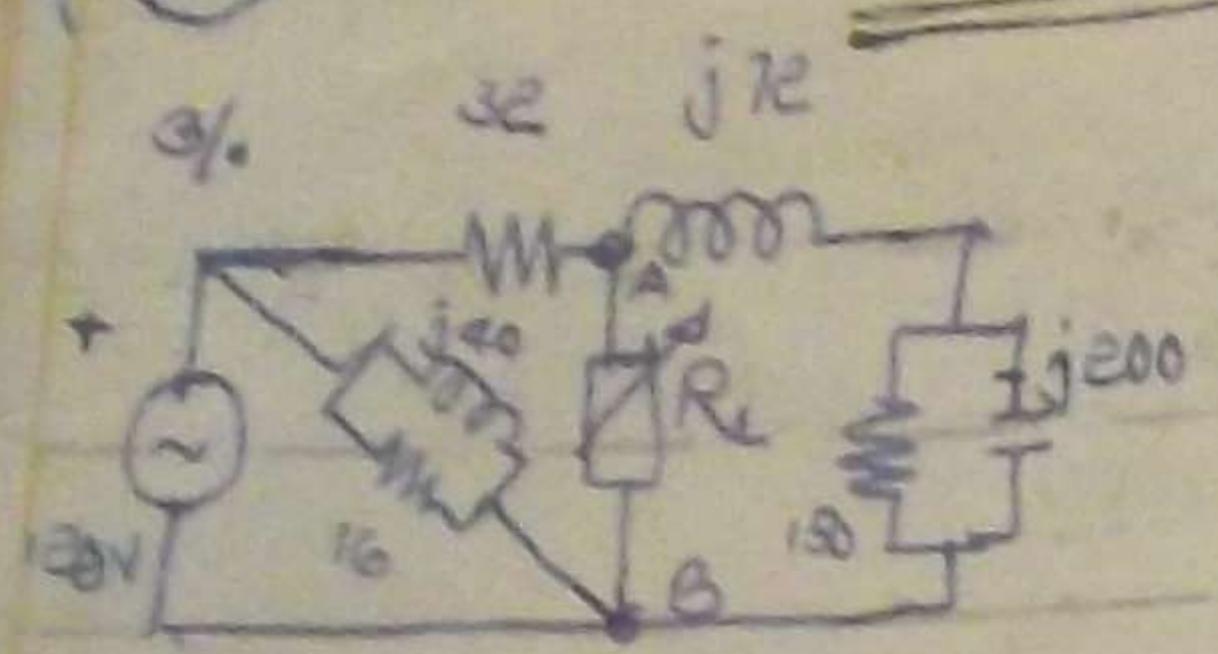
$$P_{max} = 38.5 \text{ W}$$

THEVENIN'S EQUIV. circuit is $E_g = 50 \angle 0^\circ$ V, $Z_g = 10 + j20$ ohms.

P_{max} is at $Z_L = 10$ ohms.

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VARIOUS CKT ပုံစံများကို အသုံးပြုဆောင်ရွက်ပါ။



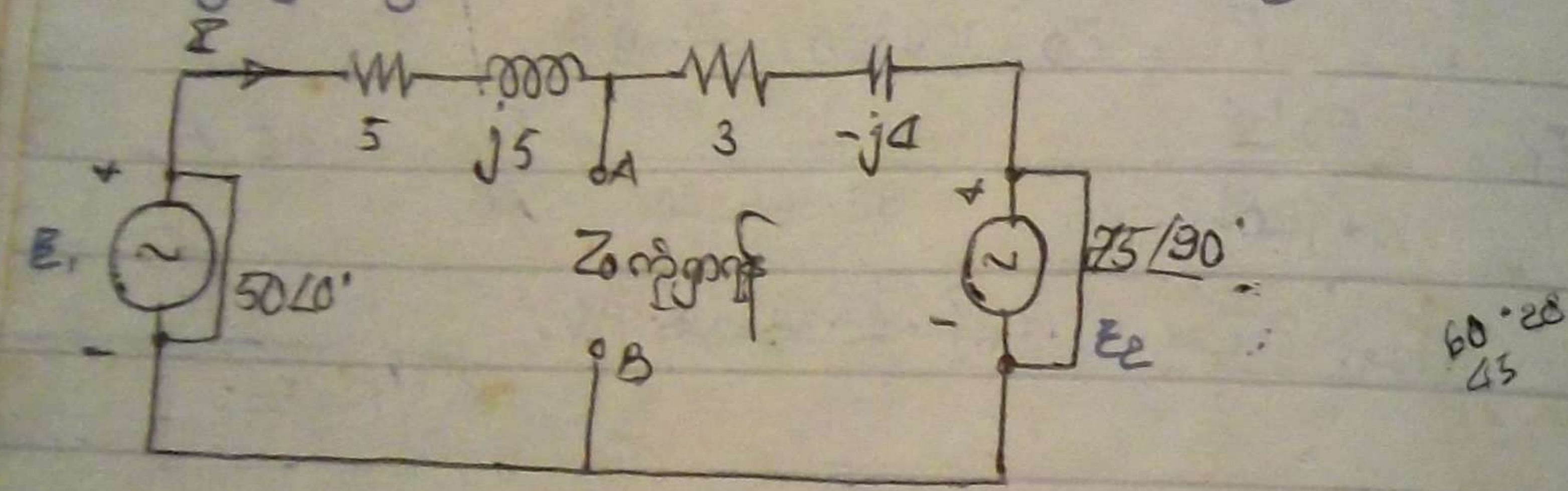
Z_0, E_0 ကို ဆက်တွက်ပါ။

ဇ. Z_0 ကို ဆက်တွက်ပါ။ Z_L ကို ဆက်တွက်ပါ။

$$Z_0 = 5 + j5 // 3 - j4 = \frac{5 \angle 45^\circ \cdot 5}{8 + j1} = \frac{25 \angle 45^\circ}{8.07} = 4.385 \angle 15.28^\circ$$

$$Z_L = Z_0^* = \text{conjugate} = 4.2 - j1.154$$

$E_1, E_2 \rightarrow$ rectangular ရှိပါက ပြောင်းပါ။



$$Z_0 = \frac{(5+j5)(3-j4)}{8+j1} = \frac{7.07 \angle 45^\circ \cdot 5 \angle -53.15^\circ}{8.06 \angle 7.13^\circ} = 4.385 \angle -15.28^\circ = (4.2 - j1.154) \Omega$$

$$E_T = 50 \angle 0^\circ - 25 \angle 90^\circ = 50 - j25 = 55.9 \angle -26.58^\circ \text{ V}$$

$$E_0 = 50 \angle 0^\circ - 55.9 \angle -26.58^\circ \times \frac{5+j5}{8+j1}$$

ဆက်တွက်ရန်: $8+j(5-4) \rightarrow E_T$
 $5+j5 \rightarrow ?$

$$= 50 - 55.9 \angle -26.58^\circ \times 0.878 \angle 38.89^\circ$$

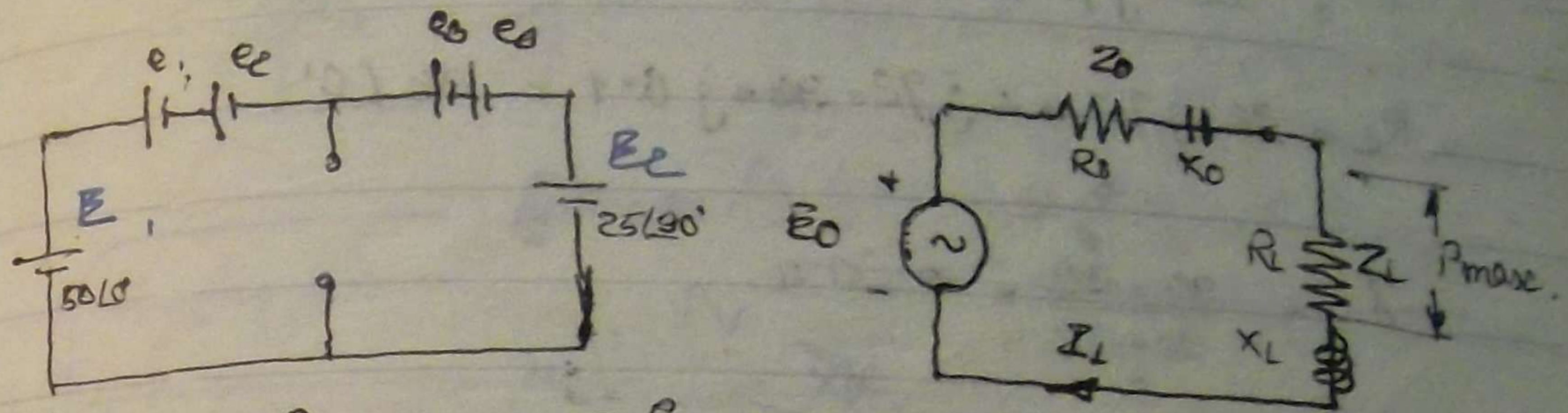
$$= 50 - 49.1 \angle 12.29^\circ = 50 - 48 - j10.46$$

$$= 2 - j10.46 = 10.63 \angle -79.17^\circ \text{ V}$$

conjugate sign.

$$Z_L = Z_0^* = 4.2 + j1.154 = 4.385 \angle 15.28^\circ$$

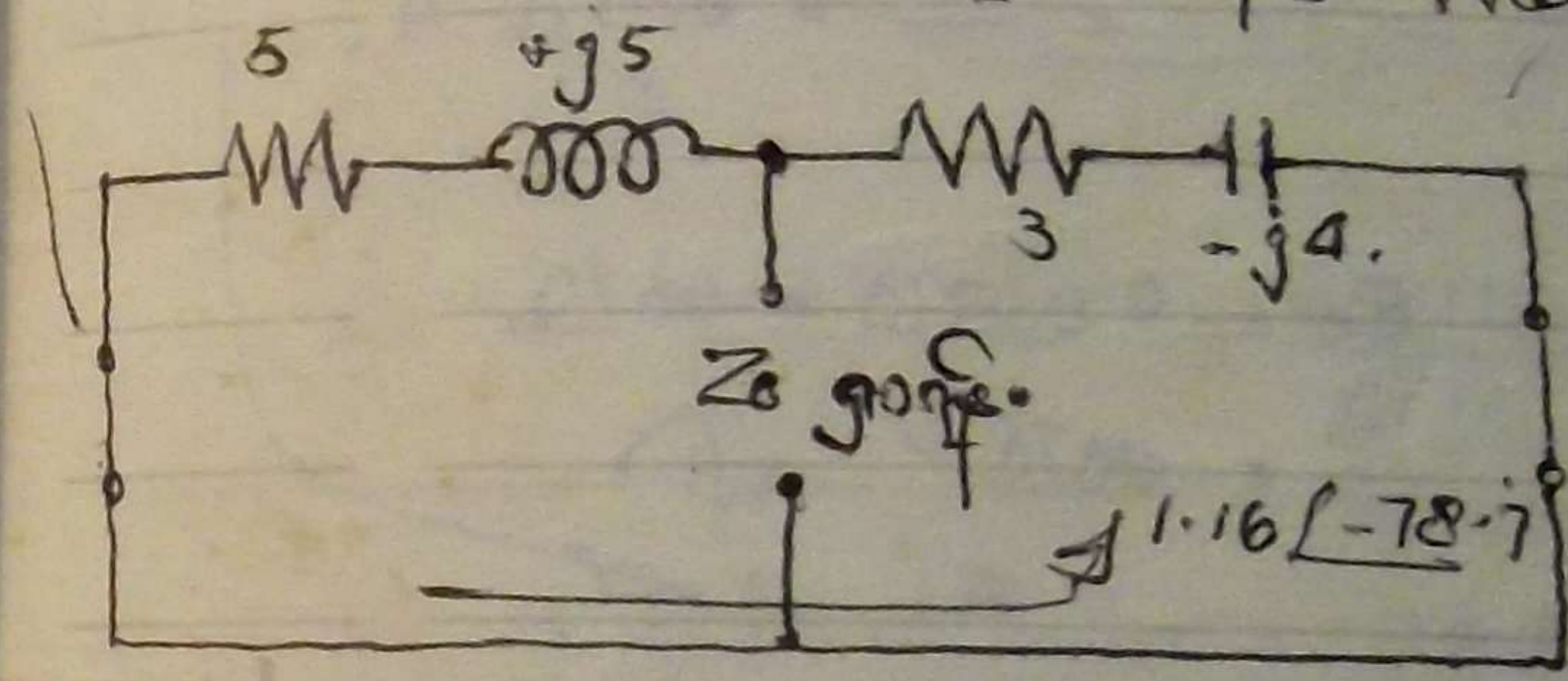
$$I_L = \frac{E_0}{Z_0 + Z_L} = \frac{10.63 \angle -79.17^\circ}{8.4 \angle 0^\circ} = 1.267 \angle -79.17^\circ \text{ A}$$



$$P_{max} = I_L^2 \times R_L$$

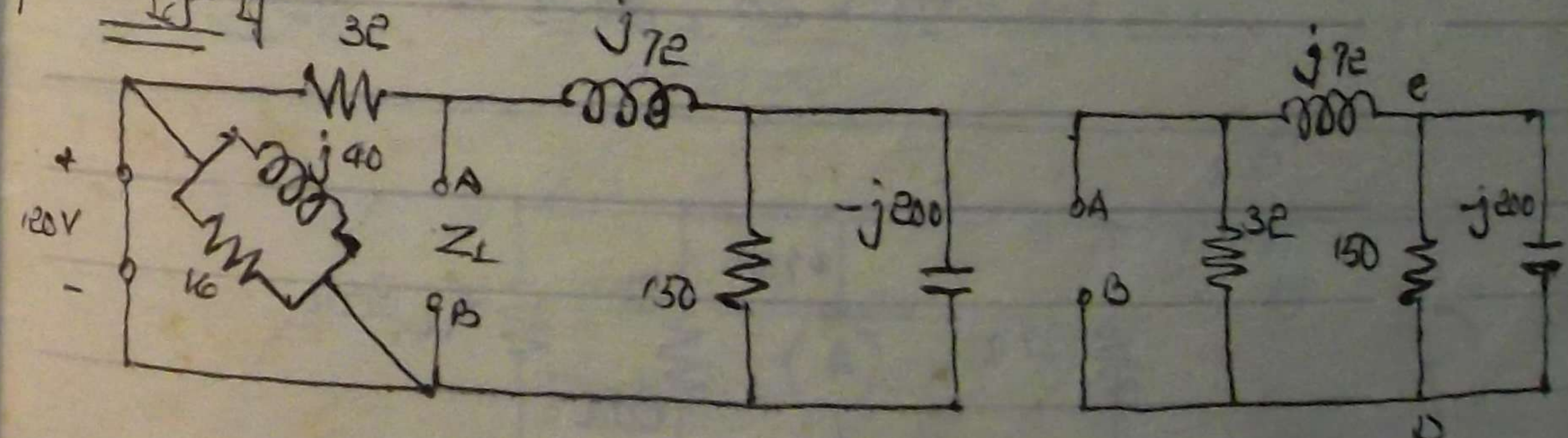
$$= 1.267^2 \times 4.2 = 6.73 \text{ Watts}$$

(Ans: 5.68W)



Ans: $Z_L = 4.2 + j1.154 = 4.385 \angle 15.3^\circ \Omega$
 $P_m = 0.73 \text{ W}$

ဇ. Z_0 ကို ဆက်တွက်ပါ။



13.1.93.

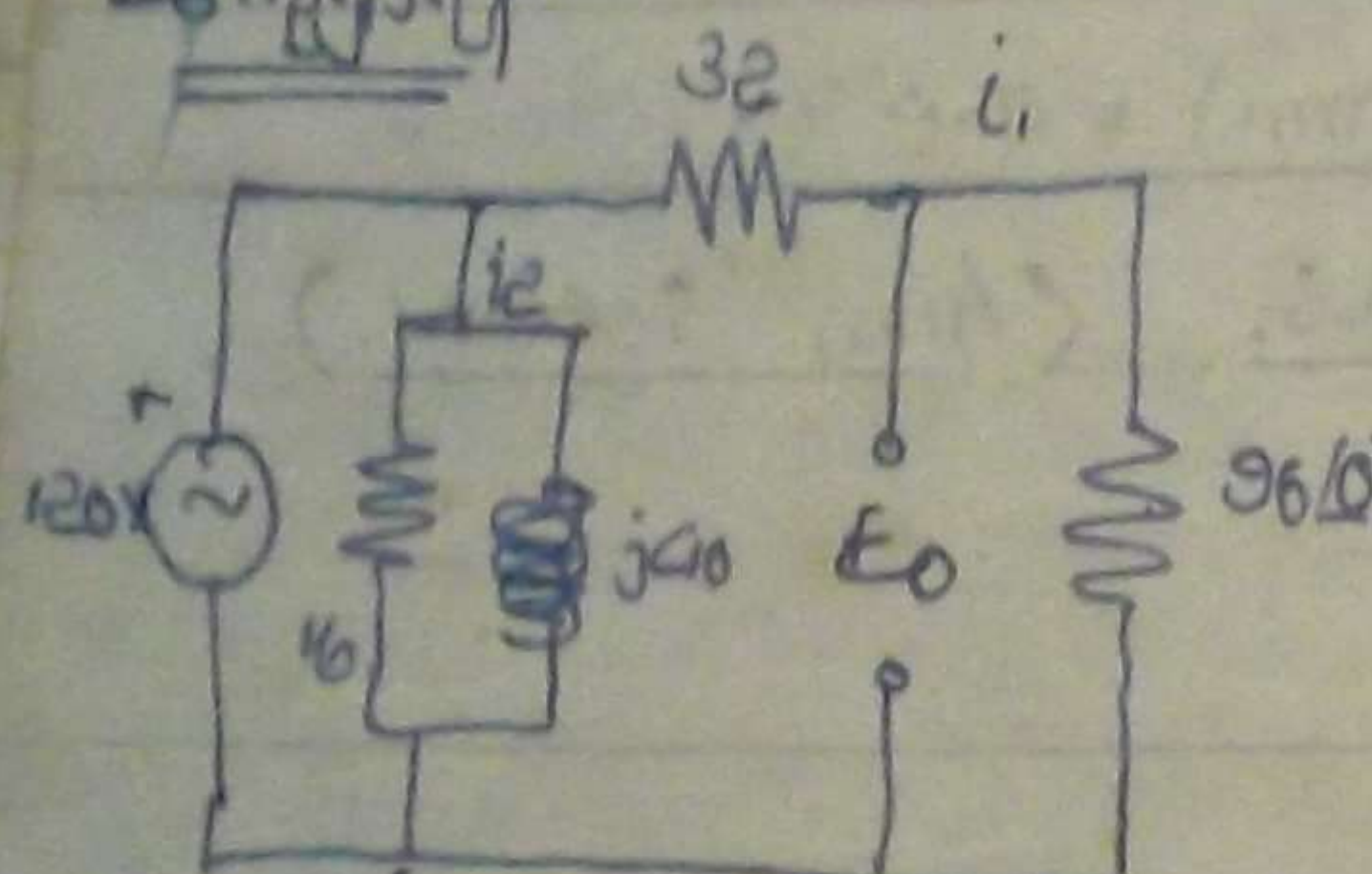
$$R_1 = \frac{150 \times 200 \angle -90^\circ}{150 - j200} = \frac{30000 \angle -90^\circ}{250 \angle -53.15^\circ} = 120 \angle -36.85^\circ$$

$$= 96 - j71.9 \Omega$$

$$R_2 = 96 - j71.9 + j72 = 96 \angle 0^\circ$$

$$Z_0 = \frac{32 \times 32}{32 + 32} = 16 \Omega$$

Equivalent



$$I_1 = \frac{15}{(32 + 32) \angle 0^\circ} = \frac{15}{64} = 0.234 \angle 0^\circ \text{ A}$$

$$= 0.938 \angle 0^\circ \text{ A}$$

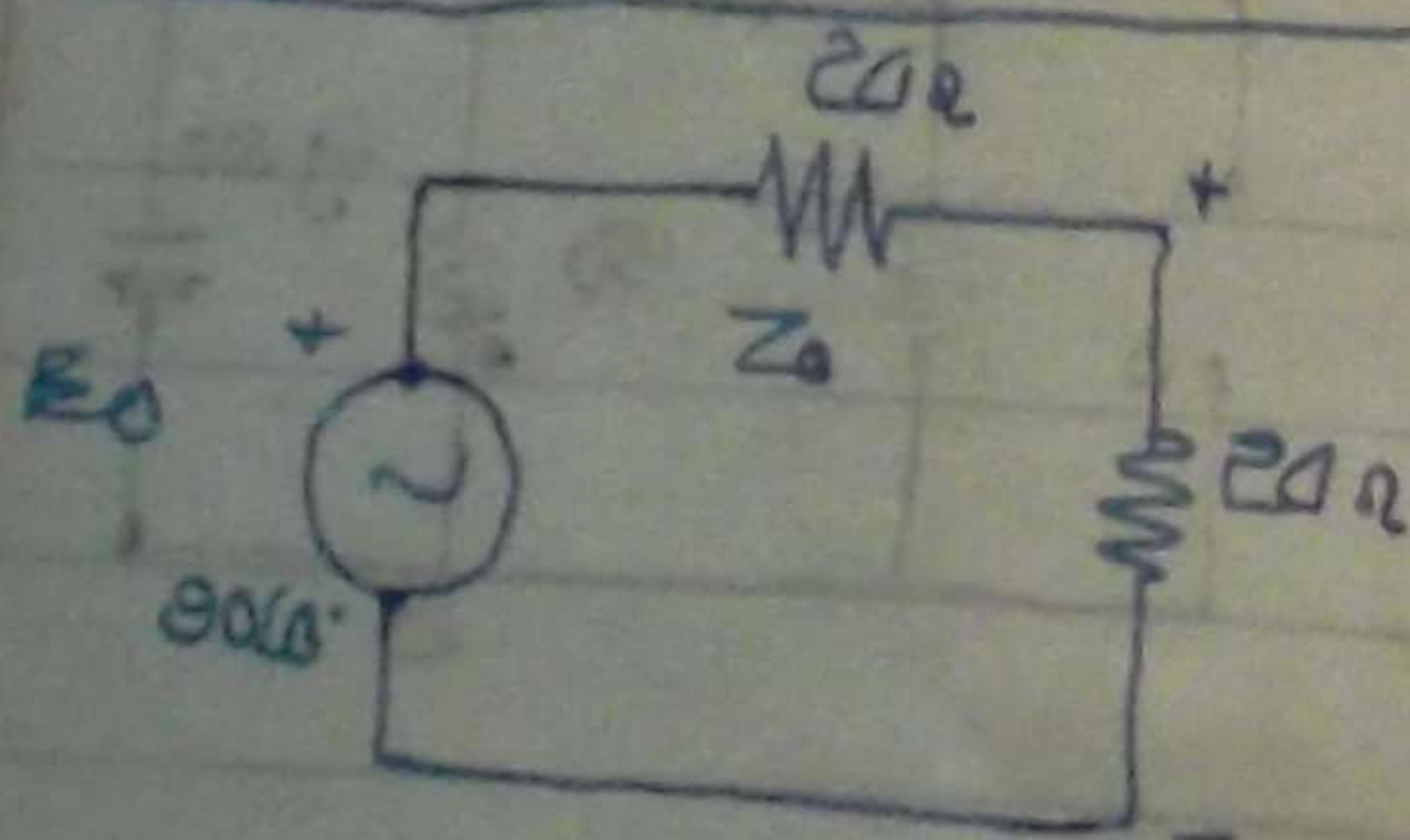
$$E_0 = 0.938 \angle 0^\circ \times 96 \angle 0^\circ = 90 \angle 0^\circ$$

$$Z_L = 24 \Omega$$

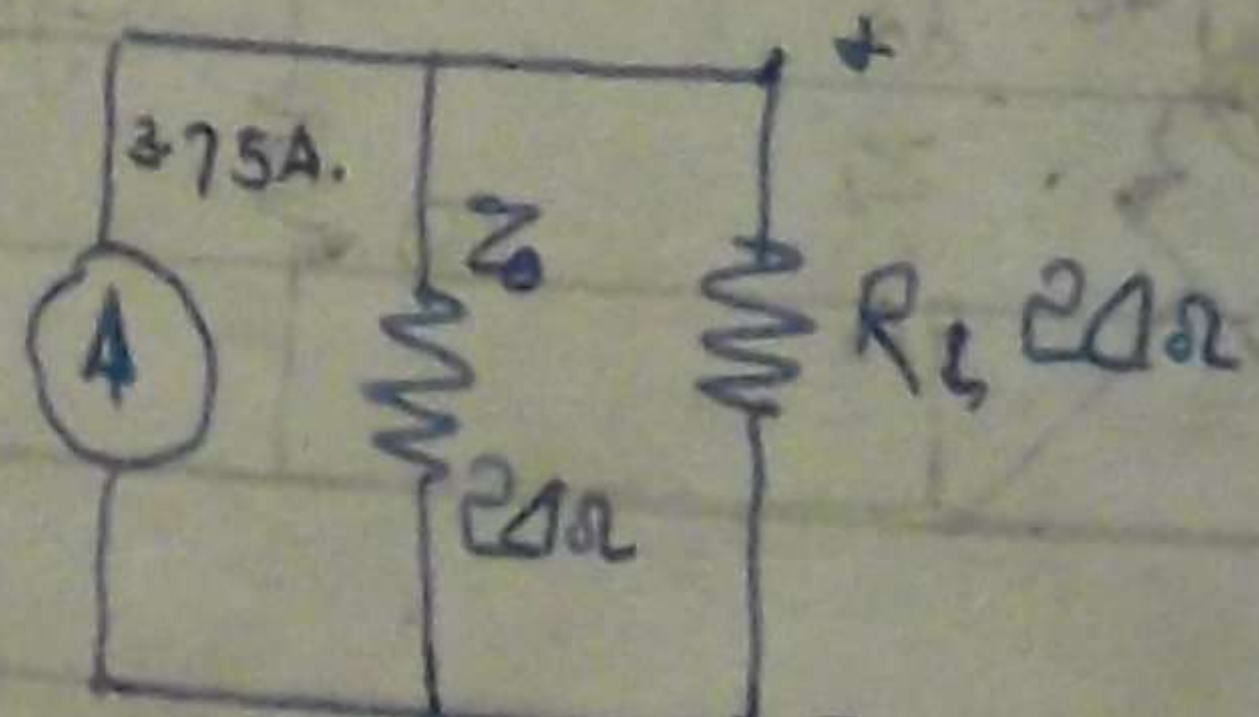
$$I_L = \frac{E_0}{Z_L + Z_0} = \frac{90 \angle 0^\circ}{24 + 16} = 1.875 \text{ A}$$

$$P_{max} = I_L^2 \times Z_L$$

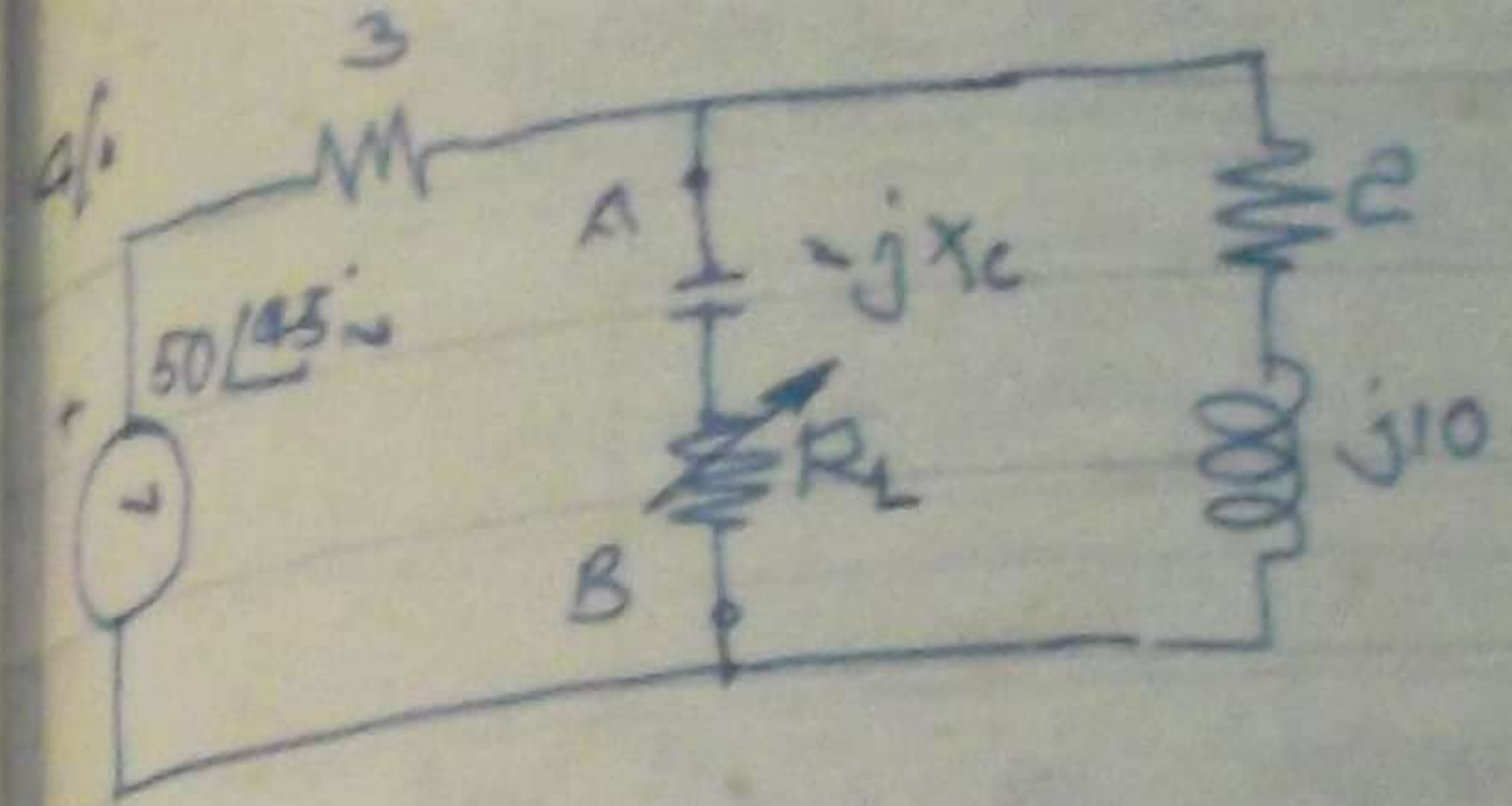
$$= 1.875^2 \times 24 = 84.25 \text{ W}$$



V. source Ex. Ckt.

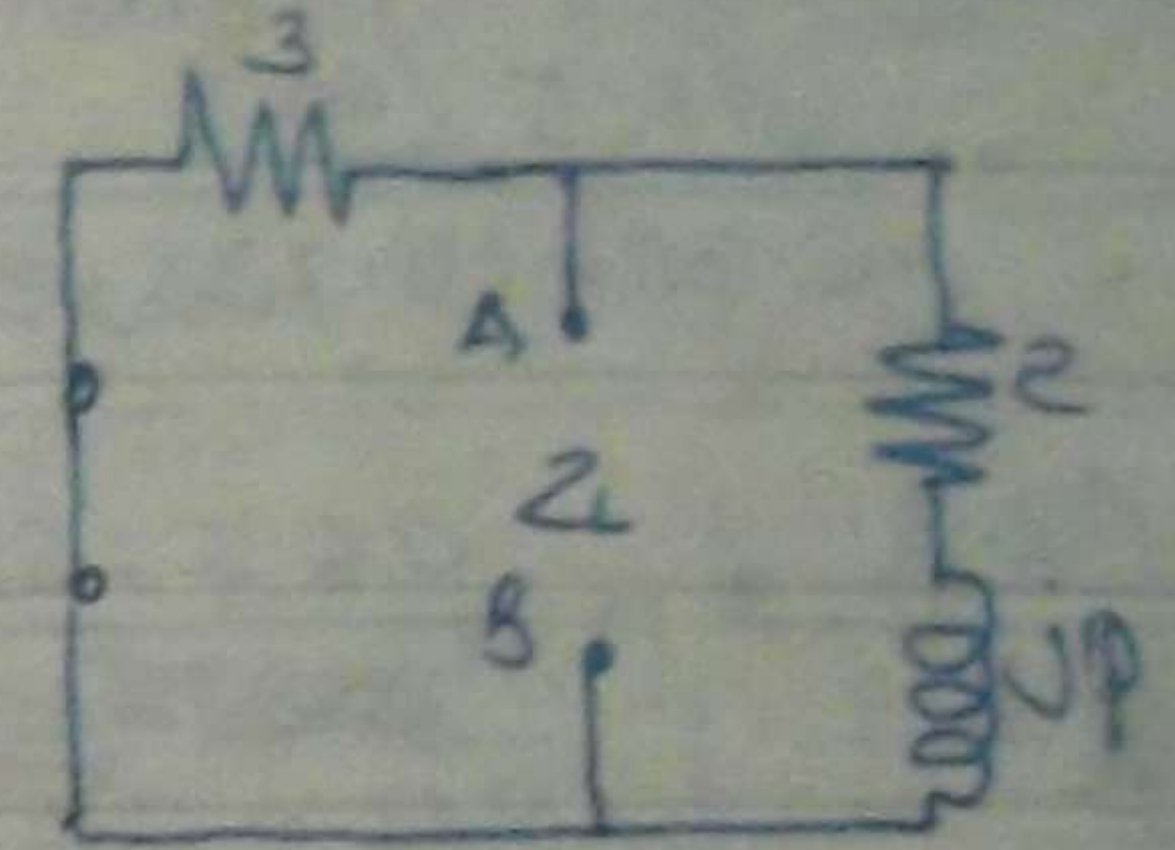


I. source Ex. Ckt.



for power transfer
Z0 is required

Terminal A & B load is variable resistor. It is required to vary the capacitor. Find the max. power transfer. Find the value of capacitor. max. P is required to find the value.



$$Z_0 = \frac{3 \times (2 + j10)}{3 + 2 + j10} = \frac{6 + j30}{5 + j10} = \frac{30.6 \angle 78.7^\circ}{11.18 \angle 63.4^\circ}$$

$$= 2.74 \angle 15.3^\circ = 2.64 + j0.723 \Omega$$

$$\therefore Z_L = 2.64 - j2 \Omega \quad R_L = 2.64 - j(2 - 0.723) \Omega$$

$$Z_L = \frac{50 \angle 45^\circ}{2.64 + j0.723 + 2.64 - j2} = \frac{50 \angle 45^\circ}{5.28 - j0.277}$$

RL = ?
Find the value of RL
for max. power

$$= \frac{50 \angle 45^\circ}{5.28 - j0.277} = 9.475 \angle 48^\circ$$

$$P_{max} = I_L^2 \times Z_L = (4.475)^2 \times 2.64 = 230 \text{ W}$$

(Answer: $Z_L = 2.93 - j2$, $P_{max} = 187.5 \text{ W}$.)

CHAPTER IX

NEPERS AND DECIBELS

19.1.83. WED.

57

$$db = 10 \log \frac{P_i}{P_o} = 20 \log \frac{E_i}{E_o} = 20 \log \frac{Z_i}{Z_o}$$

$$\log_e \frac{E_i}{E_o} = x \text{ Nepers} \Rightarrow \frac{E_i}{E_o} = e^x$$

$\log e$ - Natural Logarithm.

$$P = I^2 R = E^2 / R \Rightarrow E = \sqrt{PR}$$

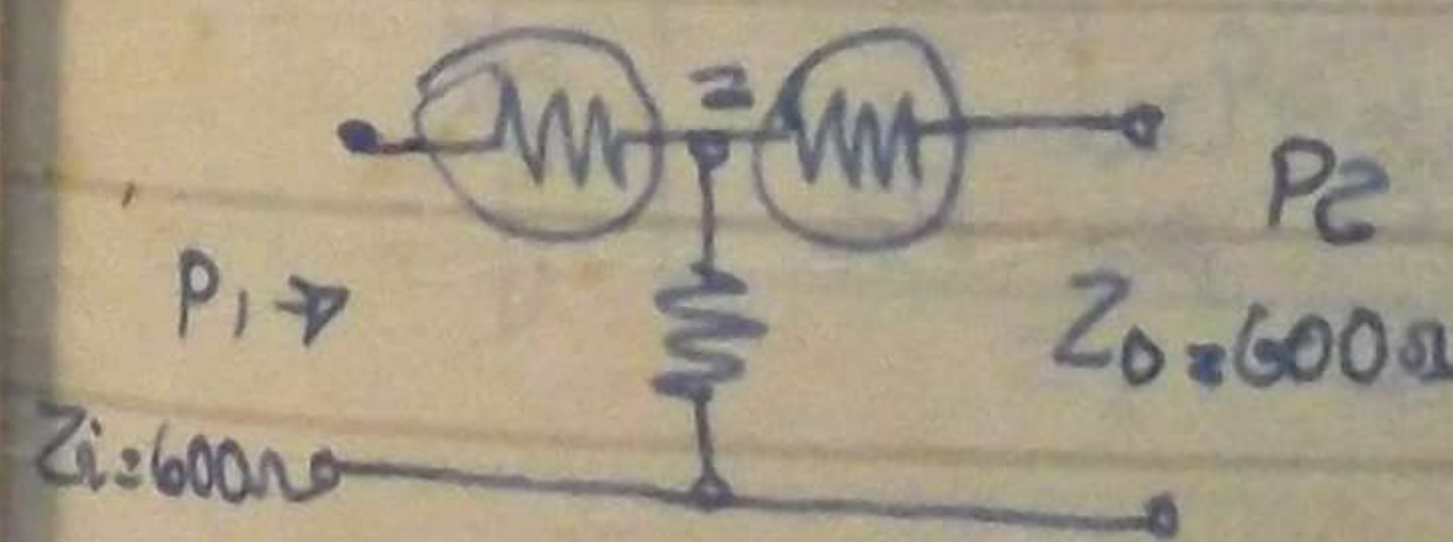
$$\log_e \frac{E_i}{E_o} = \log_e \left\{ \frac{P_i R_i}{P_o R_o} \right\}^{\frac{1}{2}} = \frac{1}{2} \log_e \frac{P_i}{P_o} \left[\text{if } R_i = R_o \right]$$

$$\log_{10} \frac{P_i}{P_o} = db.$$

$$\log_e \frac{E_i}{E_o} = x \text{ Nepers} = \log_e \frac{E_i}{E_o} = \frac{1}{2} \log_e \frac{P_i}{P_o} \Rightarrow \frac{E_i}{E_o} = e^x$$

$$N = \log_e \frac{E_i}{E_o} = \ln \frac{E_i}{E_o} = \log_e \frac{I_i}{I_o} = \ln \frac{I_i}{I_o} = \frac{1}{2} \log_e \frac{P_i}{P_o} = \frac{1}{2} \ln \frac{P_i}{P_o}$$

SYMMETRICAL



$$Z_1 = Z_2$$

$$10 \log \frac{P_i}{P_o} = \frac{1}{2} \ln \frac{P_i}{P_o}$$

x db or y Nepers.

$\rightarrow \frac{x}{20}$ Nepers.

$$\frac{20}{20} db = 1 \text{ Nepers}$$

Nepers gain

(36) {

$$Z = \frac{50/45}{3+2+j10} = \frac{50/45}{11.18/63.4}$$

$$= 4.47 \angle -18.4^\circ \text{ A.}$$

$$E_o = Z \times (2+j10)$$

$$= 4.47 \angle -18.4^\circ \times 10.2 \angle 78.7^\circ$$

$$= 45.5 \angle 60.3^\circ$$

$$I_L = \frac{E_o}{Z_L + Z_o} = \frac{45.5 \angle 60.3^\circ}{2.64 + j0.723 + 2.93 - j2}$$

$$= \frac{45.5 \angle 60.3^\circ}{5.57 \angle -1.277^\circ} = 8.17 \angle 61.577^\circ$$

$$= 7.97 \text{ A. (Amplitude)}$$

$$P_{max} = I_L^2 \times R_L' \text{ (Average power)}$$

$$= 7.97^2 \times 2.93$$

Z_L conjugate of Z_o

$$= 186.3 \text{ W}$$

$$R_L' = 2.64 + j(0.723 - 2)$$

$$= 2.64 - j1.277$$

$$= 2.93 \Omega$$

$$\therefore Z_L = 2.93 - j2 \Omega$$

Admitted

$$\therefore \text{Ans: } R_L = 2.93 \Omega$$

$$X_C = -j2 \Omega$$

$$P_m = 186.3 \text{ W.}$$

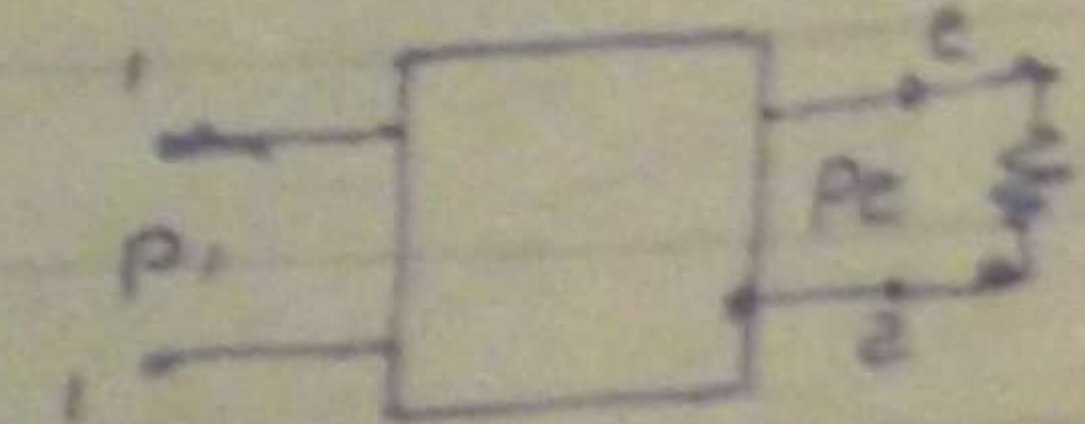
I KNOW WELL.

17.1.83. MON.

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အသံအားကိုးသည့် db ↓

$$1 \text{ Neper} = \frac{86.86}{10} \text{ db}$$



$$10 \log \frac{P_1}{P_2} = \text{db}$$

$$\frac{1}{2} \ln \frac{P_1}{P_2} = \text{db}$$

$$\log_e x = \frac{\log x}{\log e}$$

$$1 \text{ Neper} = 8.686 \text{ db} *$$

$$\text{No of db} = \log \frac{P_1}{P_2} \text{ (or) } \log \frac{P_1}{P_2} *$$

$$\text{No of db} = 10 \log \frac{P_1}{P_2} = 20 \log \frac{E_1}{E_2} = 20 \log \frac{Z_1}{Z_2} *$$

(when o/p & i/p impedances equal.)

$$\text{No of Nepers, } N = \ln \frac{E_1}{E_2} = \ln \frac{Z_1}{Z_2} = \frac{1}{2} \ln \frac{P_1}{P_2} *$$

where $\uparrow$ when $Z_0 = Z_i$

$\ln = \log_e$ - logarithm to the base 'e' or Nat. Log.

db မှ Neper သို့မဟုတ် ပြောင်း

59

Neper & Decibel တို့မှာ attenuation & amplification တို့ကို တူညီသော UNIT ဖြစ်သည်။ Neper တွင် Natural LOGARITHM သုံးသော်လည်း common LOGARITHM (TO THE BASE 10) သုံးသောကြောင့် တွက်ချက်ရာတွင် လွယ်ကူမှု ရှိလာသည်။ ထို့ကြောင့် Neper မှ db သို့ ပြောင်းလဲရာ ဆက်သွယ်သော GAIN ခြားနားမှုကို လိုက်လံသင့်သည်။

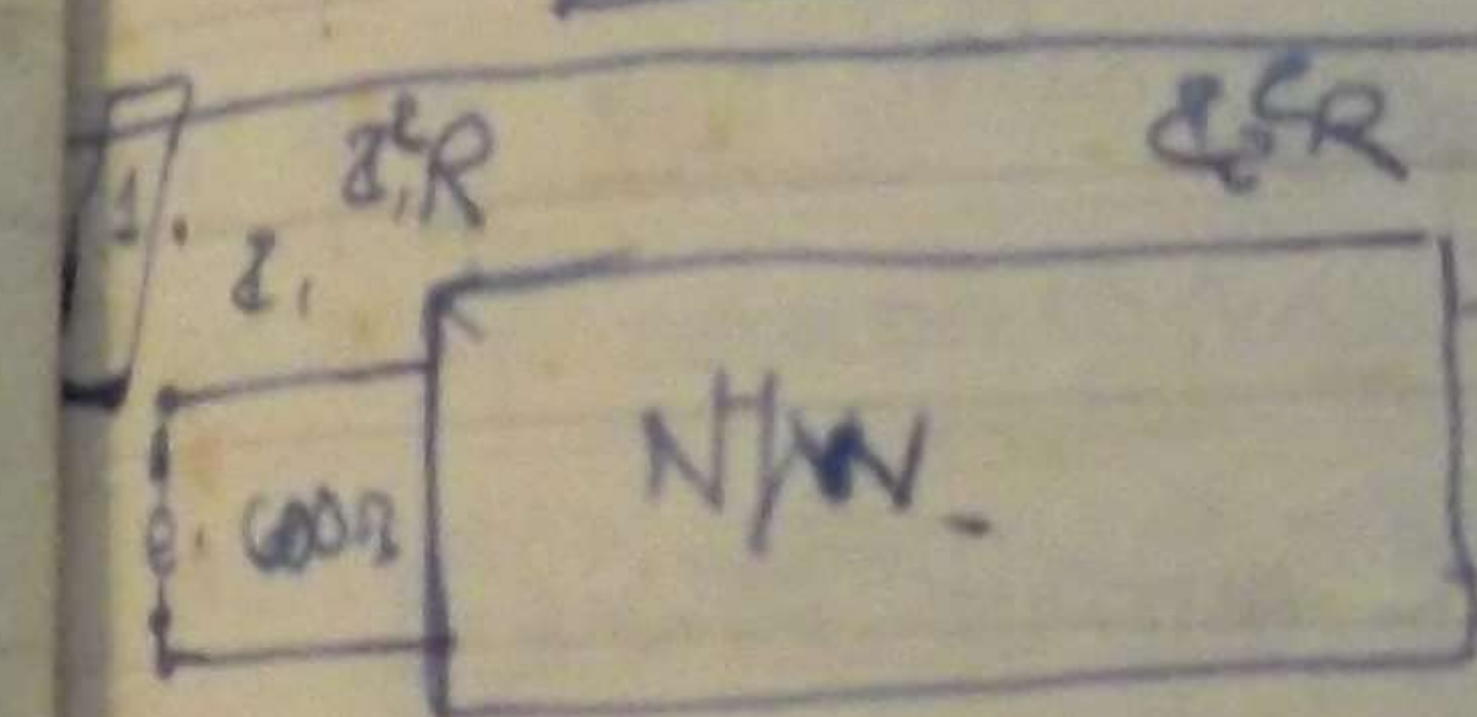
$$\frac{1}{2} \ln \frac{P_1}{P_2} \text{ Nepers} = 10 \log \frac{P_1}{P_2} \text{ db}$$

$$1 \text{ Neper} = 20 \cdot \log e \text{ db}$$

$$1 \text{ Neper} = 8.686 \text{ db} *$$

Ex. 8.

(4 - PROBLEMS.)
27.1.83 THU.



သေသကိန်း N/W တွင် $Z_{in} = 600 \Omega$,
 $R_L = 600 \Omega$, $E_1 = 1 \text{ V (RMS)}$, $E_2 = 0.05 \text{ V (RMS)}$ ဖြစ်သည်။

(a) N/W ၏ ATTENUATION ကို Db ဖြင့် ဖော်ပြပါ။

(b) ဆက်သွယ် $R_L = 10 \text{ k}\Omega$ ကို ပြောင်းလဲသော ပုံစံဖြင့် ဖော်ပြပါ။

$$\text{(a) } \text{db} = 10 \log \frac{P_1}{P_2}$$

$$\text{db} = 20 \log \frac{E_1}{E_2} = 20 \log \frac{1}{0.05} = 20 \cdot 1.3010 = 26.02 \text{ db}$$

$Z_i = Z_0$

attenuation

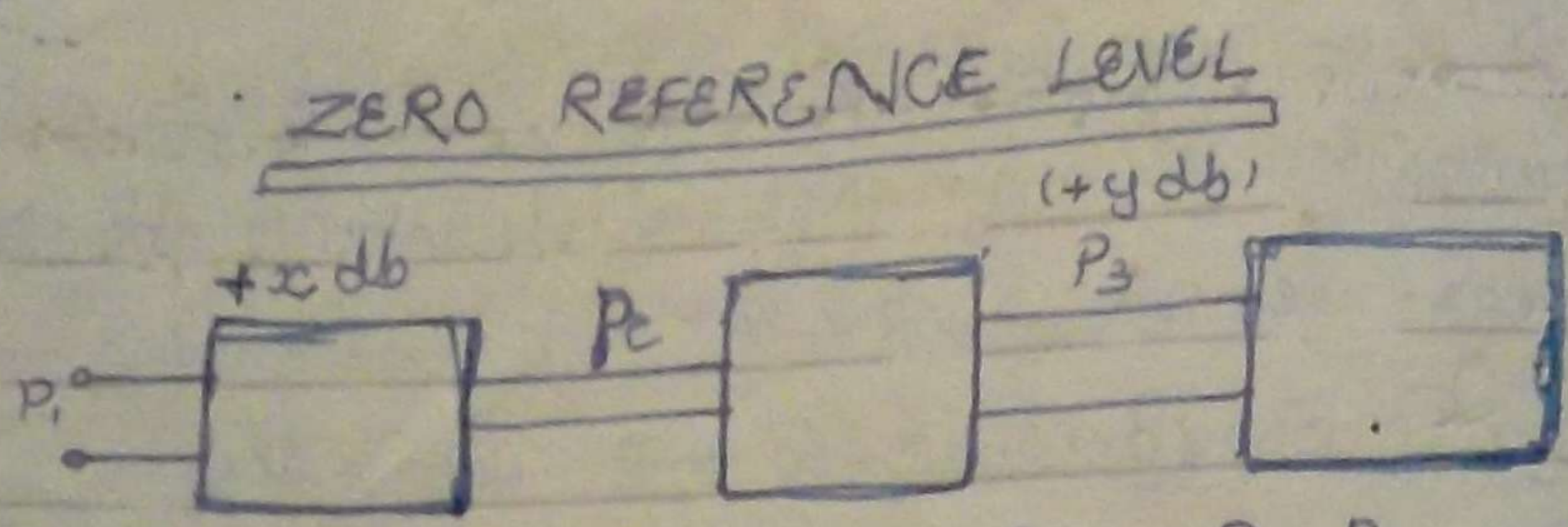
(b) $R_L \neq Z_{in}$
 $10 \text{ k}\Omega \quad 600 \Omega$

$$\text{db} = 20 \log \frac{E_1}{E_2} \cdot \sqrt{\frac{R_L}{R_i}} = 26.02 + 20 \log \sqrt{16.67}$$

$$= 26.02 + 20 \cdot 0.61 = 38.22 \text{ db} *$$

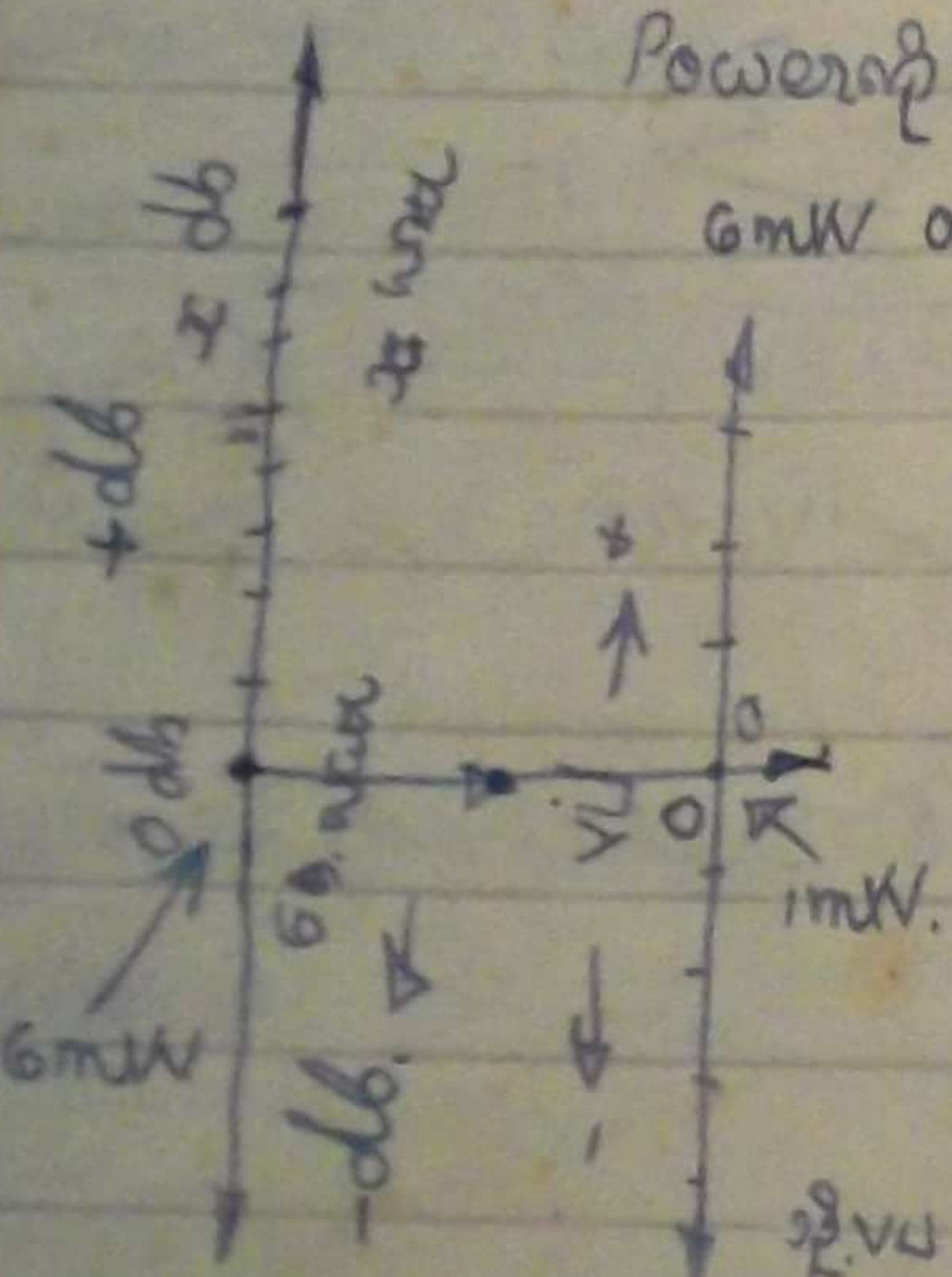
60

(POWER တစ်ခုစီကိုသာပြရန်)



Log တစ်ခုစီကိုသာ သိရသော်လည်း အချိုးအစား $\frac{P_3}{P_2}$, $\frac{P_2}{P_1}$ ရှိသည်။

• GAIN ဖြစ် $\frac{P_3}{P_2} \times \frac{P_2}{P_1}$ ရှိသောကြောင့် TOTAL GAIN ရှိသည်။ Log ယူခြင်းဖြင့် ၀ ဖြစ်စေရန် ပေါင်းဆွဲရန် TOTAL GAIN ရှိသည့် $+x+y$ db ဖြစ်သည်။



Power level (6mW အတွက် ၀ db ပုံစံ) ၀ db အောက်တွင် ရှိသည်။
6mW output ဖြစ်လျှင် ၀ db above 6mW ဖြစ်သည်။
or 1mW ဖြစ်လျှင် ၀ VU ဖြစ်သည်။

Notes:-

AMP တွင် OUTPUT POWER ကို WATT ဖြစ်သော်လည်းကောင်း၊ db ဖြစ်သော်လည်းကောင်း ခိုက်ပြီး POWER LEVEL ကို သိရသည်။ သို့သော် VU ဖြစ်သည့်အတွက် ၀ db ဖြစ်သည်။

POWER LEVEL ကို သိရသည့်အတွက် ရှိသော အားကိုးစဉ်းကို သိရသည်။ ပုံစံ ၁ db တစ်ခုကို ၁ db $= 10 \log \frac{P_1}{P_2}$ ဖြစ်သည်။ P_1 သည် power level ကိုပြသပြီး P_2 သည် ခိုက်ထားသော power level (6mW) ကိုပြသသည်။ P_2 ကို ZERO R. LEVEL ဖြစ်သော်လည်းကောင်း၊ ၀ db level ဖြစ်သည်။ ထိုအားကိုးစဉ်းကို သိရသည်။
reference power ဖြစ်လျှင် $\frac{P_1}{P_2} = 1$ ဖြစ်ပြီး $\log 1 = 0$ ဖြစ်သည်။
• reference ကိုသာထားသော wattage ဖြစ်သည်။

0db = 6mW. 0VU = 1mW.

DECI BEL

VOLUME UNIT

POWER LEVEL ကို သိရသည့် 6mW ဖြစ်လျှင် ၀ db ပုံစံရှိပြီး ၆mW အားကိုးစဉ်းကို +db, ၀ db အောက်တွင် ရှိသော POWER ကို -db ပုံစံအား သိရသည်။
တွက်ချက်ရန် $db = 10 \log \frac{P_{mW}}{6mW}$ ကို အသုံးပြုရသည်။

• VU ဖြစ်လျှင် ၁mW သည် ၀ db ဖြစ်ပြီး ၀ db အောက်တွင် ရှိသည်။
-VU သည် power ကို VU ပုံစံသာ VOLUME UNIT ဖြစ်သည်။

$$VU = 10 \log P_{mW}$$

(2) VACUUM TUBE AMPLIFIER တွင် OUTPUT သည် 5.2W ဖြစ်သည်။
(က) ခိုက် OUTPUT POWER LEVEL ကို သိရပြီး ပြပါ။ (ခ) ထုတ်ရှိ OUTPUT POWER ကို တွက်ရန် ခိုက်ရန် သိရသည်။ (ဂ) 70% EFFICIENCY ရှိသော TRANSFORMER တွင် OUTPUT ဖြစ်သော LOAD ကို သိရသည်။

(က) $P = 5200 mW$

$$\therefore VU = 10 \log 5200 = 10 \times 3.716 = 37.16 VU$$

(ခ) $P = 5200 \times 4 = 20800 mW$

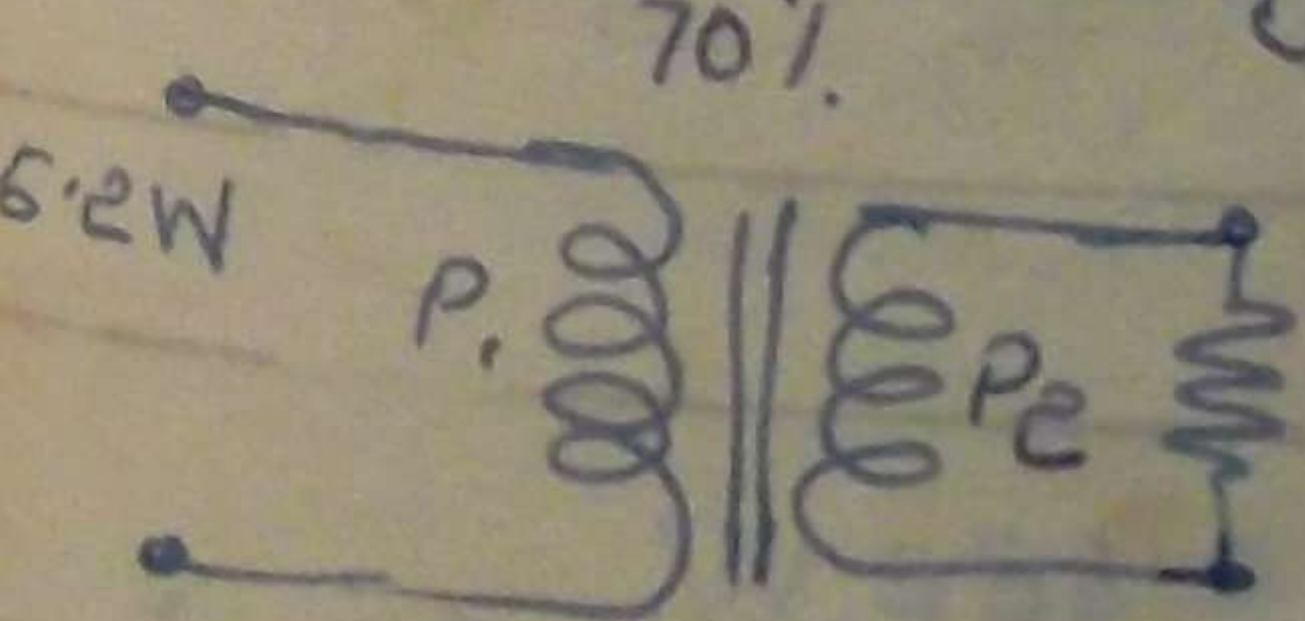
$$\therefore db = 10 \log \frac{5200}{6} = 10 \log 866.7 = 29.38 db$$

$$db = 10 \log \frac{20800}{6} = 10 \log 3467 = 35.4 db$$

$$\therefore db \text{ အား} = 35.4 - 29.4 = 6 db$$

(ဂ) $db = 10 \log \frac{5200 \times 0.7}{6} = 10 \log 606.7 = 27.83 db$

$$\therefore \text{သိရသော} = 29.38 - 27.83 = 1.55 db$$



(0.7)

$$\text{loss db} = 10 \log \frac{5.2}{5.2 \times 0.7}$$

$$= 10 \log 1.429 = 1.5425$$

3

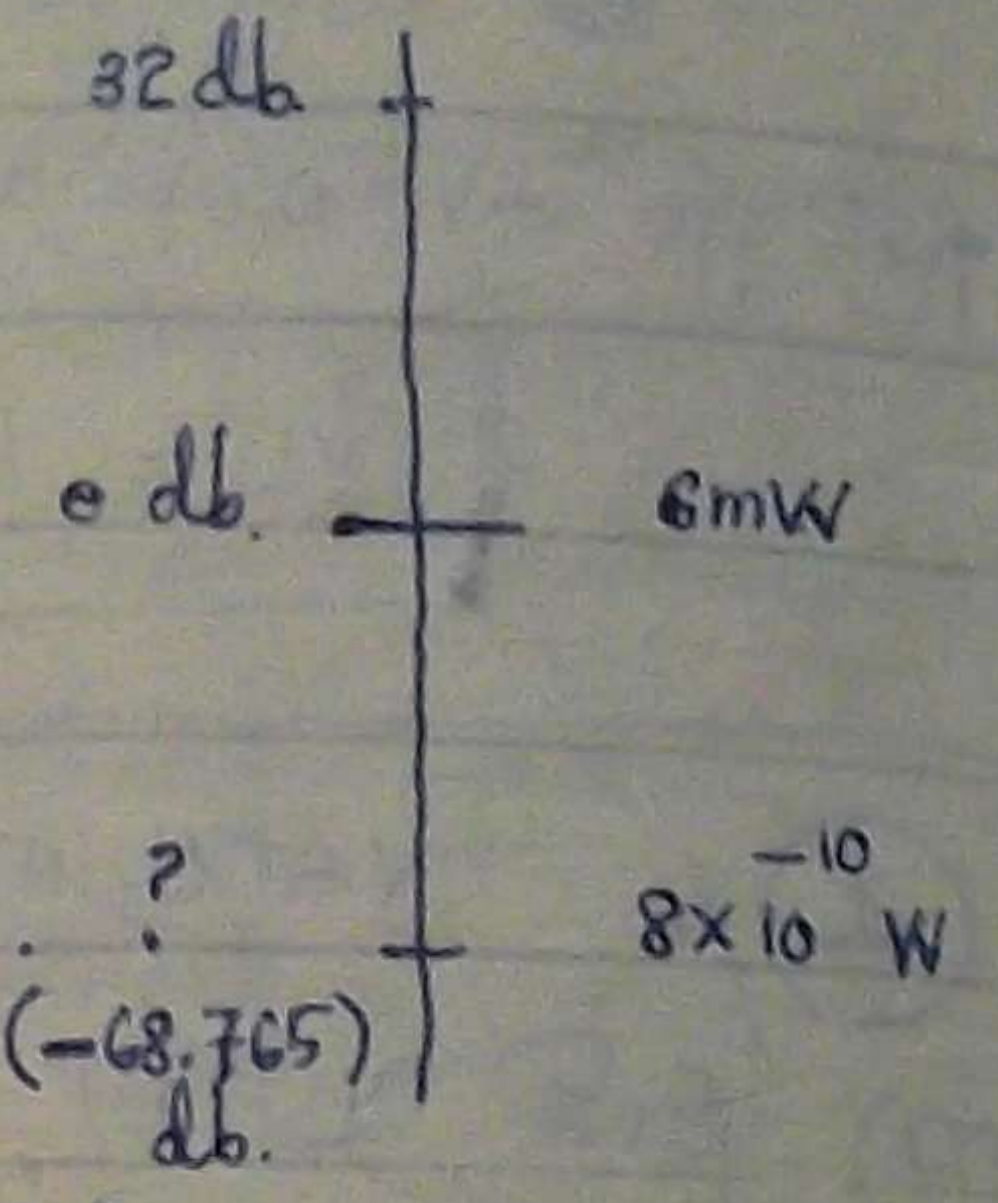
81 → ၅၅၀ ဝပ်စ်

INPUT Z = 200 Ω, 400 μV INPUT SIGNAL INDUCED. LOUSPEAKER POWER LEVEL +32db

- (a) INPUT POWER LEVEL သို့မဟုတ် (b) GAIN သို့မဟုတ်
- (c) OUTPUT POWER WATT သို့မဟုတ်

(a) INPUT POWER = $\frac{E^2}{R} = \frac{400^2 \times 10^{-12}}{200}$
 $= 8 \times 10^{-10} W$

∴ INPUT POWER LEVEL, db = $10 \log \frac{8 \times 10^{-10}}{6 \times 10^{-13}}$
 $= 10 \log 1.33 \times 10^{-7} (-68.765)$
 $= 10 \log 0.000000133$
 $= 10 \times 7.1235$
 $= -70 + 1.235 = -68.765 db$



(a) ∴ R & GAIN db = $32 + 68.765 = 100.765 db$
 $100.765 = 10 \log \frac{P_o}{8 \times 10^{-10}}$
 $10.0765 = \log \frac{P_o}{8 \times 10^{-10}}$
 $\therefore P_o = 8 \times 10^{-10} \times \text{Antilog } 10.0765$
 $= 8 \times 10^{-10} \times 1.1925 \times 10^3$
 $= 9.54 \times 10^{-7} W$

(c) OUTPUT POWER
 $db = 10 \log \frac{P_o}{6mW}$

∴ $P_o = 6 \times 10^{-3} \times \text{Antilog } 3.2 = 6 \times 1.587 = 9.522 W$

65

(a) R & GAIN DB = $10 \log \frac{P_o}{P_i}$

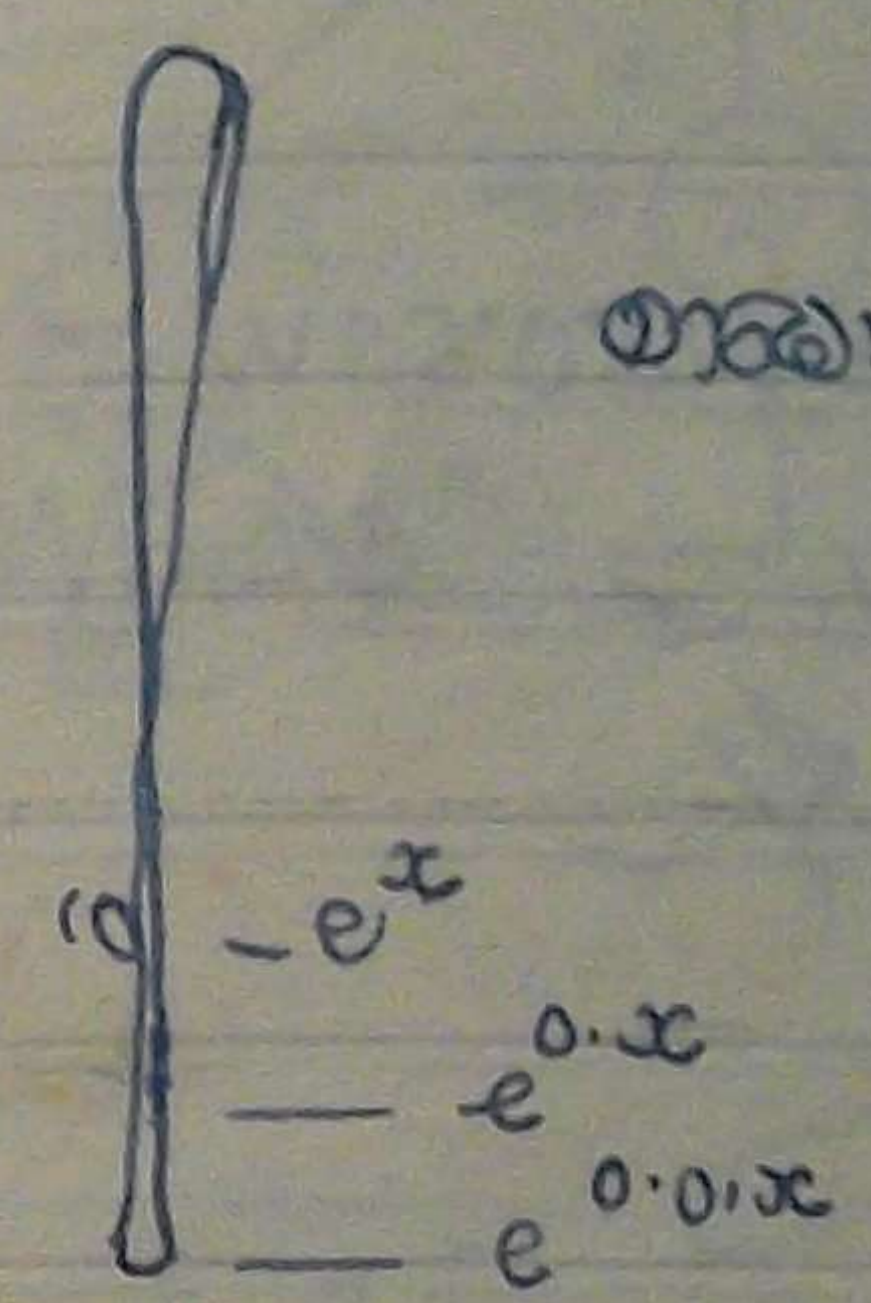
$= 10 \log \frac{9.522}{8 \times 10^{-10}}$

$= 10 \log 1.19 \times 10^9$

$= 10 \times 9.075 = 100.75 DB \leftarrow \text{Ans.}$

ဇယား 3.1 WBO:

- LL01
- LL02
- LL03



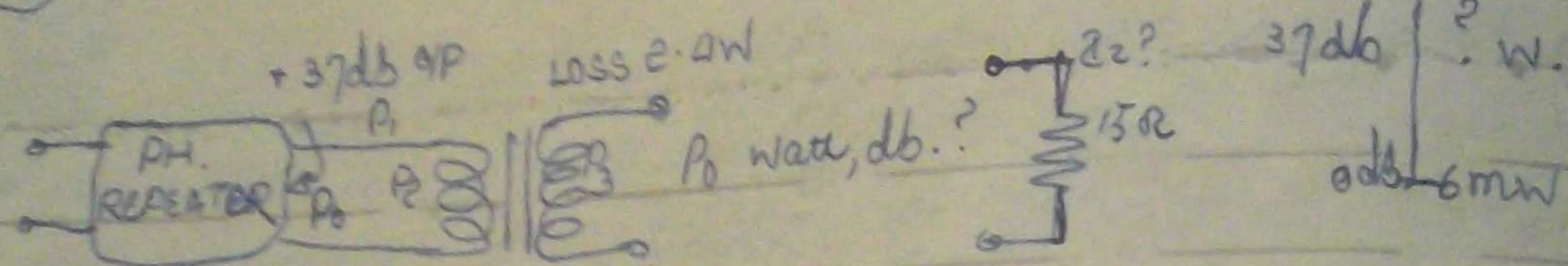
စာနားခွင့် * လေ့ရှိ index ပုံစံများ
 တွက်ချက်ရန်
 * db ကို အသုံးပြုရန် အတိုကောက်
 ရှာဖွေရန် လိုသည်

- LL3 1.0e
- LL2 0.0x
- LL1 0.001x

4/ ~~RECEIVER INPUT UNDER NOISE 200 μV~~
~~SIGNAL INDUCED. LOUSPEAKER POWER LEVEL~~
 TELEPHONE REPEATER တစ်ခု၏ OUTPUT သည် +37db ဖြစ်ပြီး 60%
 EFFICIENCY ရှိသော TELEPHONE ရှိတတ်သည်။ ဤ LINE ၏ အားကိုး 2.0 WATTS LOSS
 ရှိသော TRANSFORMER တစ်ခု၏ တွက်ချက်မှုများ (a) TRANSFORMER ပစ္စည်း၏
 POWER ကို WATT အားဖြင့် ဖော်ပြပါ။ (b) LINE LOSS ကို db ဖြင့် ဖော်ပြပါ။
 NEPER ဖြင့် ဖော်ပြပါ။ (c) TRANSFORMER ၏ LOSS ကို db ဖြင့် ဖော်ပြပါ။
 (d) LOAD သည် 5 Ω ဖြစ်သော ဖြစ်ပြီး ဖြစ်သော CURRENT ကို ရှာပါ။

1.3×10^{-1} 0.163

64



$$db = 10 \log \frac{P_0}{6 \times 10^{-3}}$$

$$\frac{P_0}{6 \times 10^{-3}} = \text{Antilog } 3.7$$

$$\therefore P_0 = 6 \times 5.015 = 30.09 \text{ W.} \checkmark$$

$$P_1 = 60\% \text{ of } P_0 = 30.09 \times 0.6 = 18.054 \text{ W.}$$

$$\therefore (m) P_3 = 18.054 - 2.4 = 15.654 \text{ W.} \leftarrow (\text{Ans.})$$

$$\text{or } db = 10 \log \frac{15.654}{0.006}$$

$$= 10 \log 2612$$

$$= 10 \times 3.41625$$

$$= 34.1625 \text{ db} \leftarrow (\text{Ans.})$$

(n) LINE LOSS

$$db = 10 \log \frac{P_{in}}{P_{out}} = 10 \log \frac{30.09}{18.054}$$

$$= 10 \log 1.667 = 10 \times 0.2215 = 2.215 \text{ db.}$$

$$= \frac{2.215}{8.686} = 0.255 \text{ Nepers.} \leftarrow (\text{Ans.})$$

(o) TRANSFORMER LOSS

$$db \text{ loss} = 10 \log \frac{18.05}{15.65} = 10 \times 0.0613 = 0.613 \text{ db.}$$

65

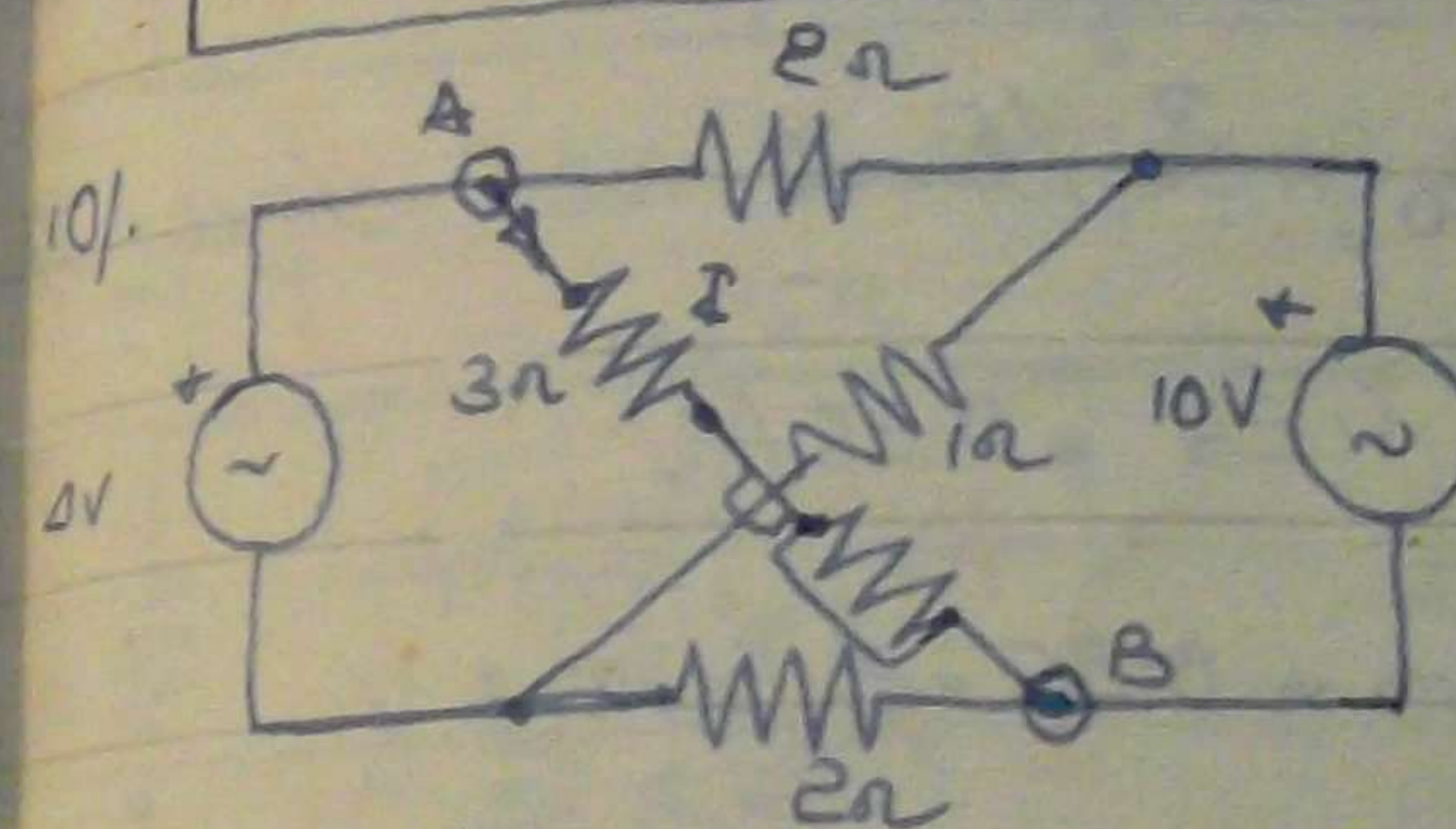
$$P_3 = 15.654 \text{ W,}$$

$$W = I^2 R \quad I = \sqrt{W/R}$$

$$\therefore I = \sqrt{15.65/15} = \sqrt{1.043} = 1.021 \text{ Amp.} \leftarrow (\text{Ans.})$$

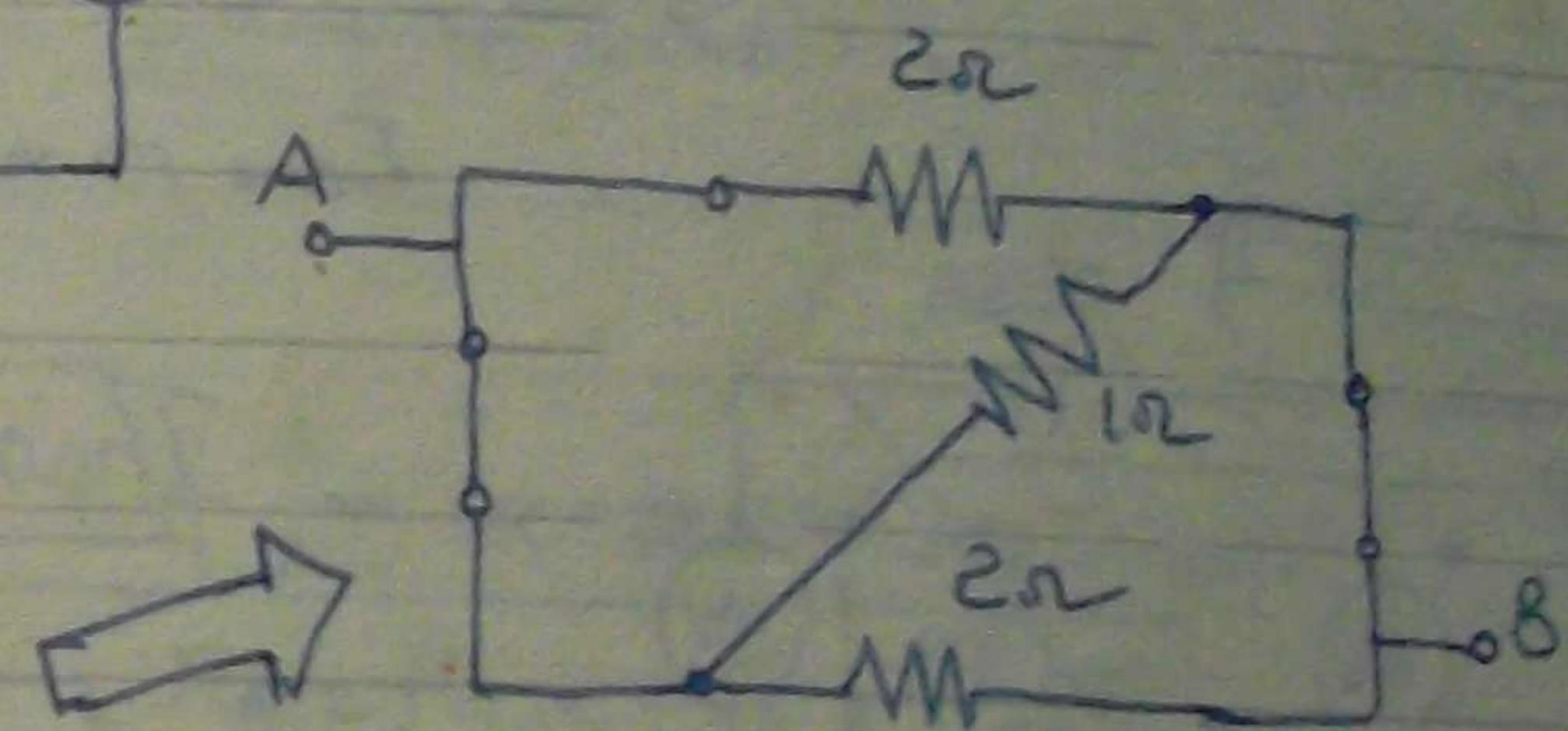
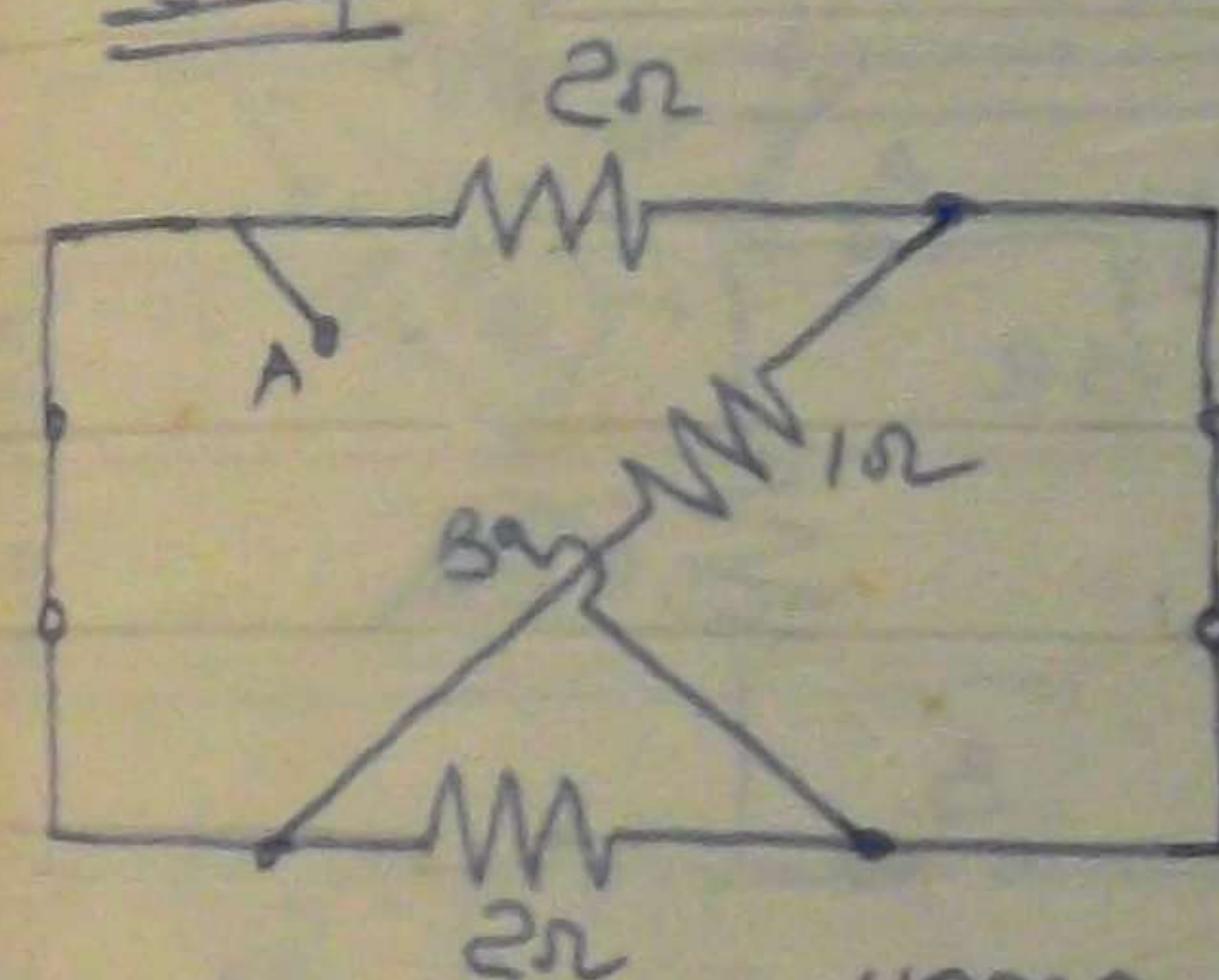
(TO PAGE - 66.)

P. 48 Ex. 6



3Ω Resistor is in series with the 10V source.

Zo



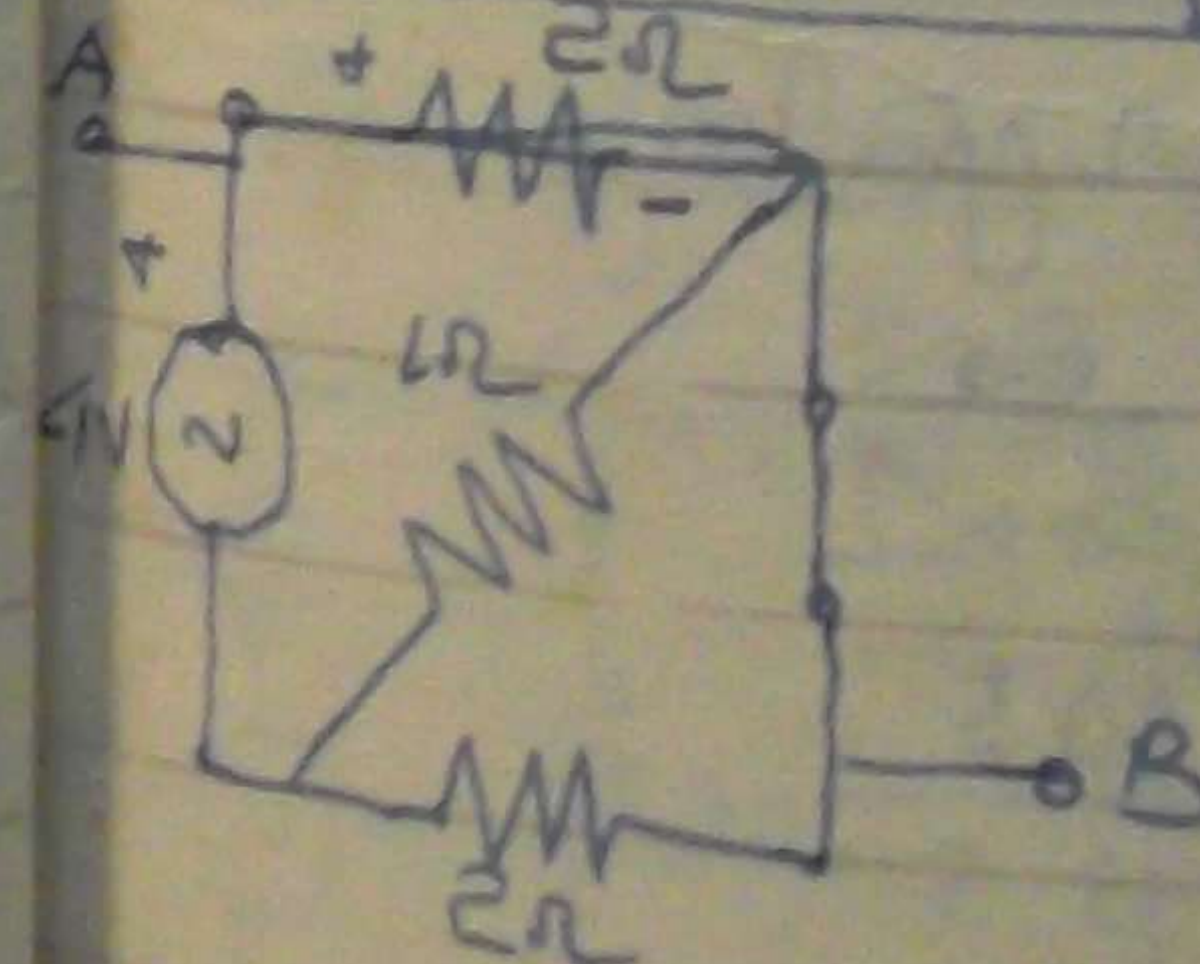
$$\therefore Z_o = \frac{1 \times \frac{2}{2}}{1 + \frac{2}{2}} = \frac{1}{2} \Omega$$

3 resistors parallel.

UPPER 2Ω Res current

Super Position Theorem

10V E. source

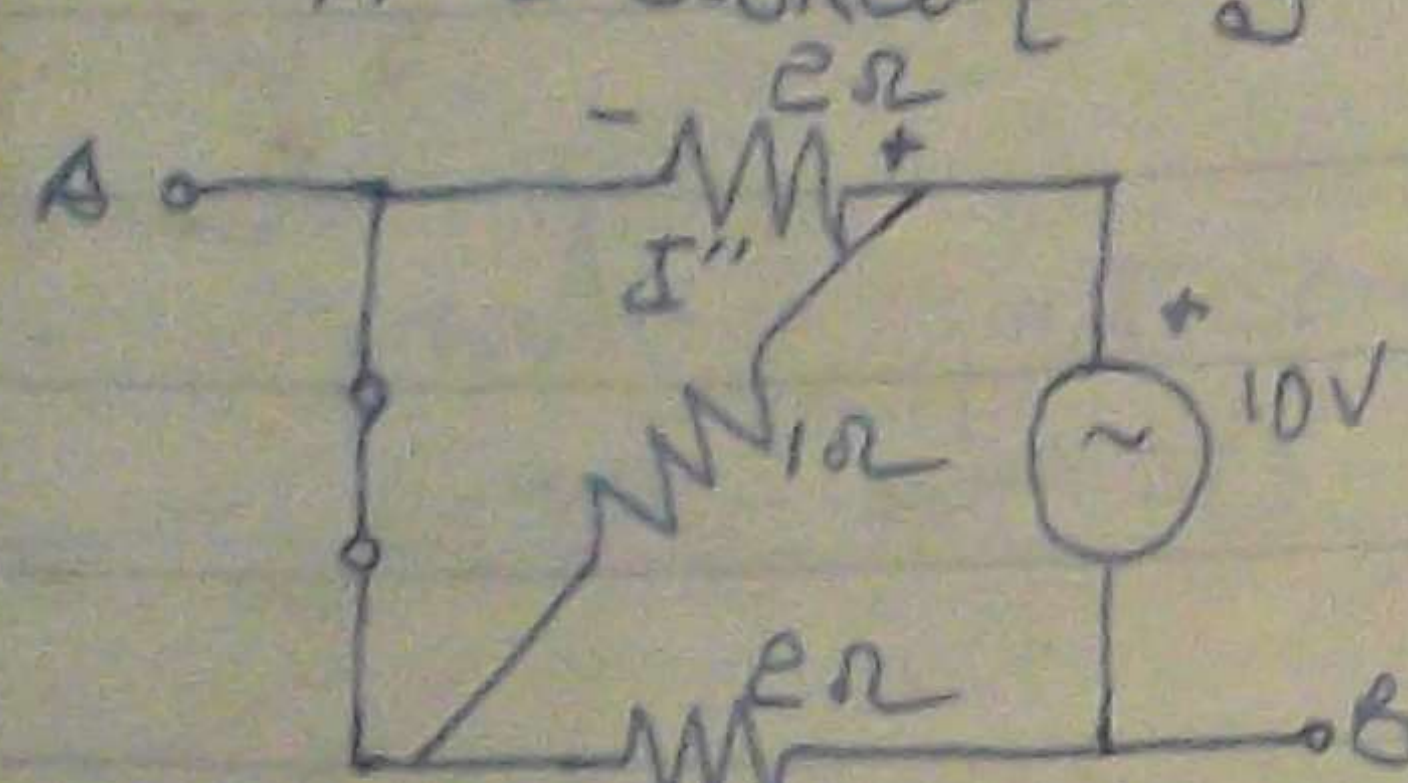


$$R_x = 2 + \frac{2 \times 1}{2 + 1} = \frac{8}{3} \Omega$$

$$\therefore I'_{E20} = \frac{4}{8/3} = 1.5 \text{ A.}$$

66

4V E SOURCEကိုယ် 10V. တစ်ခုတည်းရှိသောကြောင့် -



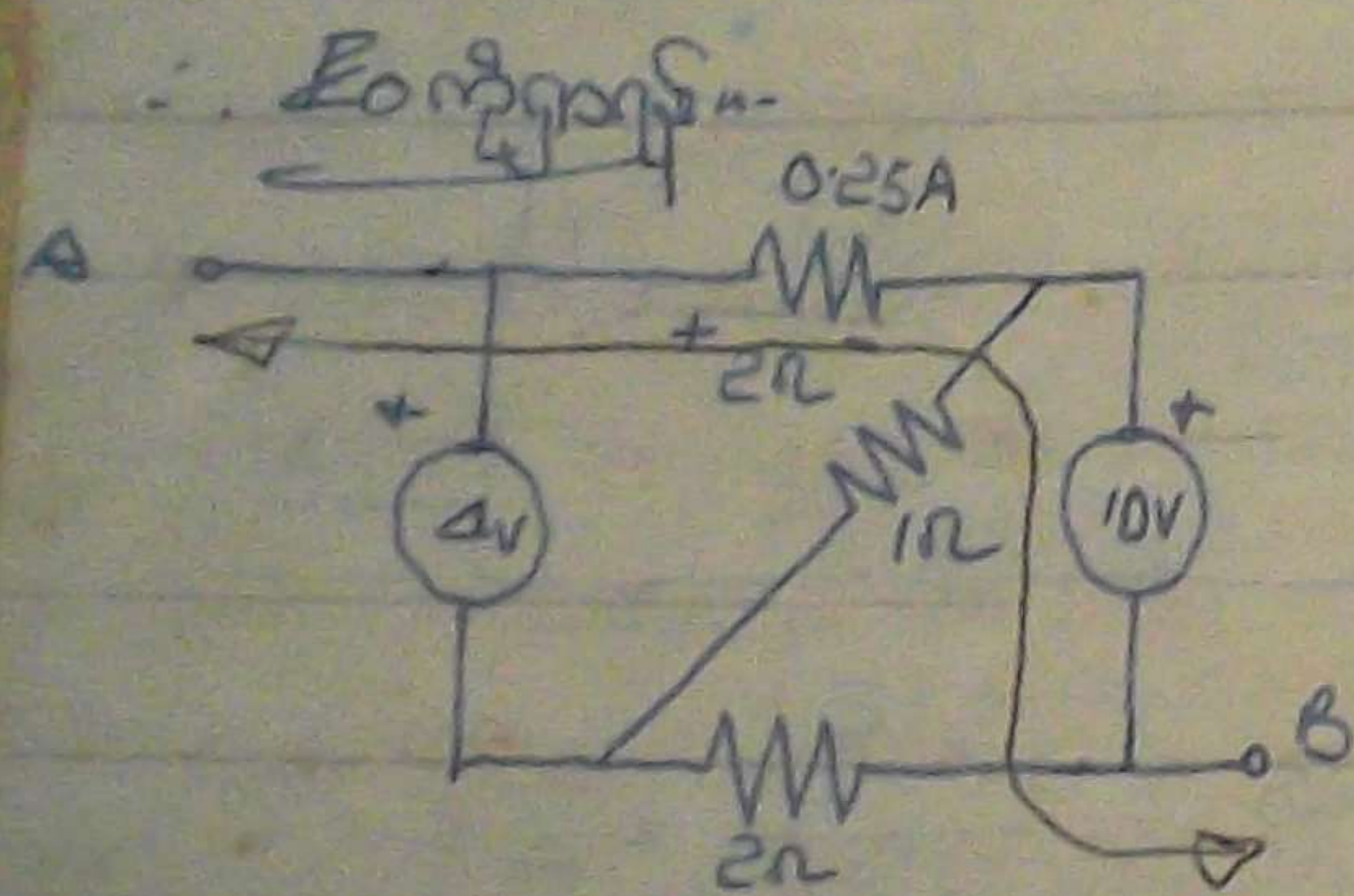
$R_t = \frac{8}{3} \Omega, I_t = \frac{10}{\frac{8}{3}} = \frac{15}{4} A.$

$\therefore I'' = \frac{1}{1+2} \times \frac{15}{4} = \frac{5}{4} A = 1.25 A.$

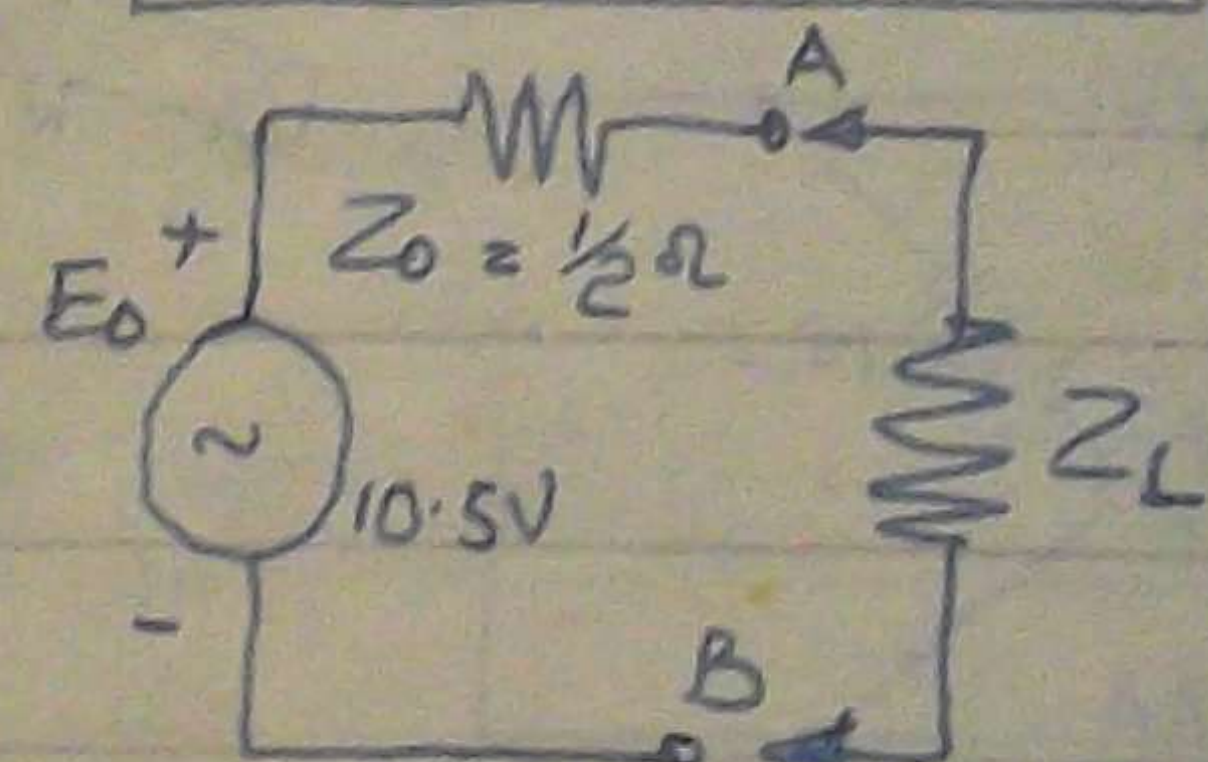
$\therefore$ S. Position $\rightarrow I_{2\Omega} = I'/E_{2\Omega} + I''/E_{10V}$

$I_{2\Omega} = 1.5 - 1.25 = 0.25 A.$

$E_0 = 10 + 0.25 \times 2 = 10.5 V.$

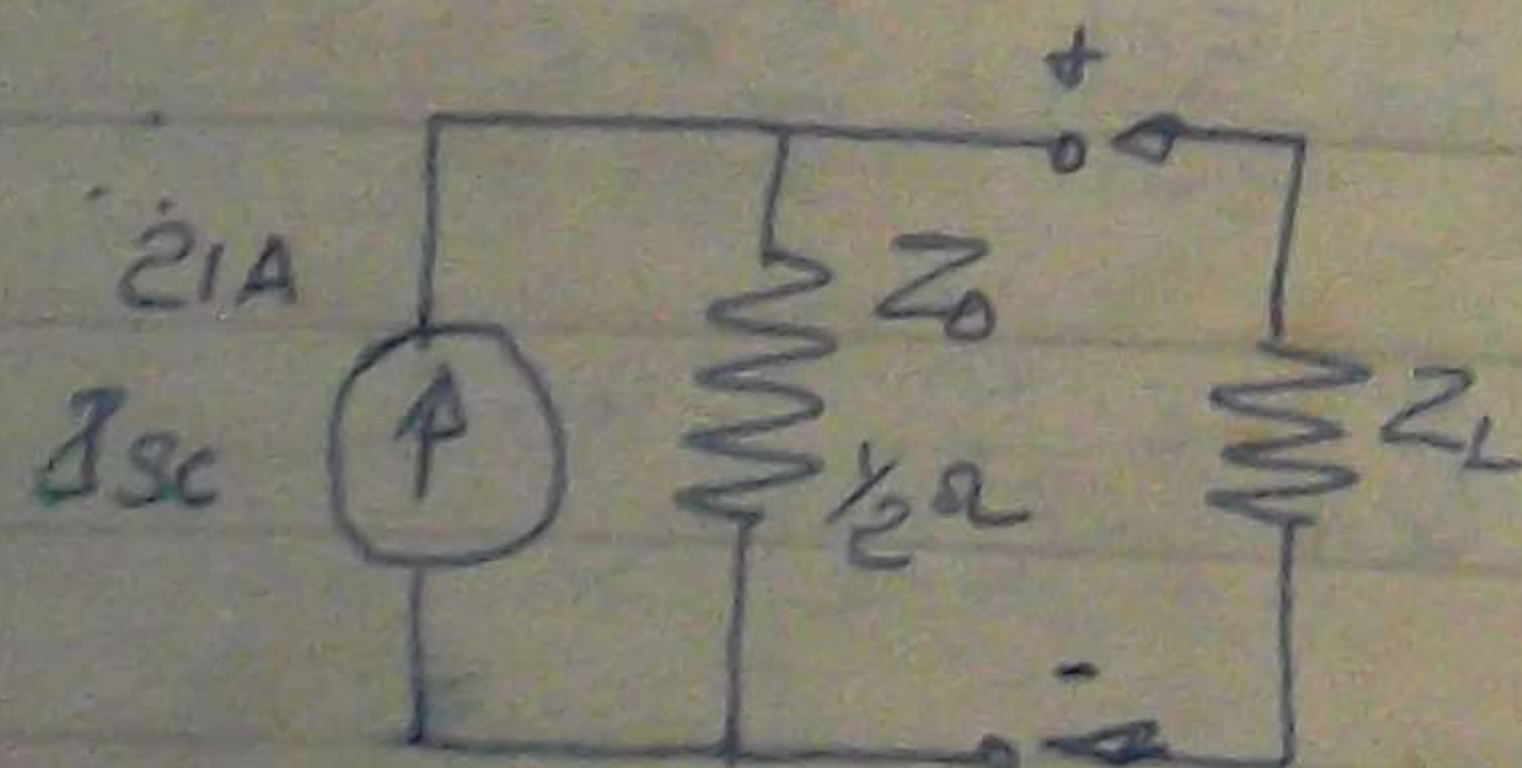


$\therefore$ Thevenin's Eq. Ck:



Norton's Theorem, Isc ကိုရှာရန် ZL ကို SHORT ပြုရမည်

$I_{sc} = \frac{E_0}{Z_0 + 0} = \frac{10.5}{\frac{1}{2}} = 21 A.$



PROVE NORTON'S EQ. CK. ရှိသည်။

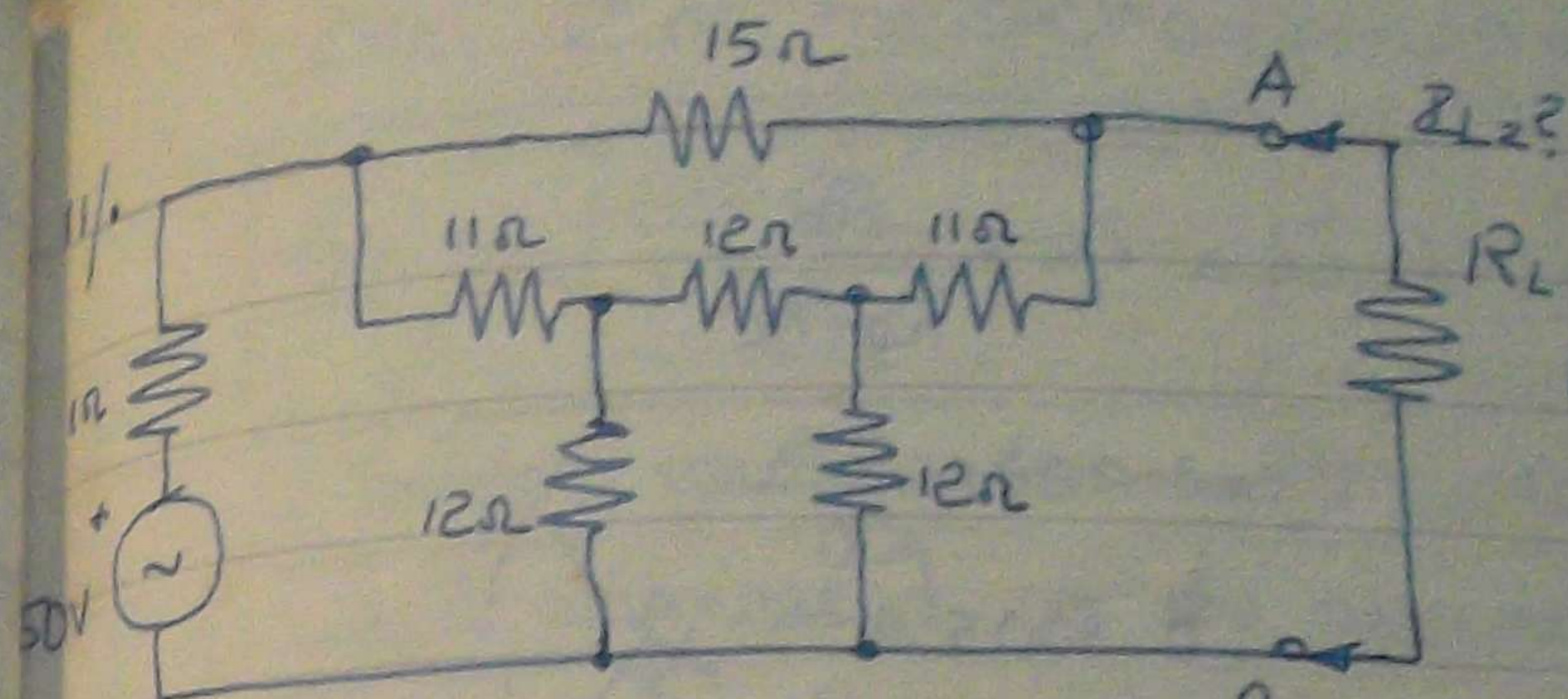
$Z_L = 3 \Omega$ ဖြစ်ပါက

$I_L = \frac{E_0}{Z_0 + Z_L} = \frac{10.5}{3.5}$

$= 3 A \leftarrow$ (Ans)

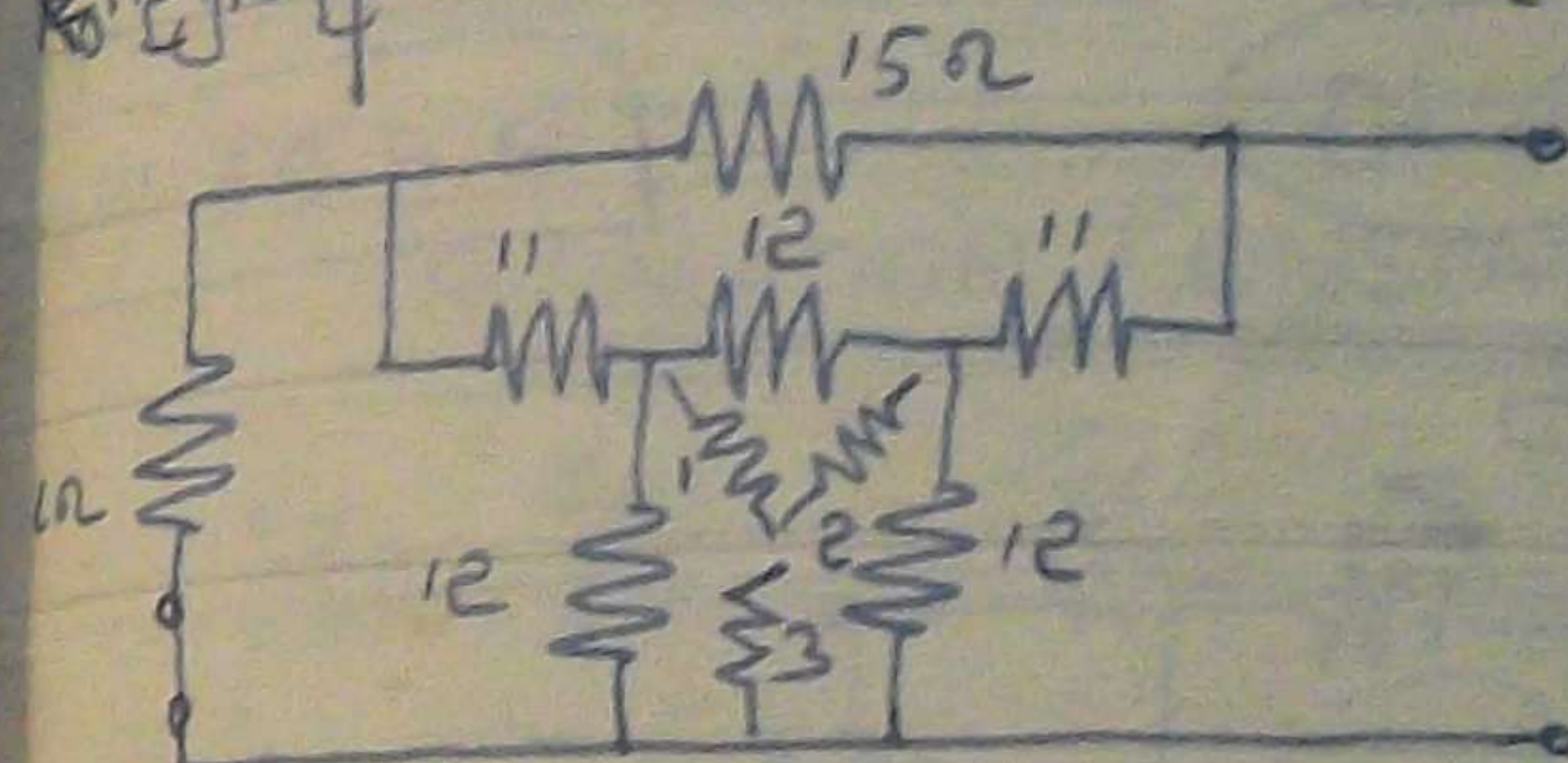
15

67



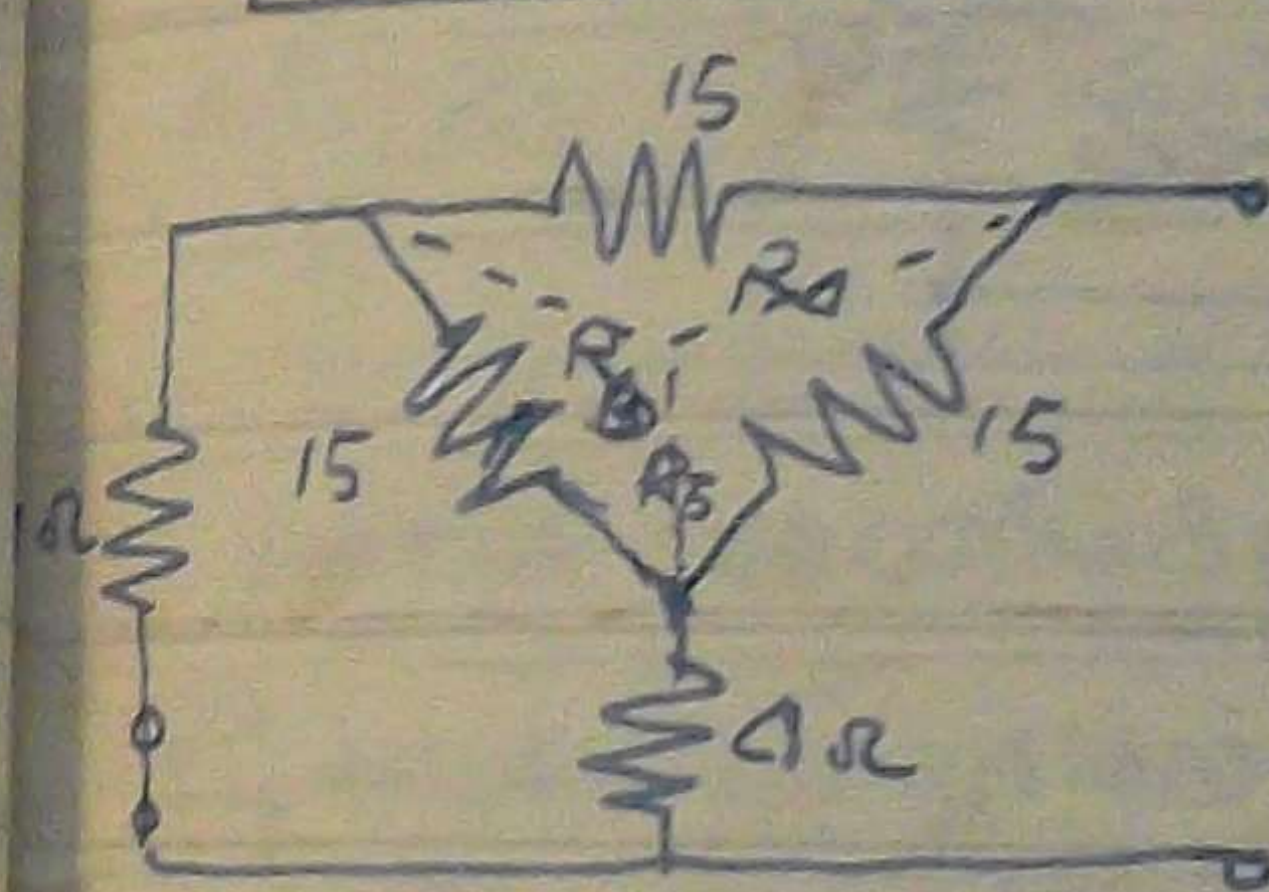
$R_L = 91.4 \Omega$
Norton's Eq. Ck နှင့်
 $I_{sc} = ?$
 $R_0 = ?$
 $I_L = ?$

50V. E. SOURCE ကို SHORT ပြုရမည် -



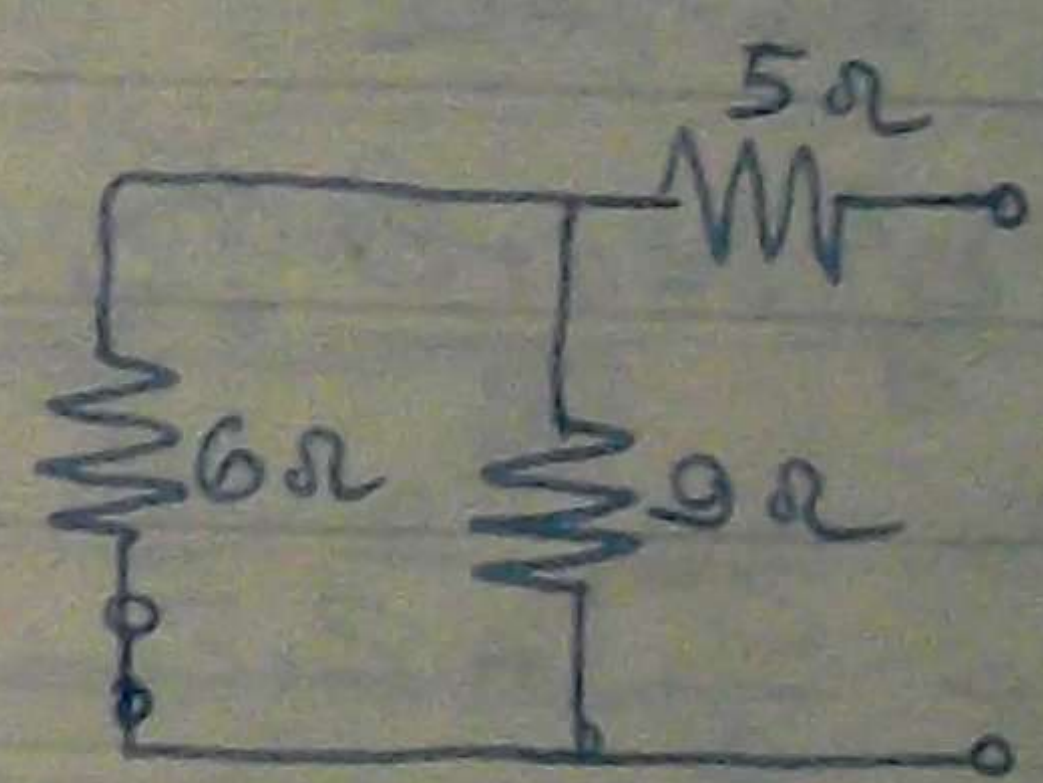
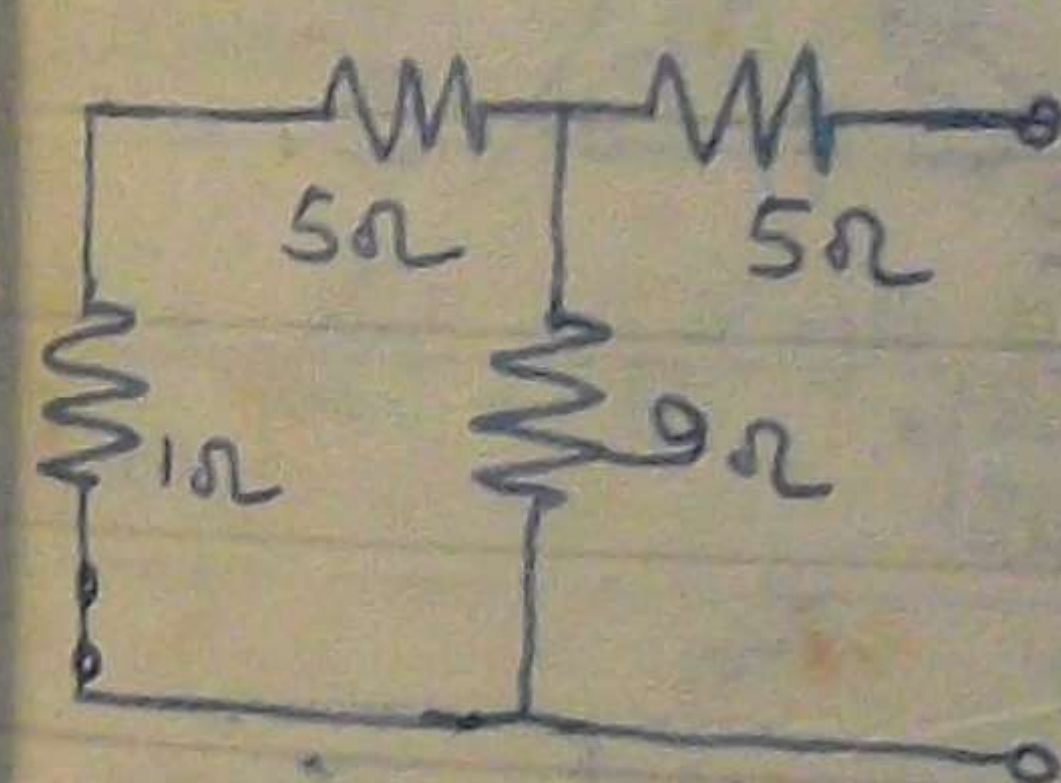
(PI - T SECTION FORMULA ဝေရာ)

$R_1 = R_2 = R_3 = \frac{12 \times 12}{12 + 12 + 13} = 0.9 \Omega.$



PI - T SECTION FORMULA ဝေရာ -

$R_0 = R_1 = R_5 = \frac{15 \times 15}{15 + 15 + 15} = 5 \Omega.$

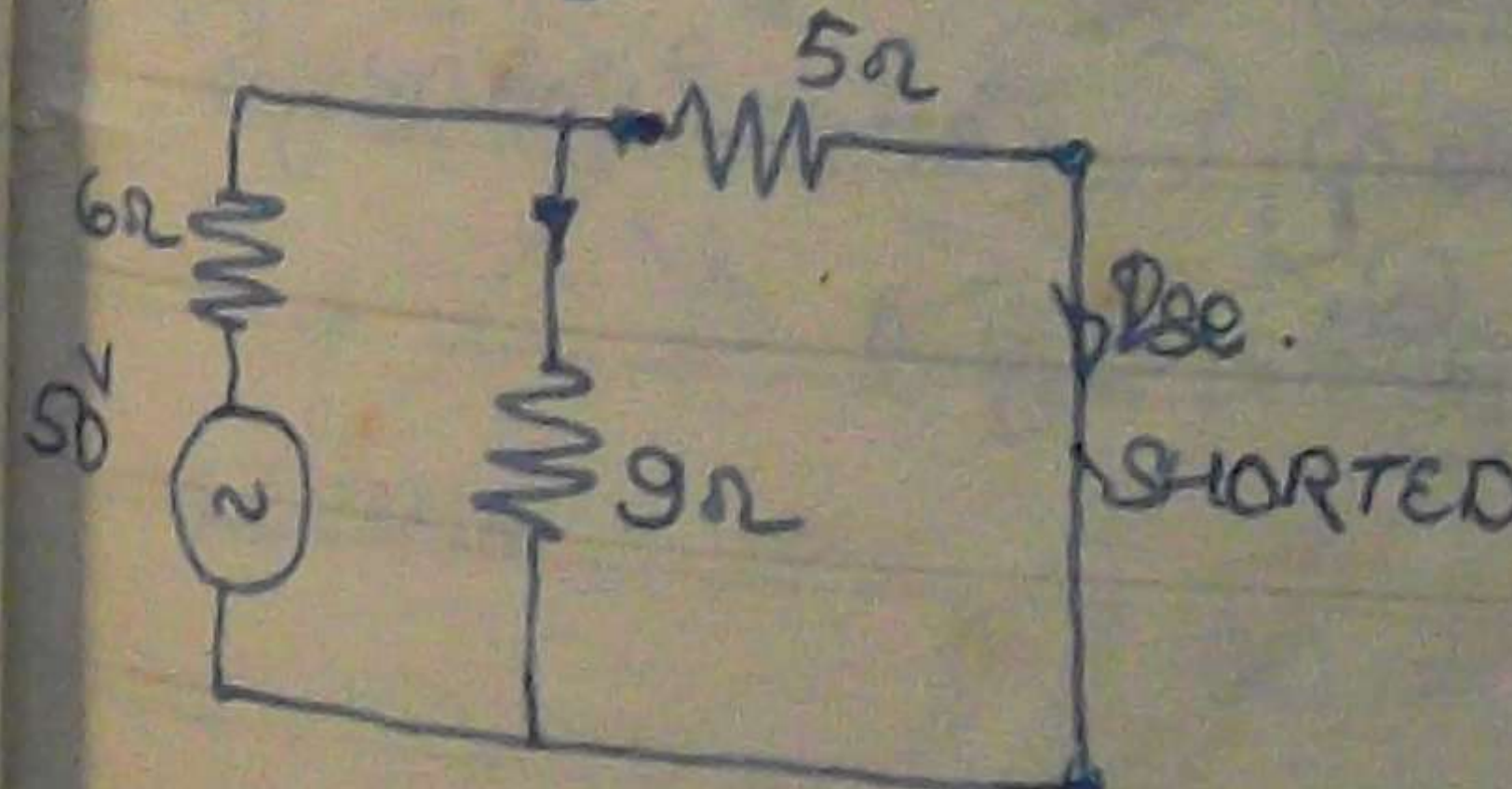


$R_0 = 5 + \frac{6 \times 9}{6 + 9} = 8.6 \Omega.$

$\therefore$ Isc ကိုရှာရန် -

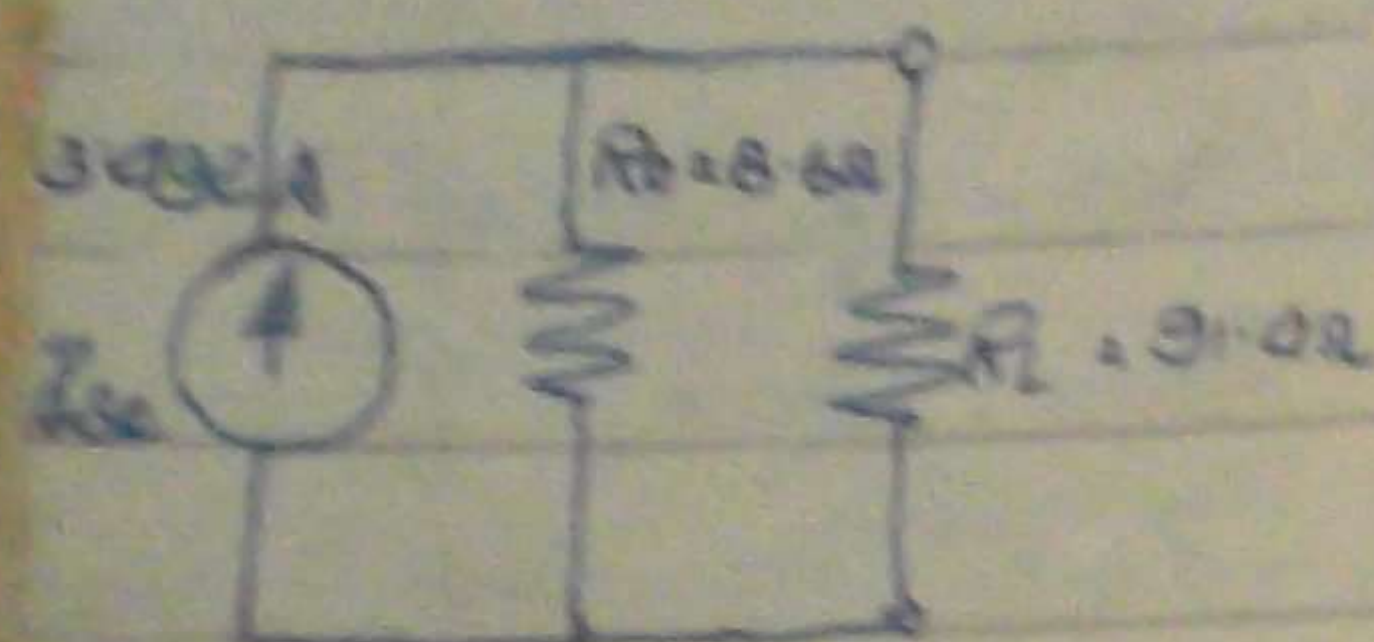
$R_{eq} = 6 + \frac{5 \times 9}{5 + 9} = 9.212 \Omega.$

$\therefore I_L = \frac{50}{9.212} = 5.43 A.$



$\therefore I_{sc} = \frac{9}{9 + 5} \times 5.43 = 3.492 A.$

$\therefore$ Norton's Eq. the



$$\therefore Z_L = Z_{SC} \times \frac{R_0}{R_0 + R_L}$$

$$= 3.492 \times \frac{8.6}{100}$$

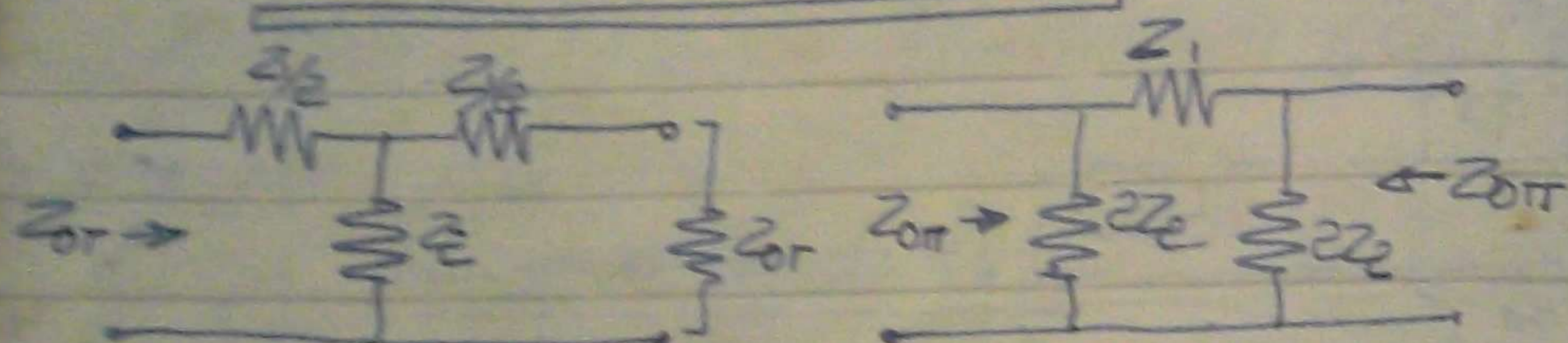
0.3005 A

P-65, ഗാലറിയം

CHAP. 10

9.2.83.WED

CHARACTERISTIC IMPEDANCE



$$Z_{OT} = \frac{Z_1}{2} + \frac{(Z_E + Z_{OT}) Z_E}{(Z_E + Z_{OT}) + Z_E}$$

$$\cancel{\frac{Z_0 \times Z_1}{2}} + \cancel{Z_0^2} + \cancel{Z_0 \times Z_2} + \frac{Z_1^2}{4} + \cancel{\frac{Z_0 \times Z_1}{2}} + \frac{Z_1 \times Z_2}{2} + \frac{Z_1 \times Z_2}{2} + \cancel{Z_0 \times Z_2}$$

$$Z_{OT}^2 = \frac{Z_1^2}{4} + Z_1 Z_e$$

$$\therefore Z_{or} = \sqrt{Z_c^2 + \frac{Z_1^2}{4}} = \sqrt{Z_c^2} \sqrt{1 + \frac{Z_1^2}{4Z_c^2}}$$

ဤတွင် T အောက်မေ့ရမည့် $Z_1 = Z_2 = \dots = Z_n$ နှင့် Z_n အောက်မေ့ရမည့် $Z_1 = Z_2 = \dots = Z_n$ ဖြစ်သည်။

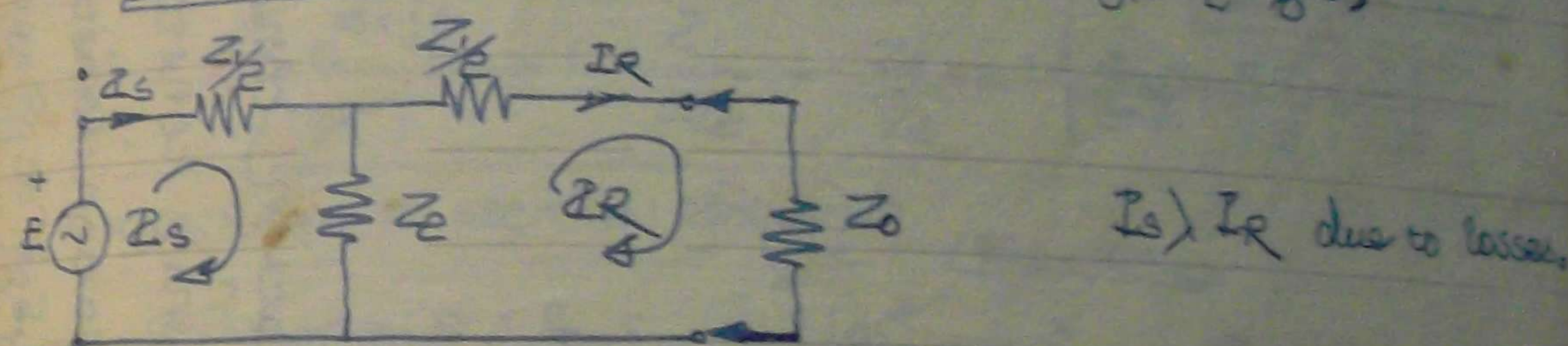
Q.4: Z OF π SECTION

$$Z_{\text{off}} = \sqrt{\frac{Z_1 Z_e}{1 + \frac{Z_1}{\Delta Z_e}}}$$

proper termination $\rightarrow$ ဆိုရင် LOAD ကို ဆွဲချခိုင်း.

(if Z_0 is terminated at the receiving end, it is so called proper termination.)

PROPAGATION CONSTANT (γ) (deg. m⁻¹)



passive network ကို ဖြတ်၍ အစွမ်း စာရင်း ရေးချက်။
 ဆို. စာရင်း ? နှစ်သွားလဲ။ $\frac{1}{2s}$ ဆိုတွင် ရှိသည်။ $\frac{1}{2s}$ မှတ်တမ်းကို နှစ်
 ဆိုတွင်။ r ကို $(\omega + j\beta)$ ဟု ဖော်ပြသည်။ $\frac{1}{2s}$ နှင့် $\frac{1}{2s}$ တွင် $\angle$ ရှိသည်။

$\frac{Z_s}{R_s} \angle \theta = e^{\alpha + j\beta} \frac{Z_s}{R_s} \angle \theta$ $\angle = e^{j\theta}$ ဟု ဆိုလိုတာကို ရှင်းပြရမည်။

$\therefore \left| \frac{1s}{2q} \right| z e^{\alpha}, e^{j\omega}, z e^{j\omega}, \dots$

1/ $\Delta \alpha = ?$ (LL SCALE 0: 0.5 m) $\rightarrow$ If spring constant is 600

α = attenuation constant.

အခု နေ့စဉ်ကျင့်သင့်သော

phase shift constant. β is called phase shift constant.
 N/w $\beta = \frac{2\pi}{\lambda}$ and $\lambda = \frac{v}{f}$
 Ex: 200m, 2, 200Hz, $\beta = \frac{2\pi}{\lambda}$

$$\text{Eq (1)} \Rightarrow \left(\frac{Z_1}{Z} + Z_e \right) \mathcal{I}_S - Z_e \mathcal{I}_R = E$$

$$E_g(z) \Rightarrow -z z_s + (z_c + z_0 + \frac{z_1}{z}) z_R = 0$$

$$D_2 = \begin{vmatrix} \frac{z_1}{2} + z_2 & -z_2 \\ -z_2 & z_2 + z_1 + \frac{z_1}{2} \end{vmatrix}$$

$$N_s = \begin{vmatrix} E & -Z_e \\ 0 & Z_e + Z_o + \frac{Z_i}{2} \end{vmatrix} = E(Z_e + Z_o + \frac{Z_i}{2})$$

$$N_R = \begin{vmatrix} \frac{Z_1}{E} + Z_e & E \\ -Z_e & 0 \end{vmatrix} = EZ_e$$

$$\therefore \underline{I_S} = \frac{E (Z_e + Z_0 + \frac{Z_1}{e})}{D}$$

$$IR = \frac{EZ_c}{D}$$

$$\therefore \frac{Z_3}{Z_R} = \frac{Z_e + Z_0 + \frac{Z_1 Z_2}{Z_e}}{Z_e} = 1 + \frac{Z_1}{Z_e} + \frac{Z_0}{Z_e}$$

$$\therefore \frac{Z_S}{Z_R} = 1 + \frac{Z_1}{Z_e} + \frac{Z_0}{Z_e}$$

α = attenuation constant. (Nepers/section.)
 β = phase shift constant. (Rads/section.)
 γ = propagation constant.
 section length l if α ပြောင်းရန်၊ β ပြောင်းရန် လိုအပ်သည်။
 ၃၁. ၂၇

⑦

$$\therefore \frac{\partial s}{\partial R} = 1 + \frac{z_1}{e z_e} + \frac{\sqrt{z_1 z_e + \frac{z_1^2}{4}}}{z_e} = 1 + \frac{z_1}{e z_e} + \sqrt{\frac{z_1}{z_e} + \frac{z_1}{4 z_e^2}}$$

$$\frac{\bar{I}_s}{\bar{I}_R} = e^r e^{\alpha + j\beta} = 1 + \frac{Z_1}{2Z_e} + \sqrt{\frac{Z_1}{Z_e} + \frac{Z_1^2}{4Z_e^2}} \quad \text{--- (1)}$$

$$e^r = e^{a+j\beta} = 1 + \frac{Z_1}{2Z_e} + \frac{a}{Z_e} - ce \quad (1.5.1) \text{ (continued)}$$

FOR π SECTION P.

$$\frac{\bar{Z}_0}{\bar{Z}_R} = e^{r} = e^{\alpha + j\beta} \Rightarrow 1 + \frac{Z_1}{2Z_0} + \frac{Z_0}{Z_2} = 1 + \frac{Z_1}{2Z_2} + \sqrt{\frac{Z_1}{Z_2} + \frac{Z_1^2}{4Z_2^2}}$$

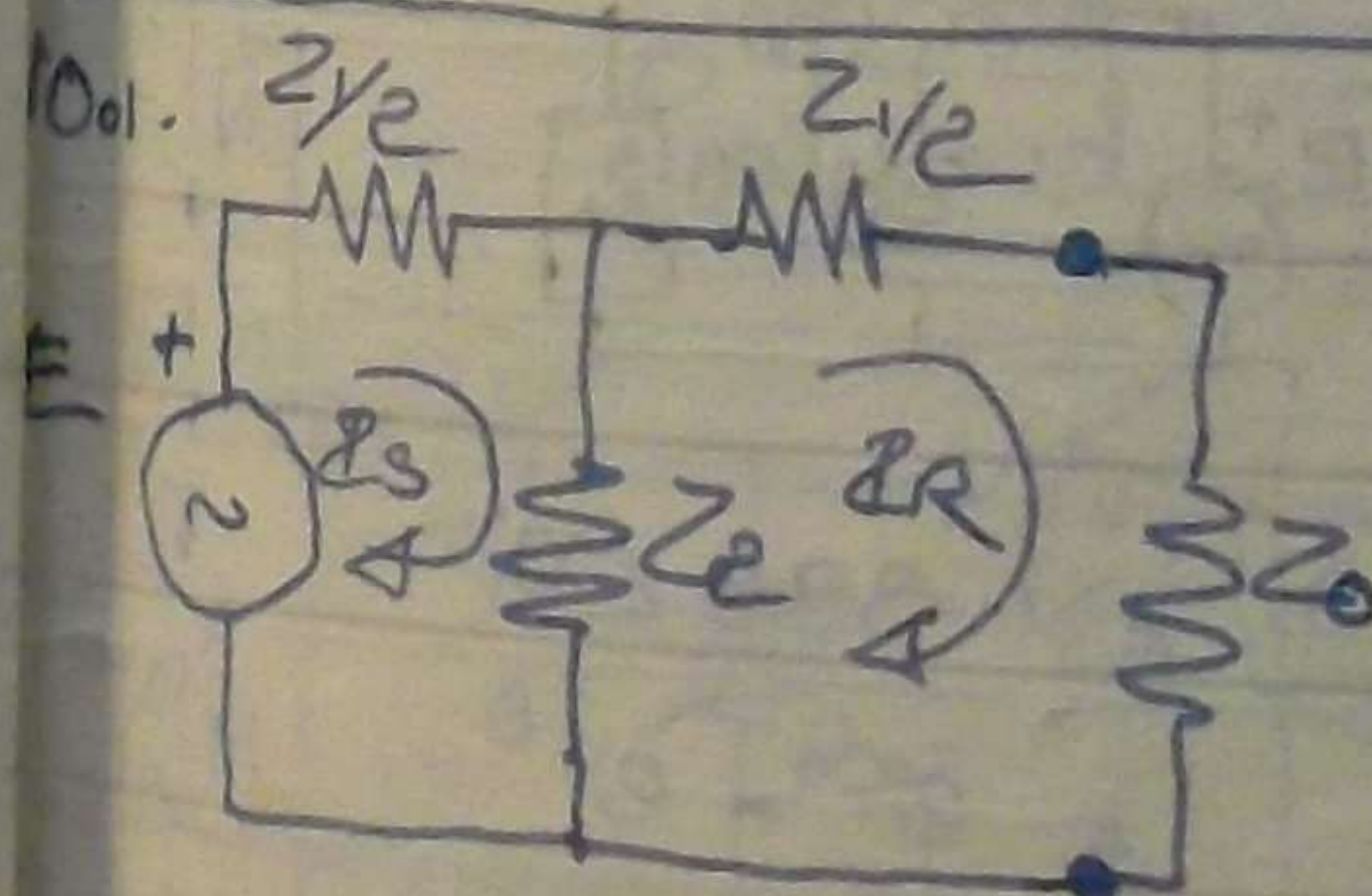
(SYMMETRICAL T. SECTION [সমমিত])

2. of phasors & L diode. $\left| \frac{I_s}{I_R} \right| \angle \phi = e^{\alpha} \times e^{j\beta}$

$$e^{j\beta} = \frac{1}{\sqrt{2}} \angle 45^\circ = \frac{1}{\sqrt{2}} \cdot \frac{\pi}{4} \text{ rad}$$

$\beta = \phi$ ← radians of arc of θ

(2 series com. impedances = 20Ω and $Z_2 = 20\Omega$ (parallel))



စက်ပြပါ T.M. 'T' SECTION တွင် $Z_E = j125 \Omega$,
 $E = 10V$ နှင့် LOAD Z_0 ရှိပြီး တွင် ဆက်သွယ်ထား။
 (က) $Z_E = -j600 \Omega$ ဖြစ်လျှင် α, β နှင့် Γ_{in} တို့ကို ရှာပါ။

Exo 9 | (2 PROBLEMS.)

(2)

(m) $Z_1 = j125 \Omega \Rightarrow Z_1 = j250 \Omega$
 $Z_2 = -j600 \Omega$ $E = 10V$

$$e^r = 1 + \frac{Z_1}{2Z_2} + \sqrt{\frac{Z_1}{Z_2} + \frac{Z_1^2}{4Z_2^2}}$$

$$= 1 + \frac{j250}{-j600} + \sqrt{\frac{-j250}{j600} + \frac{250^2}{600^2 \cdot 4}}$$

$$= 1 - 0.208 + \sqrt{-0.416 + 0.0434} = 0.792 + j\sqrt{0.3726}$$

$$= 0.792 + j0.611 = 1 \angle 37.6^\circ$$

$$e^r = e^{\alpha + j\beta} = e^\alpha \times e^{j\beta}$$

$$= 1 \angle 37.6$$

$$\therefore e^\alpha = 1 \quad \therefore \alpha = 0 \text{ Neper/section.}$$

$$\beta = 37.6 = \frac{37.6\pi}{180} = 0.656 \text{ rad/section.}$$

(a) $Z_1 = j125 \Omega$ $Z_2 = -j600 \Omega$ $E = 10V$

$$Z_1 = j250 \Omega, Z_2 = +j600 \Omega, E = 10V$$

$$e^r = 1 + \frac{j125}{j600} + \sqrt{\frac{j250}{j600} + \frac{-250^2}{600^2 \cdot 4}}$$

$$= 1 + 0.208 + \sqrt{0.416 + 0.0434}$$

$$= 1.208 + 0.678 = 1.886 \angle 0^\circ$$

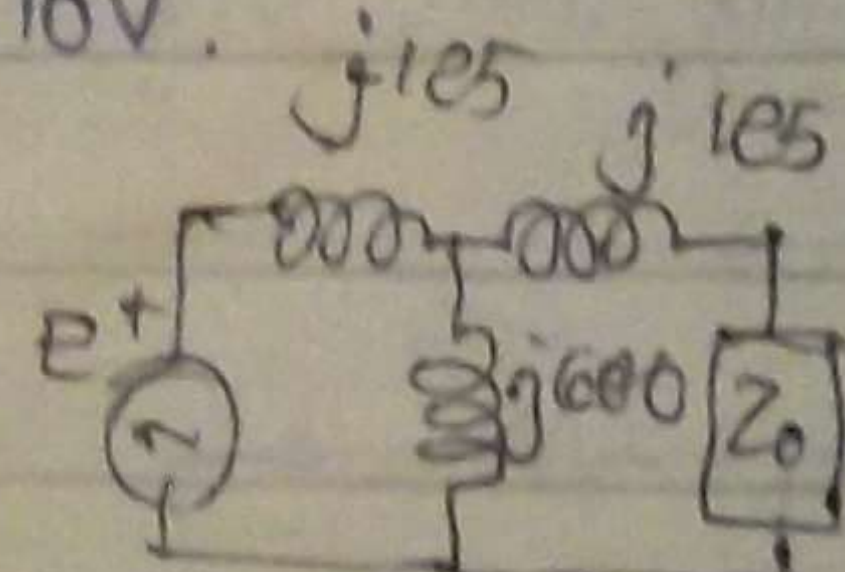
$$\therefore r = 0.630 \angle 0^\circ$$

$$\therefore \alpha = 0.630 \text{ Neper/section.}$$

$$\beta = 0 \text{ Rad/section.}$$

I know well.

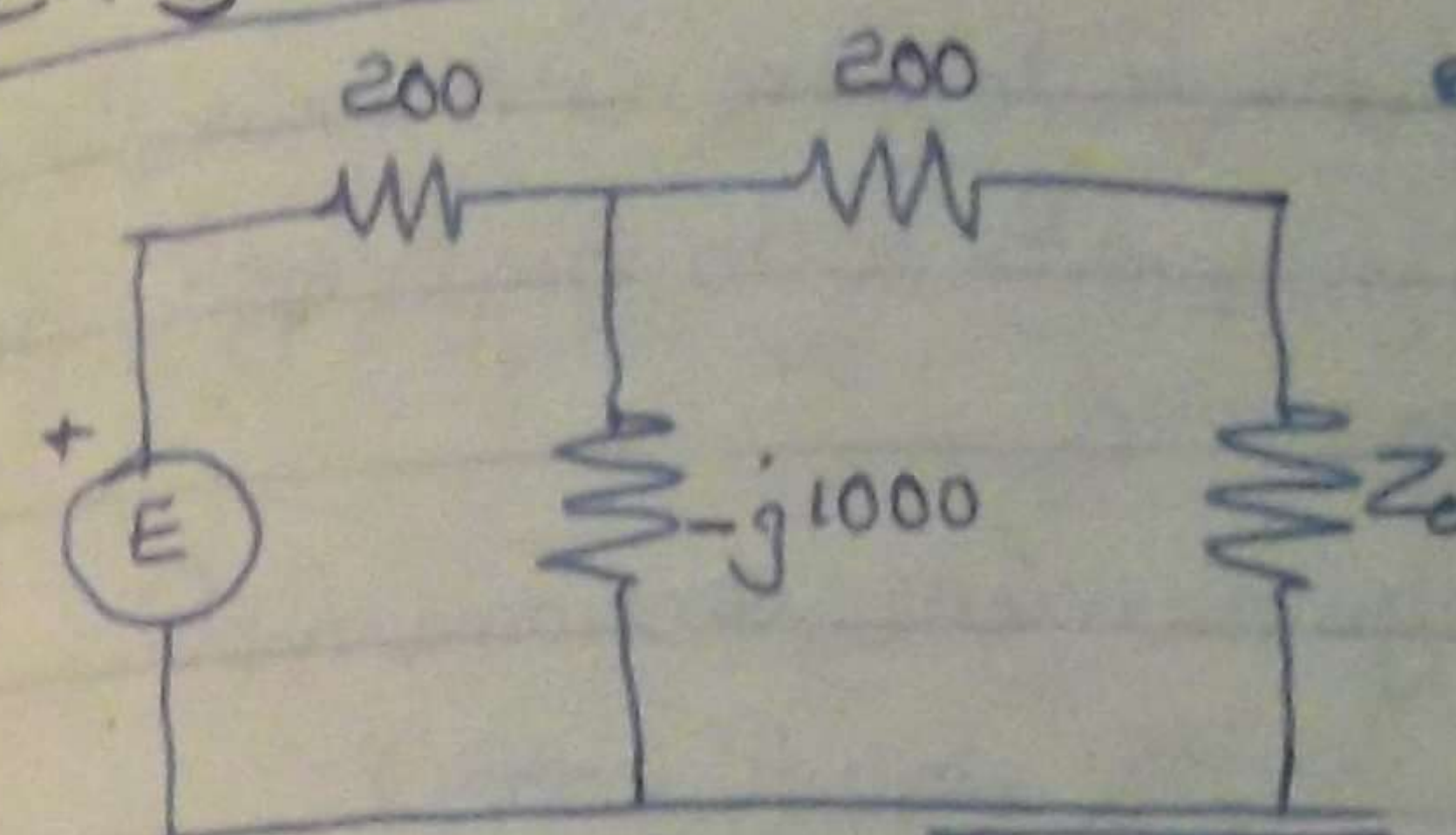
040383



$$\frac{V_2}{V_1} = \frac{Z_0}{Z_1 + Z_0}$$

EX. 9. CONT.

10.2%



output network α, β $Z_1 = 200 \Omega, Z_2 = -j1000$

sleeplessness

or go

UNDERGROUND

underground

$$\therefore e^r = 1 + \frac{Z_1}{Z_2} + \sqrt{\frac{Z_1}{Z_2} + \left(\frac{Z_1}{Z_2}\right)^2}$$

$$= 1 + \frac{200}{-j1000} + \sqrt{\frac{-400}{j1000} + \left(\frac{200}{-j1000}\right)^2}$$

$$= 1 + j0.2 + \sqrt{j0.4 - 0.04}$$

$$= 1 + j0.2 + \sqrt{-0.04 + j0.4}$$

$$= 1 + j0.2 + \sqrt{0.4 \angle 96.73^\circ}$$

$$= 1 + j0.2 + 0.632 \angle 47.865^\circ$$

$$= 1 + j0.2 + 0.424 + j0.469$$

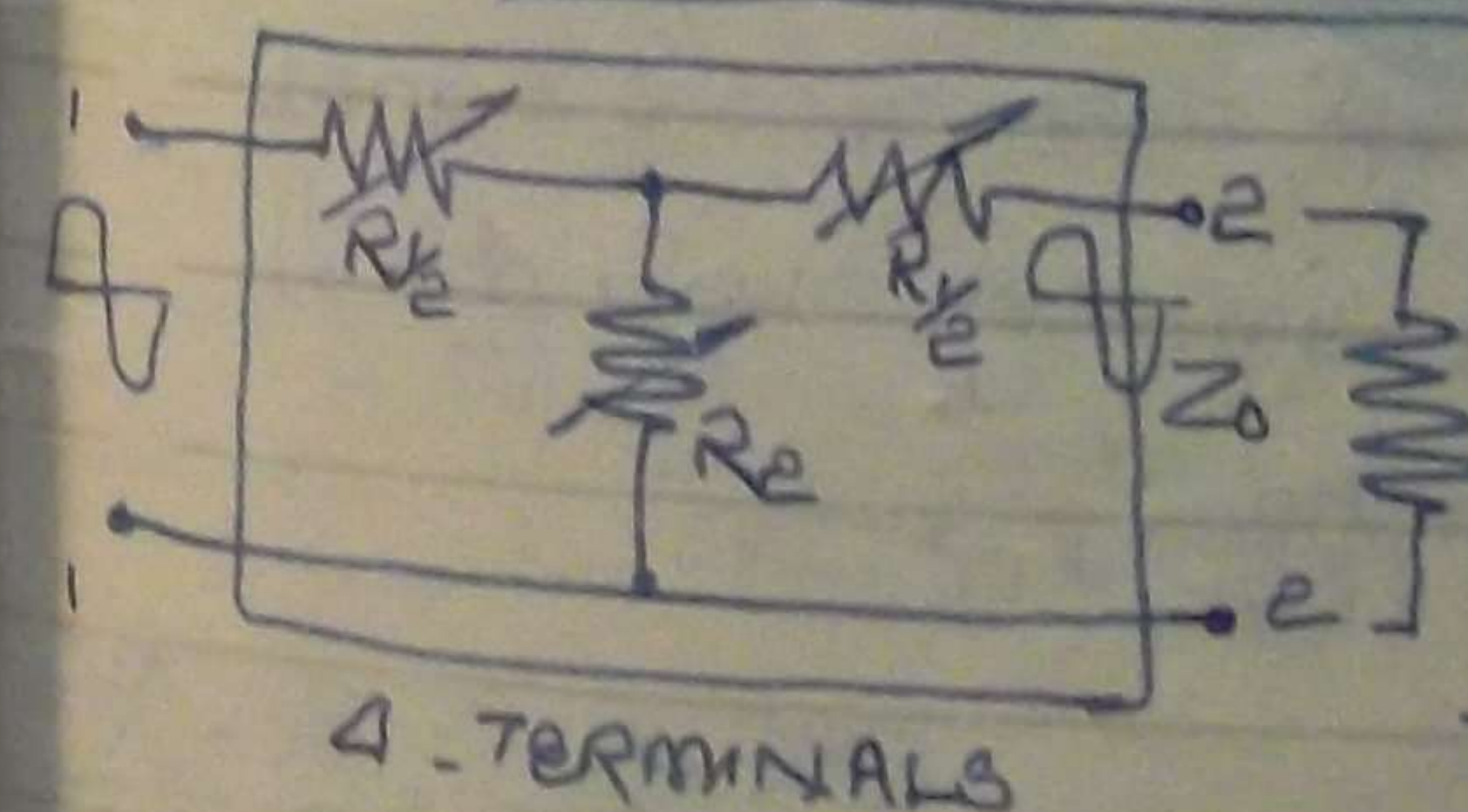
$$= 1.424 + j0.669 = 1.579 \angle 25.17^\circ = e^\alpha \times e^{j\beta}$$

$$\therefore \alpha = 0.454 \text{ Np/s, } \beta = \frac{25.17}{57.3} = 0.439 \text{ rad/section.}$$

$$\therefore r = \alpha + j\beta = 0.454 + j0.439$$

Pad and Attenuator

16-17.2.83.



output of voltage across Z_0

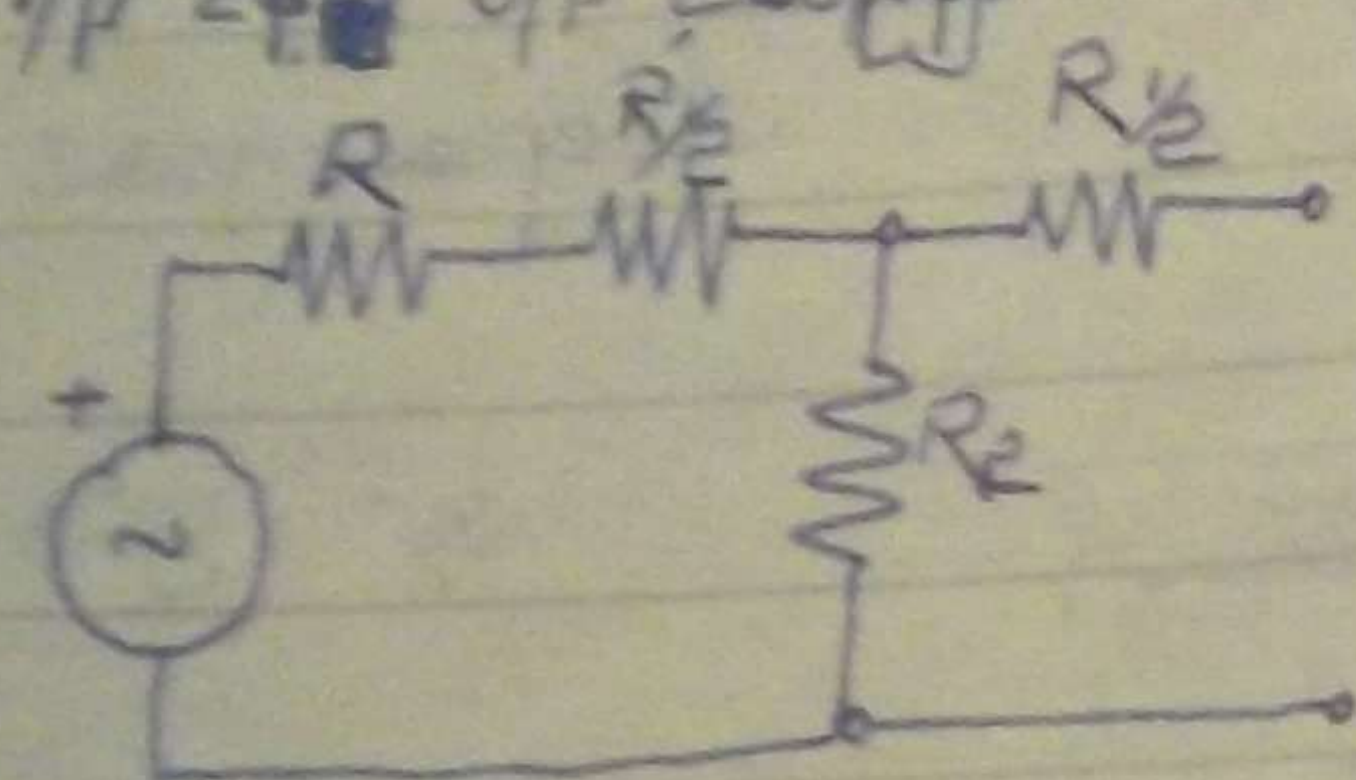
wave form preserved

distortionless output

o/p Z_0 & load Z match

i/p Z_0 & o/p Z_0 match

လုံဆဲသော attenuation ကိုရရှိရမည်။ Pad ထဲမှာ resistor တွေပါသင့်သည်။
 Attenuation db သည် လည်။ fixed ဖြစ်နေရမည်။ (db ကိုလည်း ရှိပြီး လိုရတယ်။
 Z ကိုလည်း ရှိပြီး လိုရတယ်။) + for PAD.
 i/p Z နှင့် o/p Z ဆိုရာမှာ un-symmetrical section သုံးနိုင်၏။
 (ဆင်ညှိပါအပ်၏)



ဆက်သွယ်ရန်အတွက် တွင် ဆက်သွယ်ရန်အတွက် signal strength ကို ရှေးဦးစွာ လိုဆဲသောထုတ်။

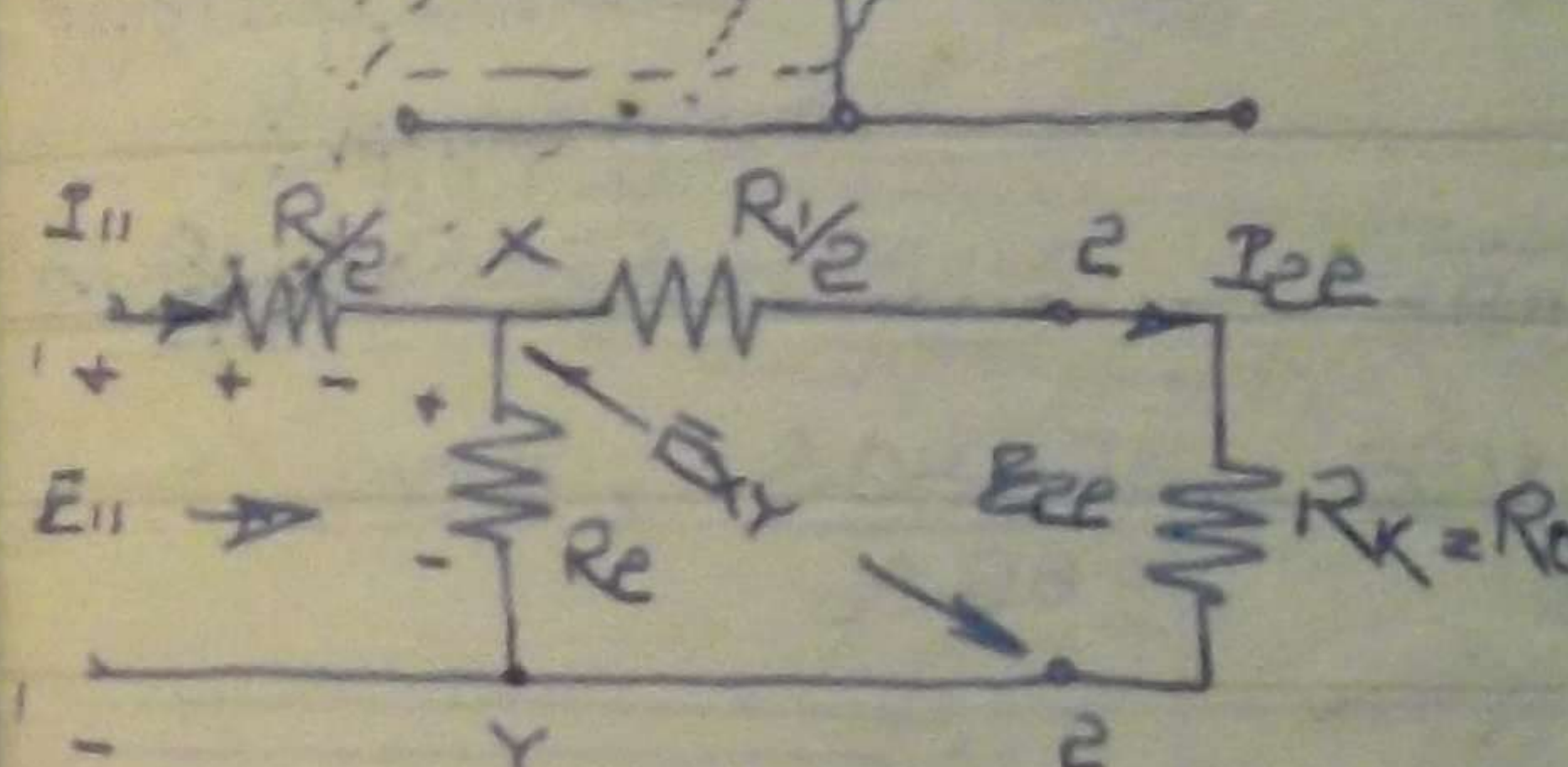
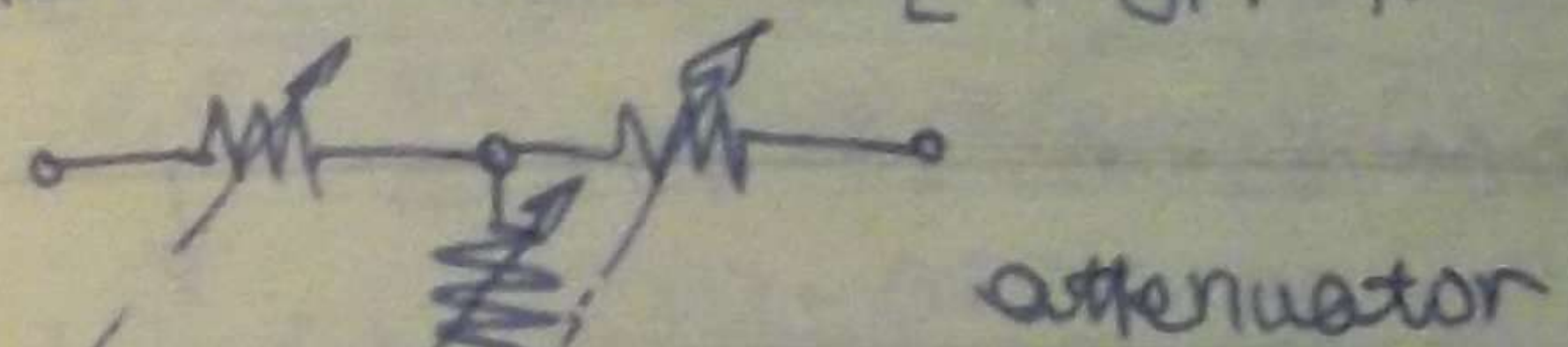
- (1) maximum power ရရှိရန် impedance matching ချက်ချင်း။
- (2) distortion မရှိစေရန် နှလုံးသွေး wave form ကို တွင် ရှိစေရန်။
- (3) လိုဆဲသော signal strength ထပ် attenuate ဖြစ်ရန် တွင် ရှိစေရန်။

PAD :- Pure resistance ဖြစ်တည်ဆောက်ထားသော 4 terminal passive network တစ်ခုဖြစ်သည်။ signal strength ကို လိုဆဲသော level ကို ရှေးဦးစွာ ရှိစေရန်။ Impedance matching ချက်ချင်းဖြစ်ပြီး resistive network ဖြစ်သောကြောင့် frequency independence ဖြစ်သည်။ Telephone line သည် ဆိုင်းအားစာရင်းပြုစုရန် အသုံးပြုရသော signal လိုဆဲသောအားဖြင့် နှိုင်းသော line မှတစ်ဆင့် signal ပြုစုရမည်။ ထို့အပြင် pad or attenuator ဖြင့် signal ကို ရှေးဦးစွာ လိုဆဲသောထုတ်။

$$\frac{2R_k - R_1}{2R_k + R_1} = \frac{R_k - R_1/2}{R_k + R_1/2}$$

ATTENUATOR :- Pad ကိုသုံးပြီး resistive network ဖြစ်တည်ဆောက်ရမည်။ နှစ်ခုစီစီသော component တွေကို လိုဆဲသောထုတ် adjust လုပ်ရမည်။ Attenuation နှင့် Characteristic Impedance ကိုလည်း လိုဆဲသောထုတ် တွင် ရှိစေရန်။ Component တွေကို adjust လုပ်ရန် ganged system ခုံးသုံးပြီး တွင် ပြုစုရမည်။

Pad နှင့် attenuator တွေ ပြုလုပ်ရန် symmetrical T နှင့် un-symmetrical T သို့မဟုတ် L section တွေကို ရှိစေရန်။ Symmetrical T section ကို i/p နှင့် o/p Z တွင် ရှိစေရန်။ un-symmetrical T section ကို i/p နှင့် o/p Z တွင် ရှိစေရန်။



$$I_{11} = \frac{E_{11}}{R_{11}}, Z_{11} = R_k$$

$$\therefore I_{11} = \frac{E_{11}}{R_k}$$

$$E_{xy} = E_{11} - I_{11} \times \frac{R_1}{2}$$

$$E_{xy} = E_{11} - \frac{E_{11}}{R_k} \cdot \frac{R_1}{2}$$

$$I_{22} = \frac{E_{xy}}{R_1/2 + R_k}$$

$$= \frac{E_{11} (1 - \frac{R_1}{2R_k})}{R_k + \frac{R_1}{2}}$$

$$= E_{11} \cdot \frac{(R_k - R_1/2)}{R_k(R_k + R_1/2)}$$

$$\therefore \frac{E_{11}}{E_{22}} = \frac{R_k + R_1/2}{R_k - R_1/2}$$

$$E_{22} = I_{22} \times R_k$$

$$= \frac{E_{11} (R_k - R_1/2)}{R_k + R_1/2}$$

$$\Rightarrow R_k \cdot R_0 = \sqrt{R_1 R_2 + \frac{R_1^2}{4}}$$

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EX. 9 CONT.

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No. 3. 600 Ω line 1db, 10db, 20db attenuation
symmetrical T pad design.

(a) 1db. $20 \log \frac{E_1}{E_2} = 1$

$$\frac{E_1}{E_2} = 10^{0.05} = 1.122$$

$$\frac{600 + R_{1/2}}{600 - R_{1/2}} = 1.122$$

Compo & Divi $\Rightarrow \frac{600}{R_{1/2}} = \frac{2.122}{0.122}$

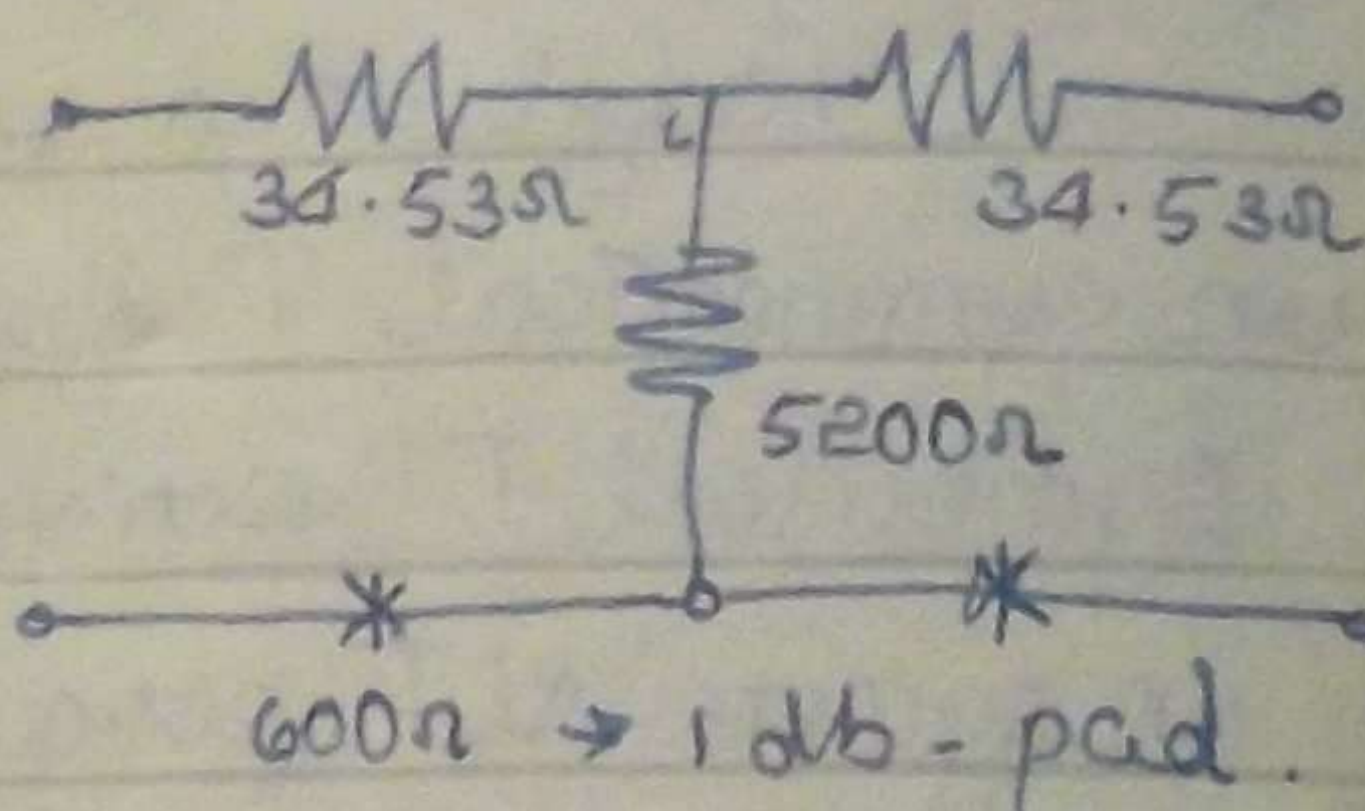
$$\therefore R_{1/2} = 0.05755 \times 600 = 34.53 \Omega$$

$$R_k = \sqrt{R_1 R_2 + \frac{R_1^2}{4}}$$

$$600 = \sqrt{69.06 R_2 + 1192}$$

$$\therefore R_2 = \frac{360000 - 1192}{69.06} = \frac{358808}{69.06} = 5200 \Omega$$

1 db. pad req:



balanced
star & series
connection

(b) 10db $20 \log \frac{E_1}{E_2}$

$$10 = 20 \log \frac{E_1}{E_2}$$

$$3.162 = \frac{E_1}{E_2}$$

$$3.162 = \frac{R_k + R_{1/2}}{R_k - R_{1/2}}$$

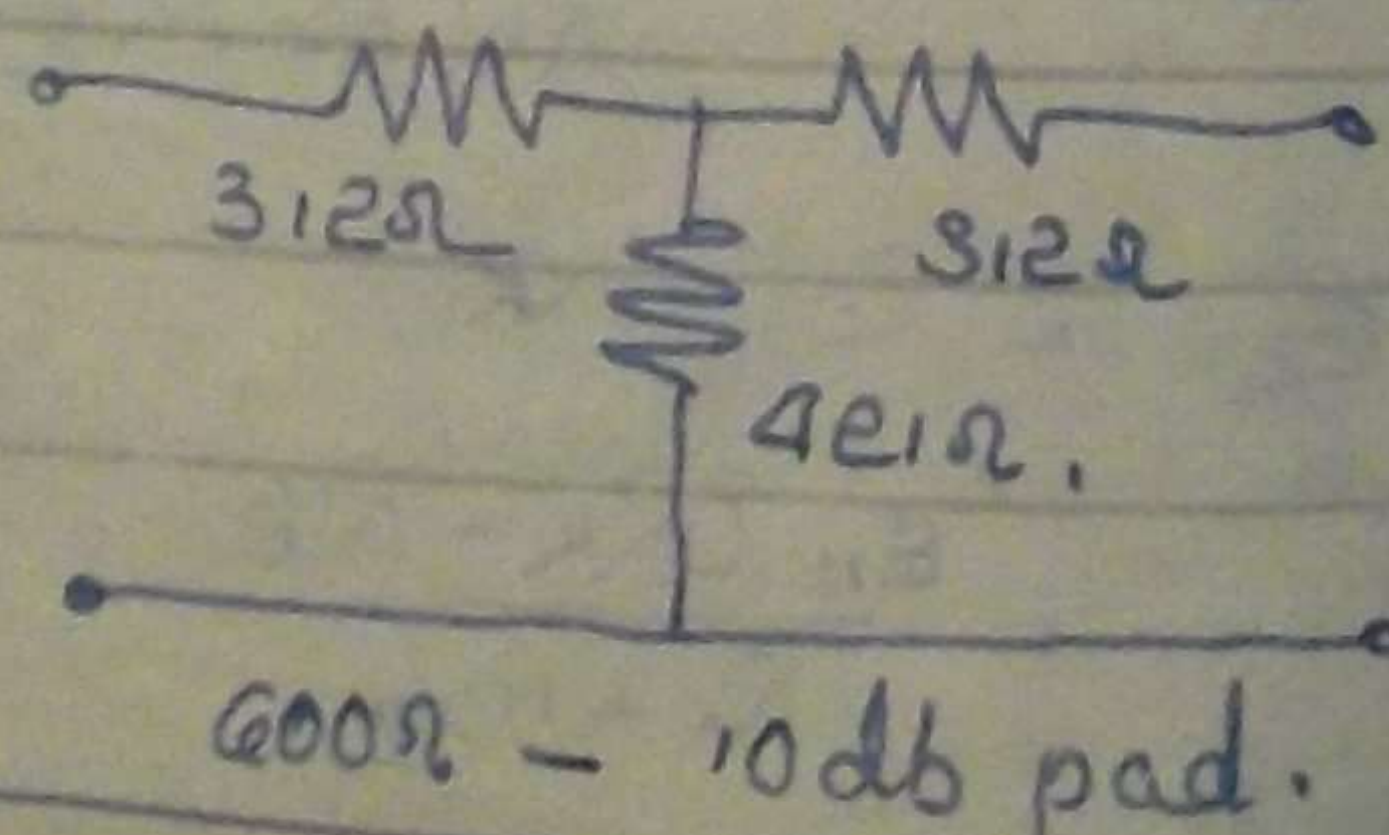
$$\frac{4.162}{2.162} = \frac{R_k}{R_{1/2}}$$

$$\therefore R_{1/2} = 600 \times \frac{2.162}{4.162} = 312 \Omega$$

$$600 = \sqrt{624 R_2 + 97400}$$

$$\therefore R_2 = \frac{360000 - 97400}{624} = \frac{262600}{624} = 421 \Omega$$

10 db. pad requested



600 Ω - 10db pad.

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4/ 600 Ω line တွင် 20db T section attenuator တည်ဆောက်ရန် $R_1 = 400 \Omega$ ဖြစ်သော R_2 တန်ဖိုးကို ရှာပါ။ ထို attenuator ၏ attenuation ကို db ဖြင့် ပြပါ။ (ဆက်တိုက် ပြုပြင်ပါ) $R_1 = 400 \Omega$ ဖြစ်သော db မှန်ပြန်ပါ။

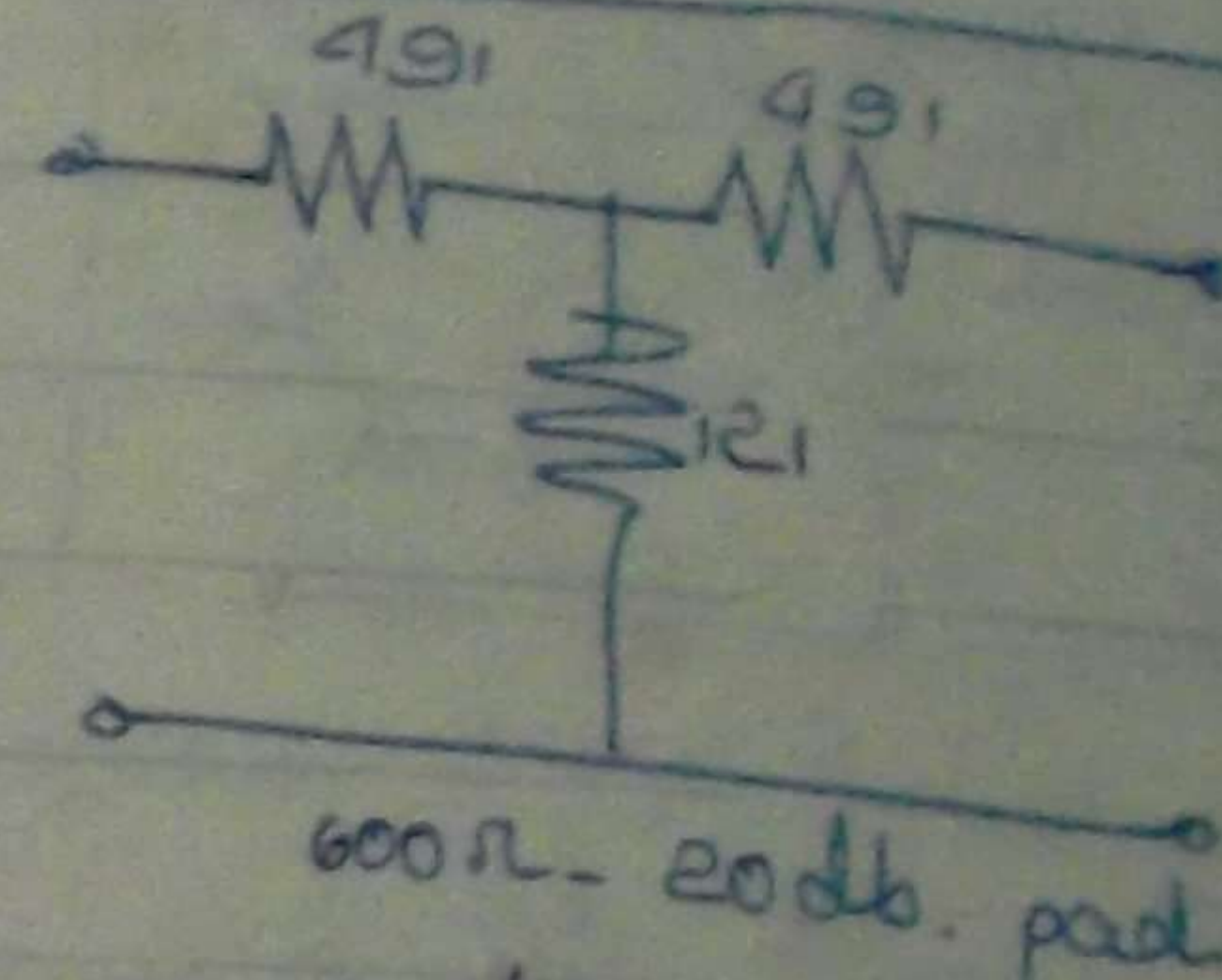
(c) 20 db $20 \log \frac{E_1}{E_2}$

$$10 = \frac{E_1}{E_2} \text{ (တစ်ခွဲလျှော့သော်)}$$

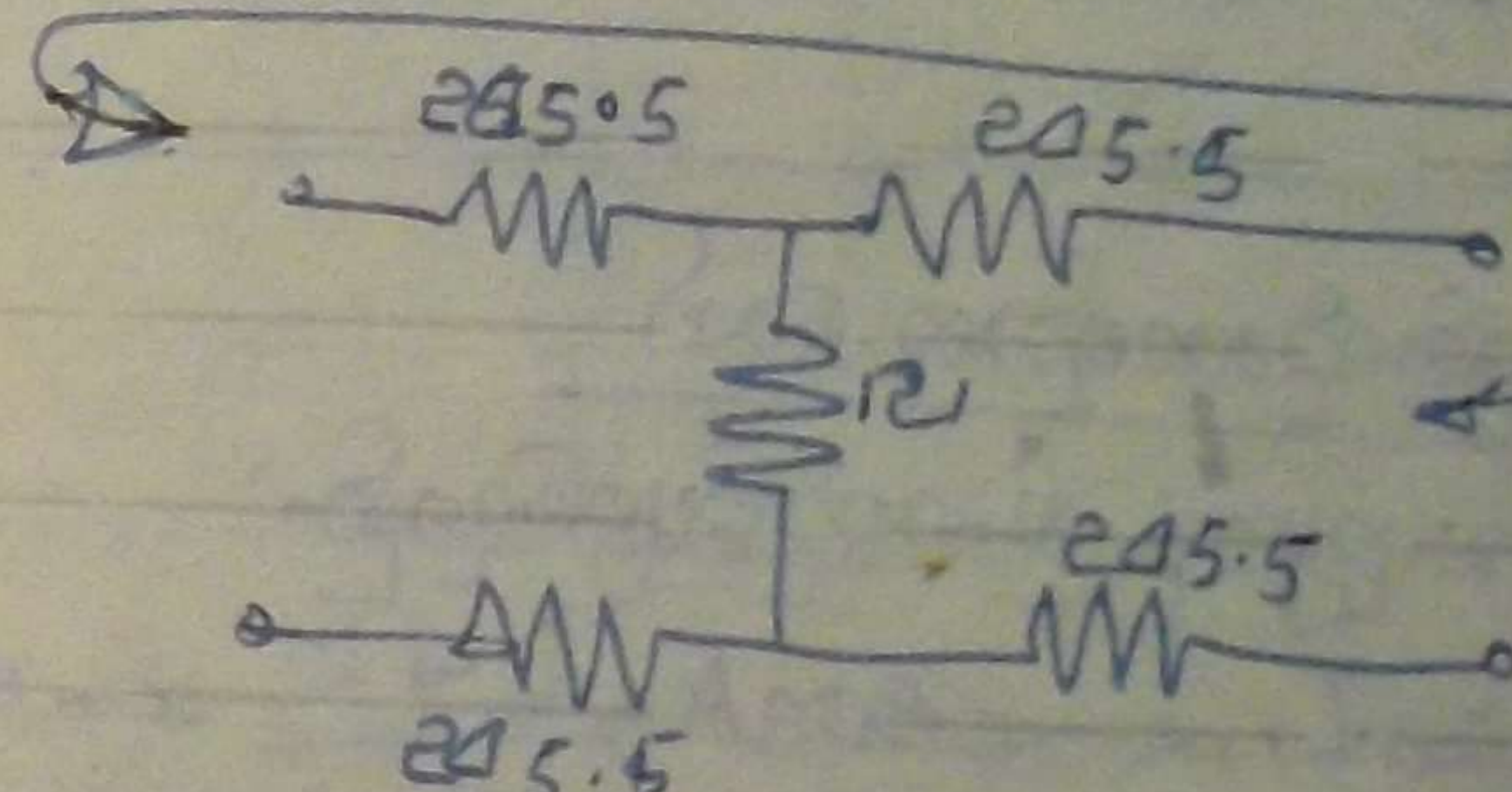
$$\therefore \frac{11}{9} = \frac{600}{R_{1/2}} \Rightarrow R_{1/2} = 491 \Omega$$

$$\therefore R_k = \sqrt{R_1 R_2 + \frac{R_1^2}{4}} = \sqrt{9820 R_2 + 241000}$$

$$\therefore R_2 = \frac{360000 - 241000}{9820} = \frac{119000}{9820} = 121.2 \Omega$$



unbalanced T section



balanced T section.

4/ $R_k = R_0 = 600 \Omega$ $R_1 = 400 \Omega$ $\therefore R_{1/2} = 20 \Omega$

$$R_2 = ? \quad R_k = \sqrt{R_1 R_2 + \frac{R_1^2}{4}}$$

$$600 = \sqrt{400 R_2 + 400} \Rightarrow R_2 = \frac{359600}{400} = 8990 \Omega$$

$$\therefore \text{db} = 20 \log \frac{E_1}{E_2} = 20 \log \frac{R_k + R_{1/2}}{R_k - R_{1/2}} = 20 \log \frac{620}{580}$$

$$= 20 \times 0.0235 = 0.57 \text{ db}$$

$$R_1 = 400 \Omega \text{ ဖြစ်သော db} = 20 \log \frac{600}{400} = 6.02 \text{ db}$$

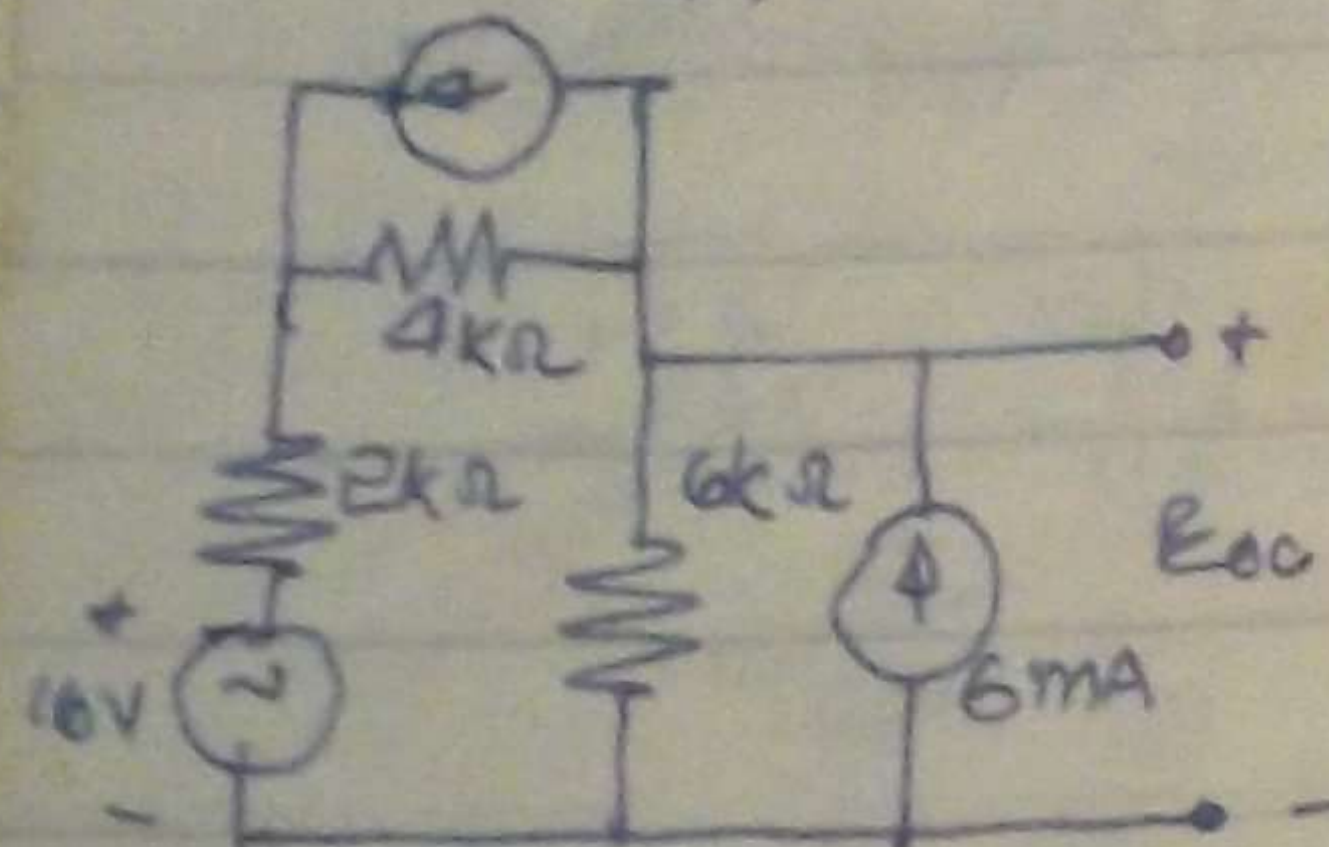
AM

23.2.23.

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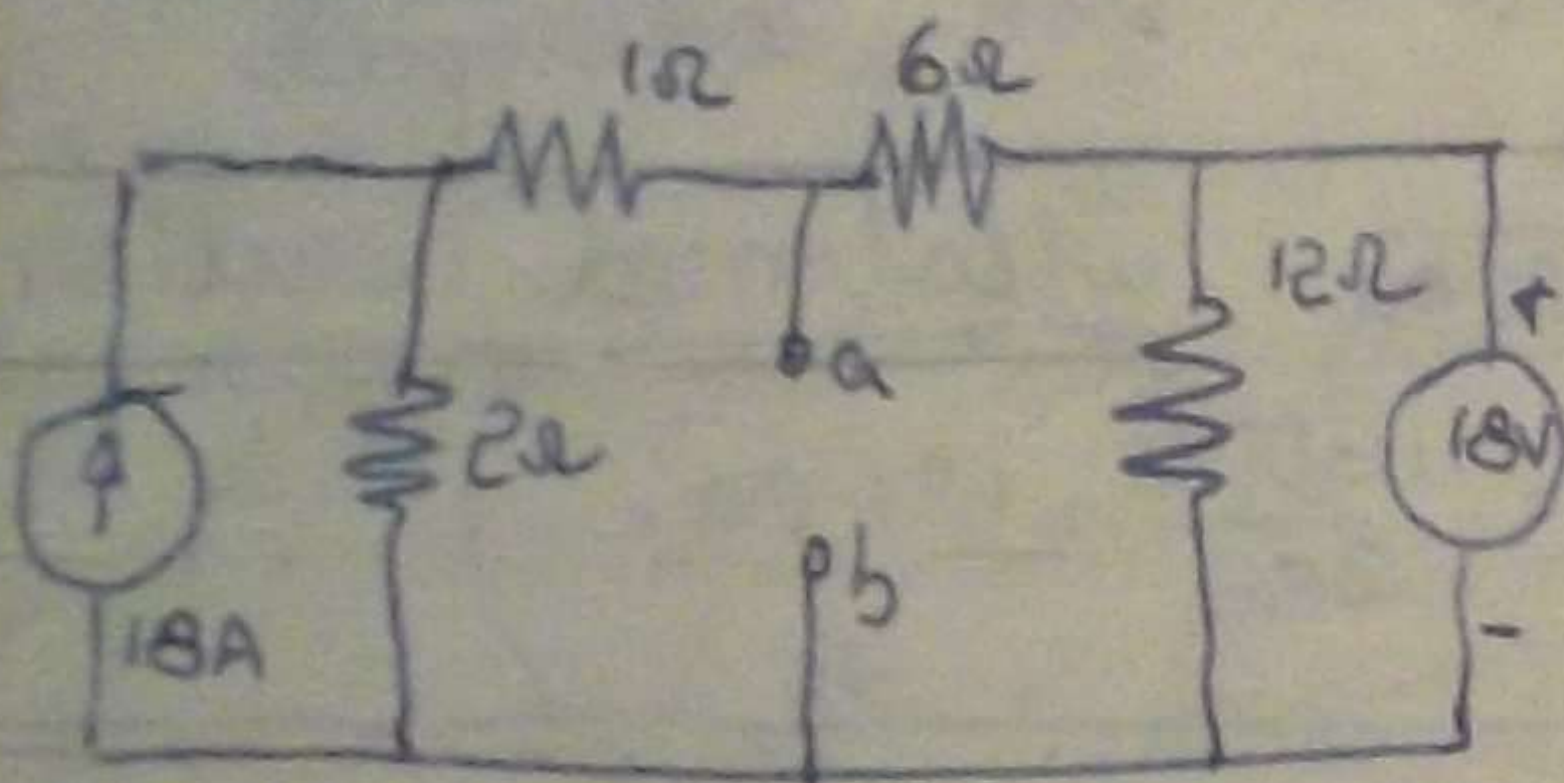
Ex 10

1. Use superposition method to find the open circuit voltage E_{oc} in the circuit.



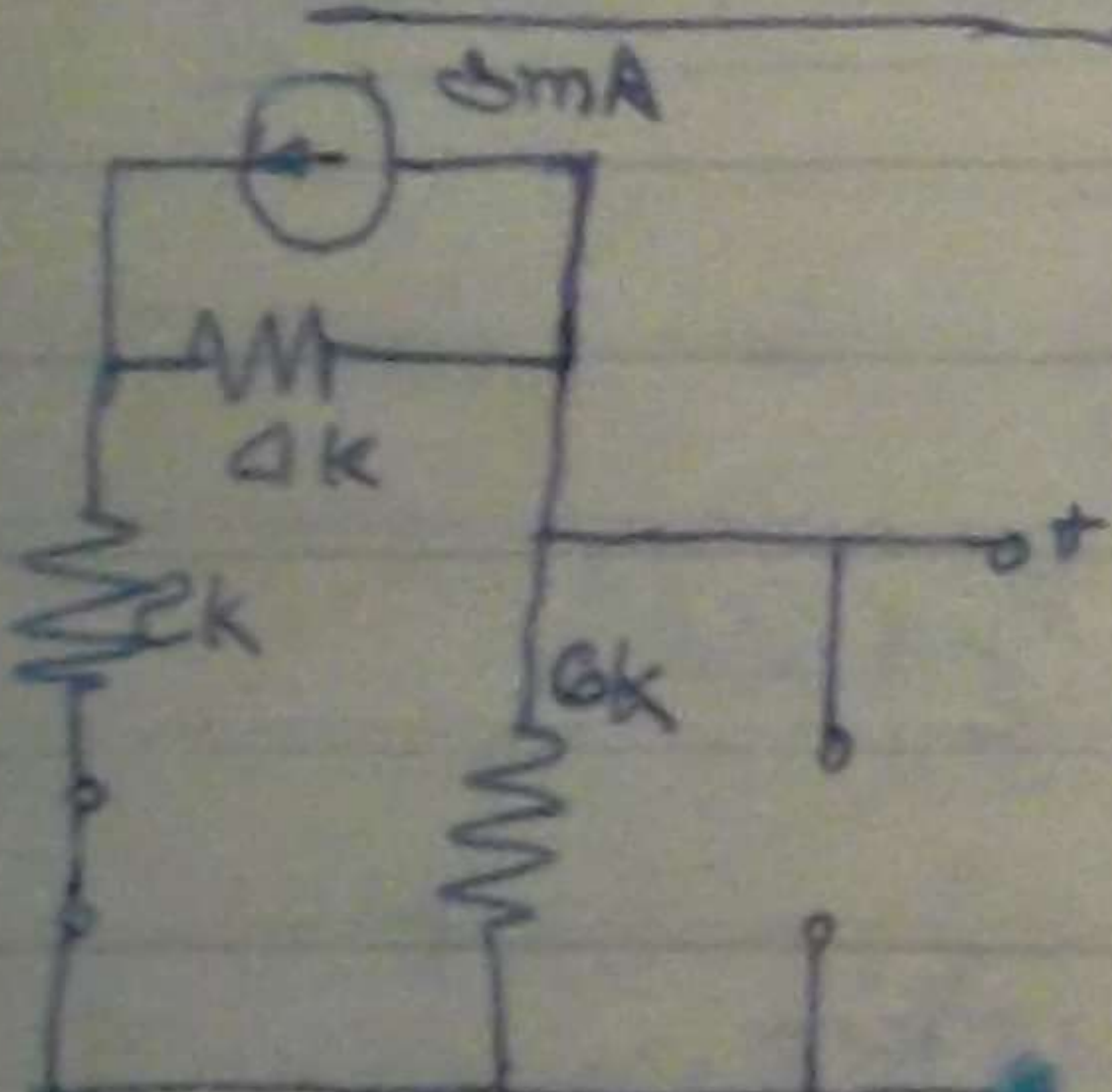
2(a) Find the Norton's Equivalent of the circuit shown in figure.

(b) Next, find the maximum power that could be drawn from terminals a, b if a variable resistor R were connected between them.



$$I = \frac{16V}{2k\Omega + 4k\Omega} = 0.00267A = 2.67mA$$

1. 3mA source

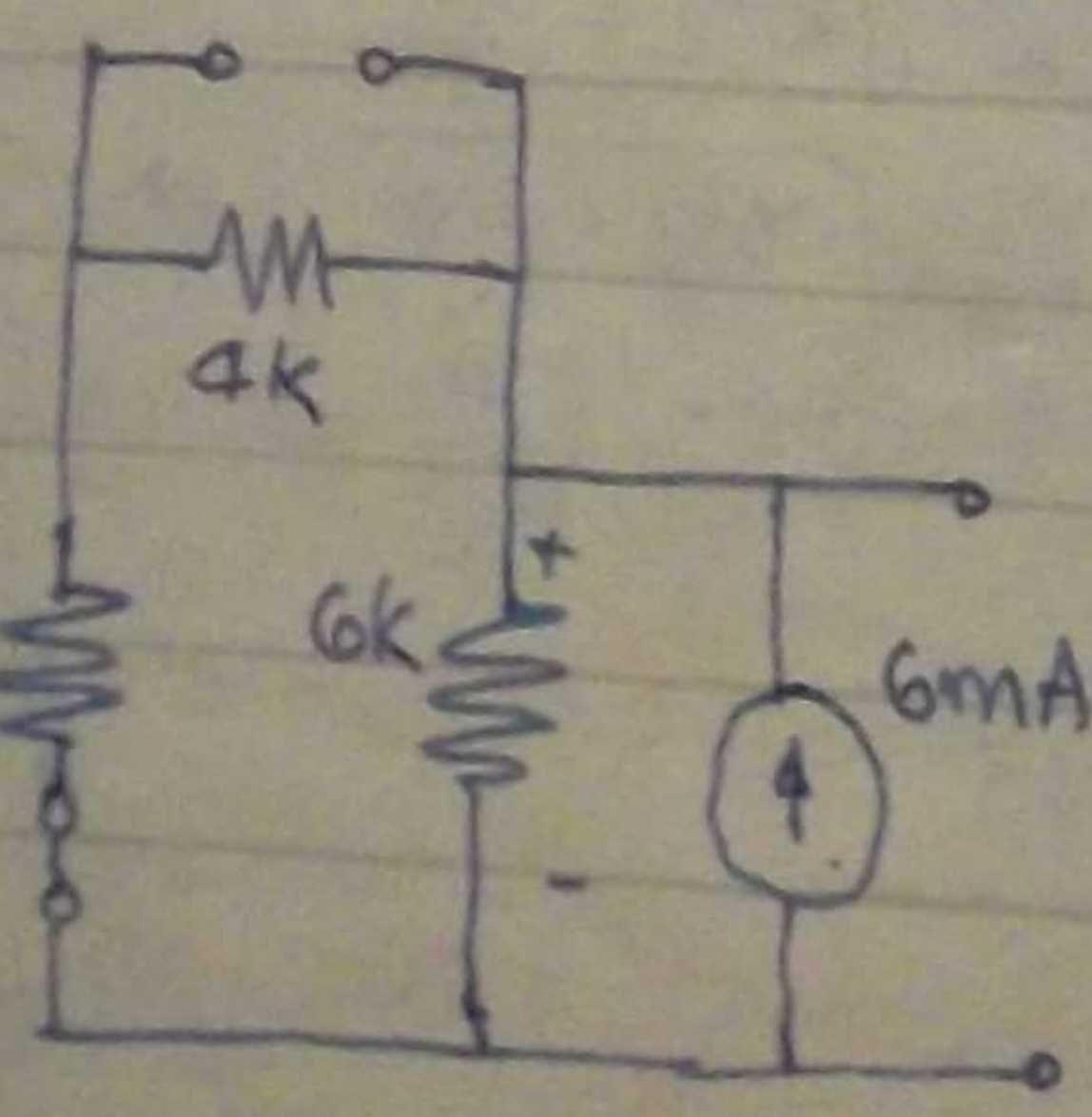


(Note: current is in the direction of the arrow)

$$I_1 = 3mA \times \frac{4k\Omega}{4k\Omega + 2k\Omega} = 2.067mA$$

$$= -\frac{8}{3}mA \quad (1)$$

6mA source



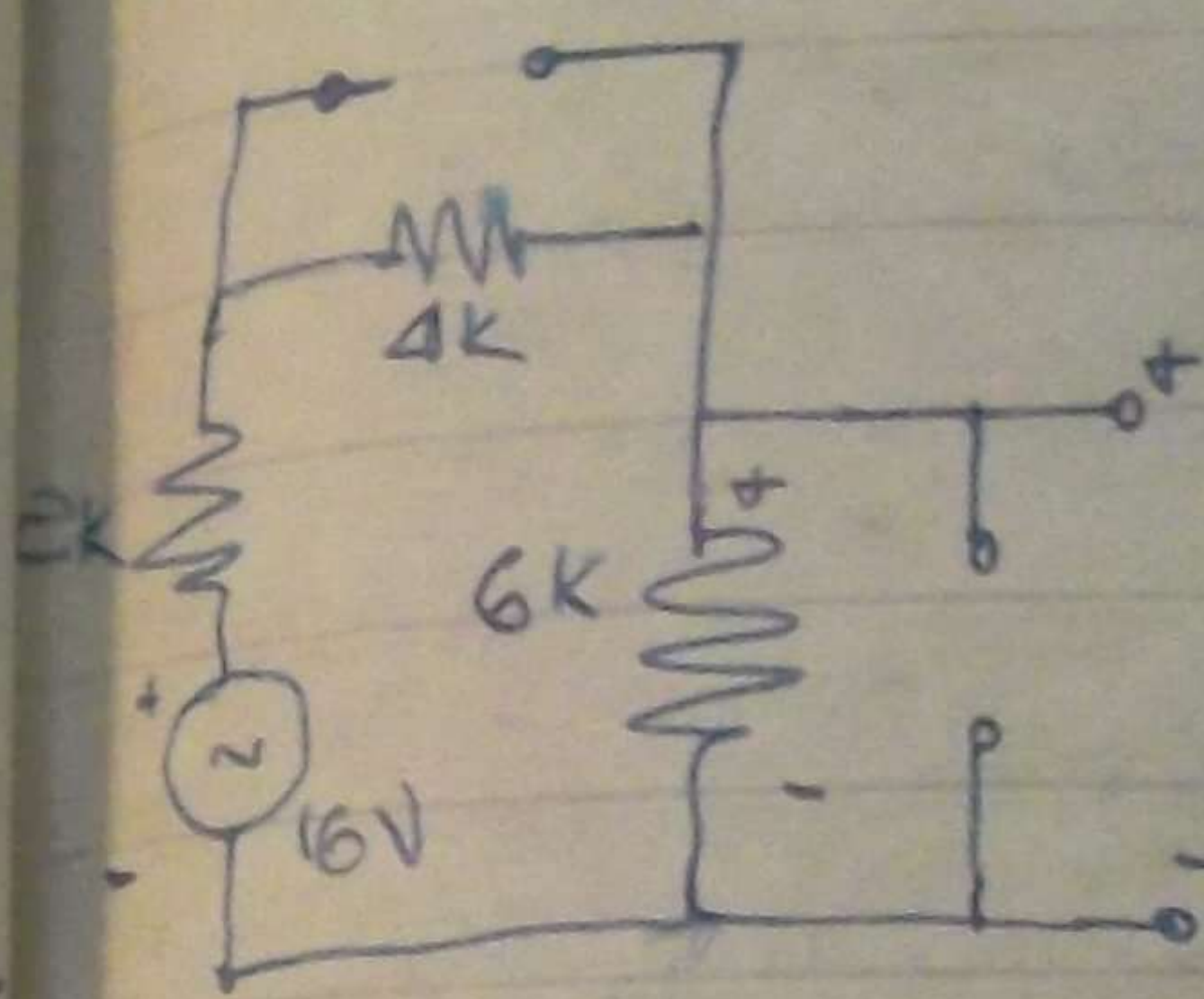
$$I_2 = 6mA \times \frac{2k\Omega + 4k\Omega}{6k\Omega + 2k\Omega + 4k\Omega} = 3mA$$

(2)

$$I_{oc} = -\frac{8}{3} + 3 + \frac{4}{3} = 1\frac{2}{3} = 1.667mA$$

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16V voltage source



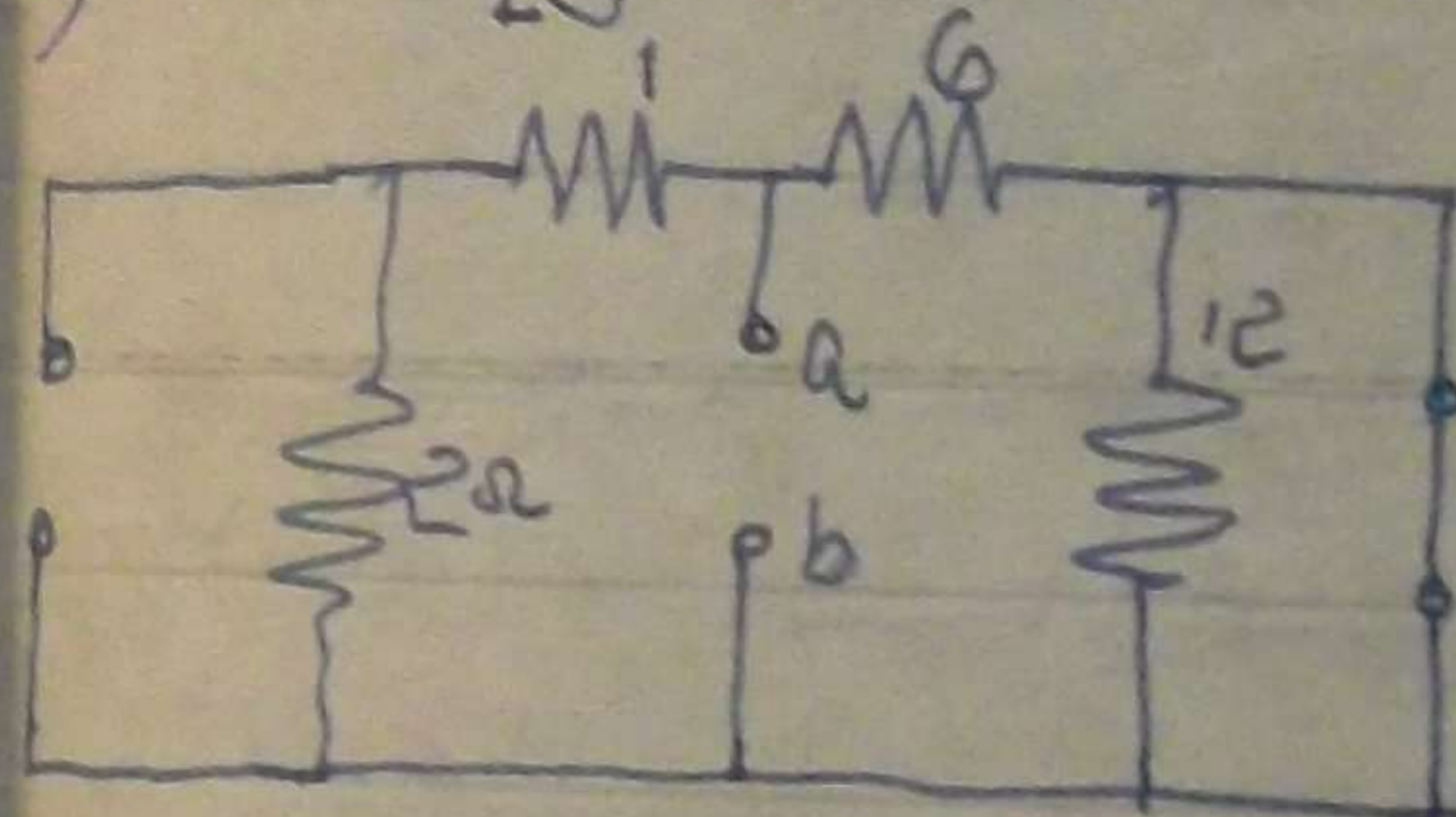
$$I_3 = \frac{16V}{(2k\Omega + 4k\Omega) \parallel 6k\Omega} = 1.33mA$$

$$Ans: I_{oc} = -2.67 + 3 + 1.33 = 1.667mA = \frac{5}{3}mA$$

$$E_{oc} = I_{oc} \times R = 1.667 \times 10^{-3} \times 6 \times 10^3 = 9.96V \approx 10V$$

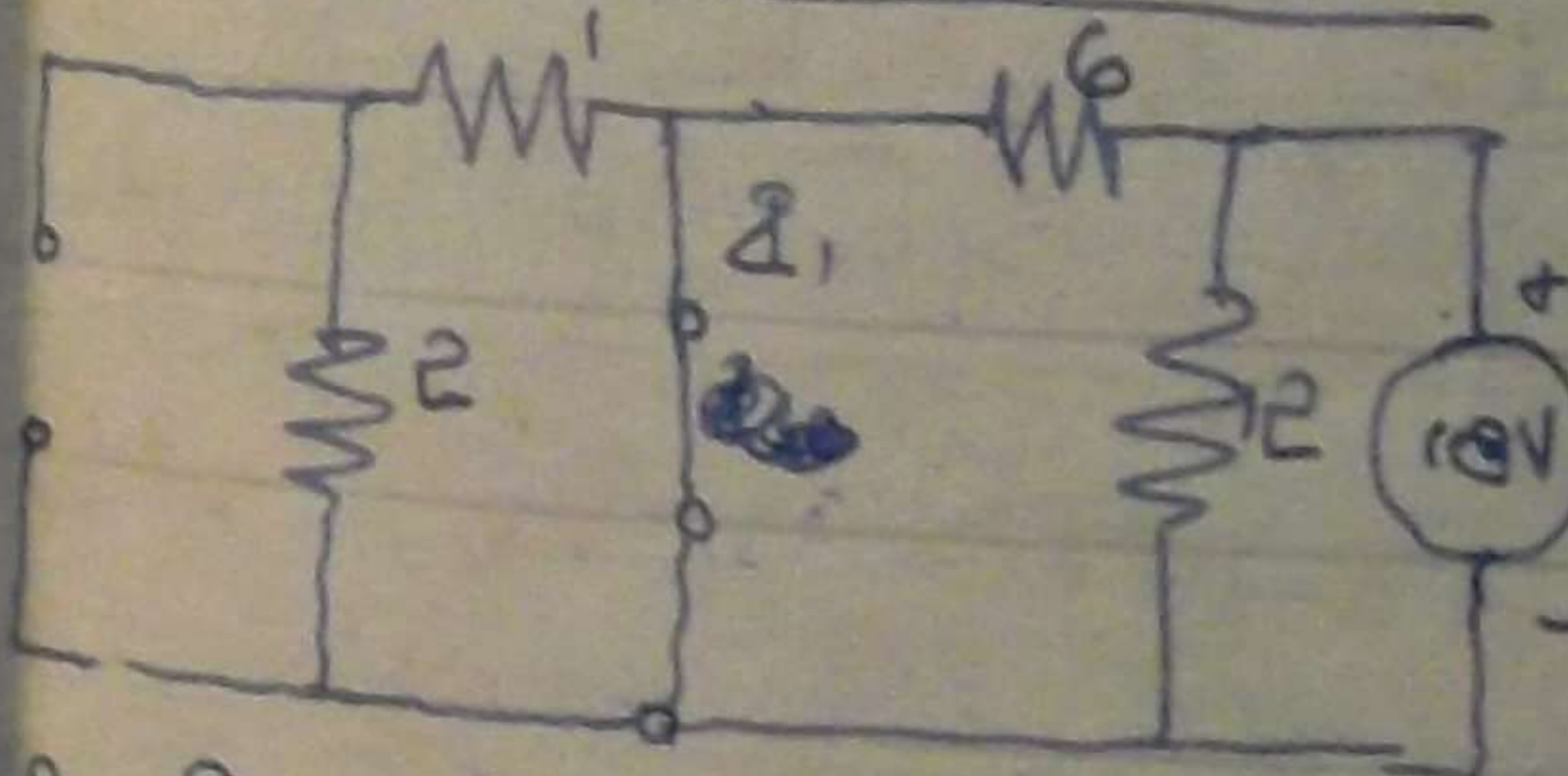
(10V source)

(a) Norton's



$$I_0 = \frac{(2+1)6}{(2+1)+6} = \frac{18}{9} = 2A$$

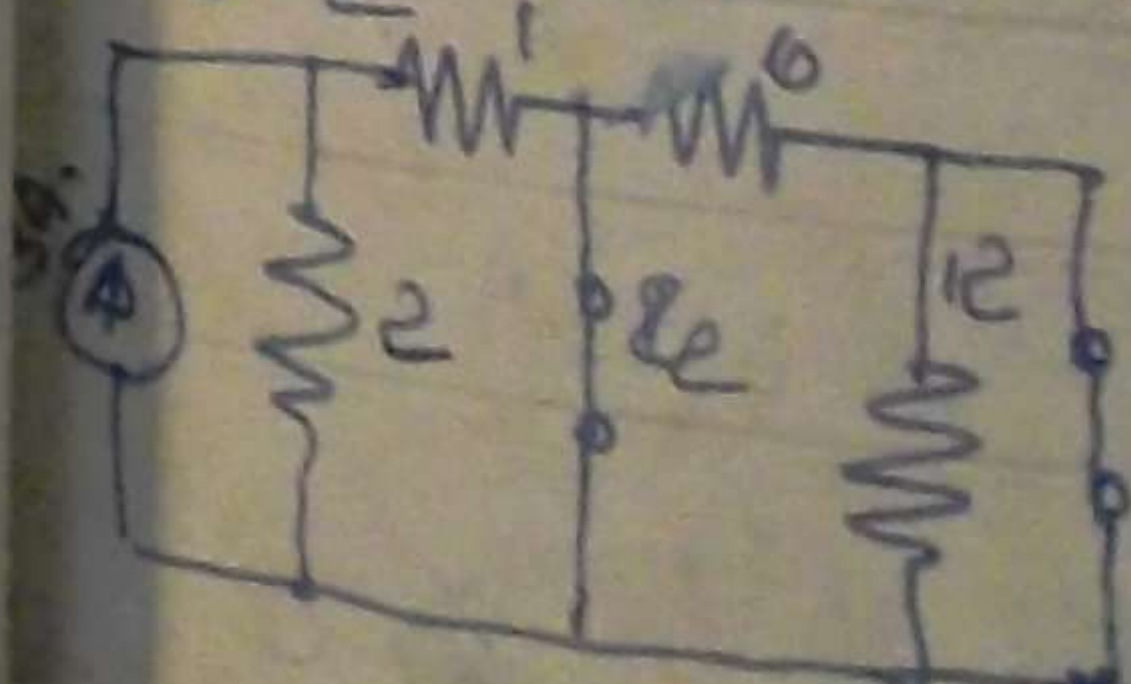
2. Norton's a and b short circuit



$$I_1 = 12V / 6\Omega = 2A$$

$$I_2 = 2A \times \frac{12\Omega}{12\Omega + 2\Omega} = 1.5A$$

3. Norton's

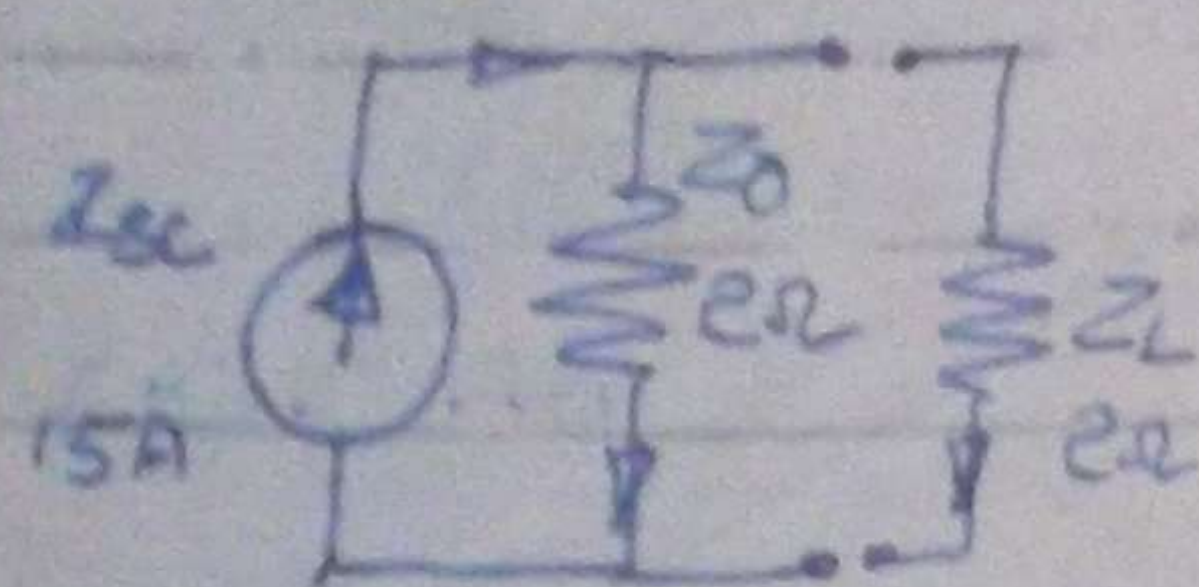


$$I_2 = 12A \times \frac{2}{1+2} = 8A$$

$$I_{oc} = I_1 + I_2 = 15A$$

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Norton's Eq. Ckt.



$$Z_L = Z_0 = 20 \Omega$$

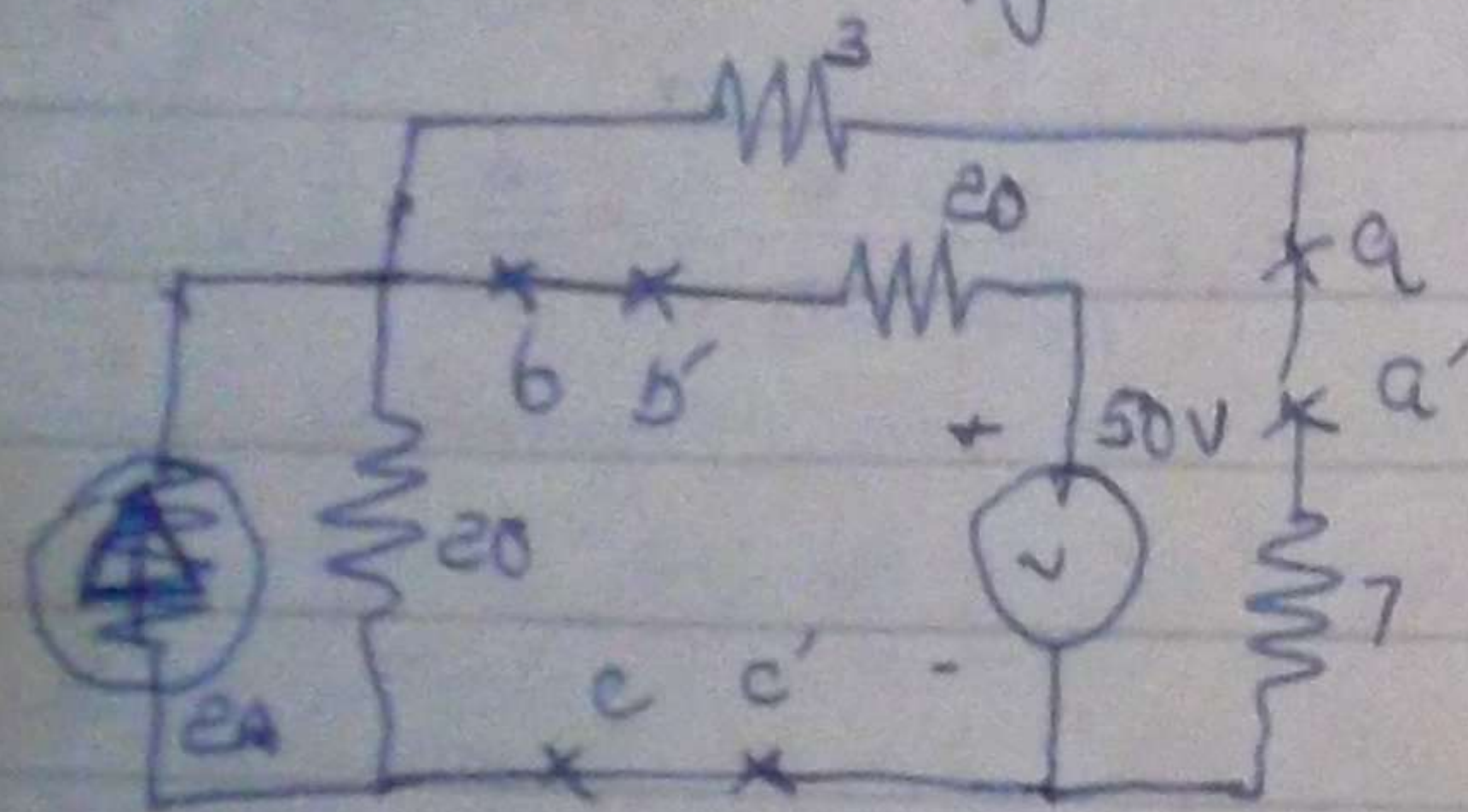
$$I_L = I_{sc} \times \frac{Z_0}{Z_0 + Z_L} = 15 \times \frac{20}{20 + 20}$$

$$= 7.5 A$$

✓ (b) $\therefore$ Max. Power = $I_L^2 \times Z_L$

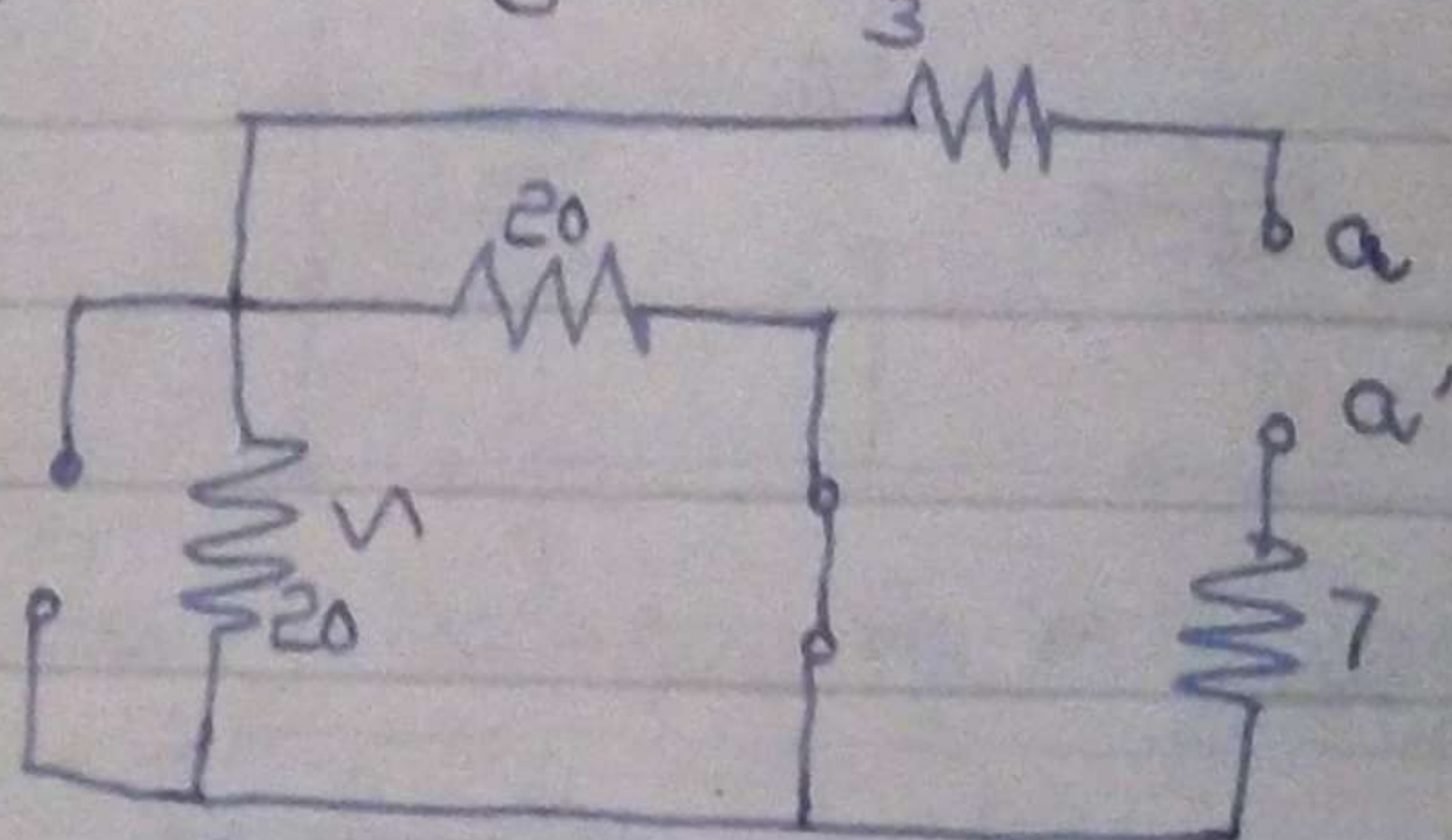
$$= 7.5^2 \times 20 = 112.5 W$$

Q. Draw the Thevenin's Equivalent Circuit obtained when the network shown in figure is broken at (a) aa', (b) bb', (c) cc'.

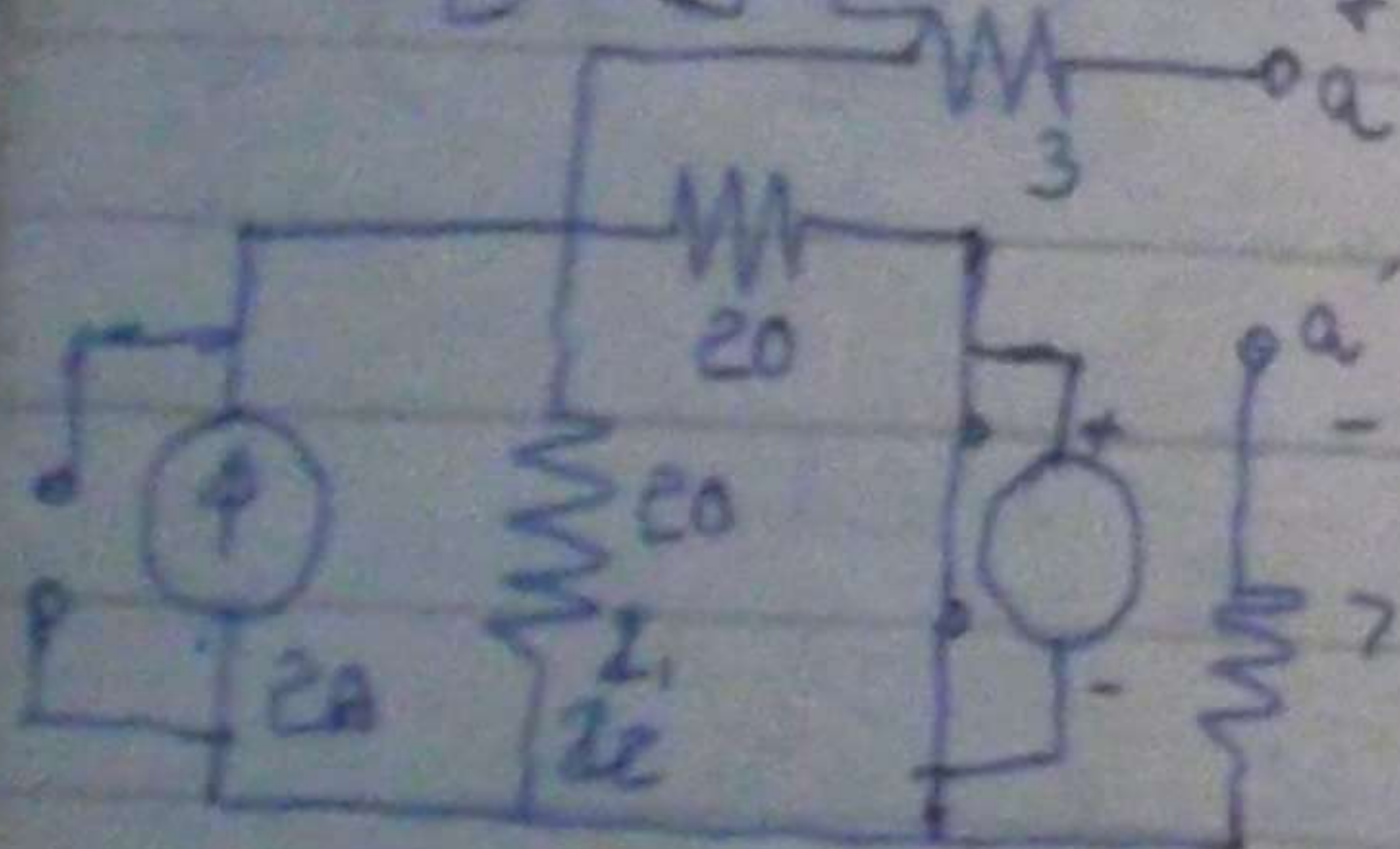


$$R_0 = 7 + \frac{20 \times 20}{20 + 20} + 3 = 20 \Omega$$

(a) aa' ဆွဲ၍ R_0 ကိုရှာရန်
Source ကို ဖယ်ရှားပေးရမည်



ဆက်လက် 20Ω R_0 ဖြစ်ပြီး ဆွဲ၍ လျှပ်စီးမှုကို Superposition theorem ကို
သုံး၍ ရှာဖွေရမည်



$$I_1 = \frac{2}{2} = 1 A$$

2A source ကို ဖယ်ရှားပေးရမည်

$$I_2 = \frac{50}{40} = 1.25 A$$

$$\therefore I_{sc} = 1 + 1.25 = 2.25 A$$

$$\therefore E_0 = 0 + 2.25 \times 20 + 0 = 45 V$$

10/30/03

~~Ex 7.1~~ No. 1.1

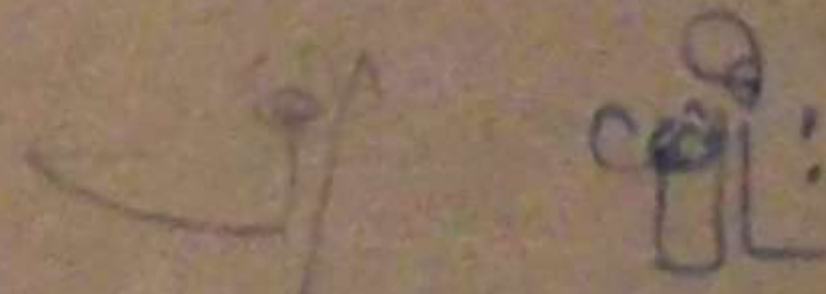
$$R_k = 600 \Omega, R_i = 400 \Omega, R_E = 200 \Omega$$

$$dB = 20 \log \frac{E_i}{E_0} = 20 \log \frac{R_k + R_i}{R_k + R_E}$$

$$= 20 \log \frac{300}{400} = -6.0206 dB$$

L.C. THEORY

အောက်ပါ ခုခံမှု ဆက်သွယ်မှု



$$23.0283$$