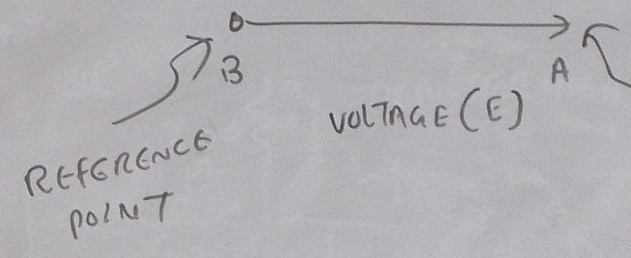
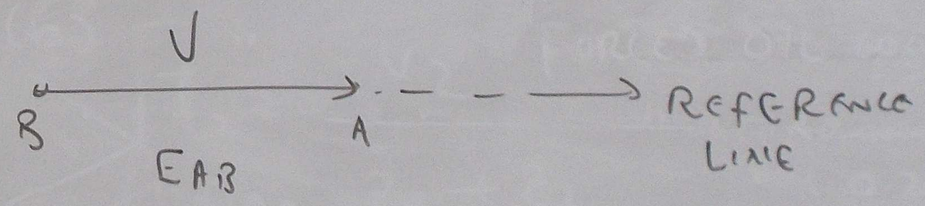
No Eating
nd drinking
No iPods

3ϕ AC supplies

DOUBLE SUB SCRIPT NOTATION



VOLTAGE AT POINT A WITH REFERENCE
TO POINT (B) = E_{AB}



$E_{AB} = V$ ∠0

E_{BA} = VOLT
REFE

B

E_{BA} =

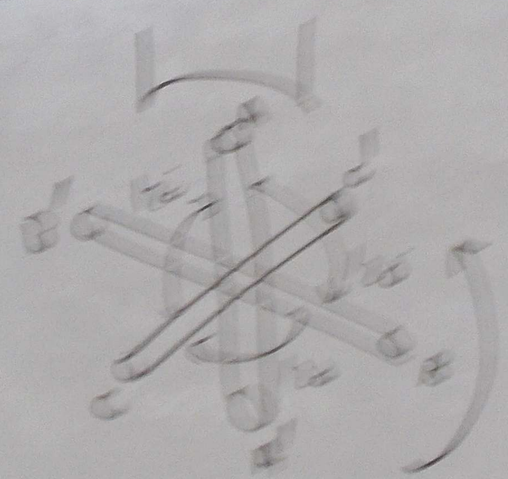
GENE
ELE

E_{BA} = VOLTAGE AT POINT (B) WITH REFERENCE TO POINT (A)

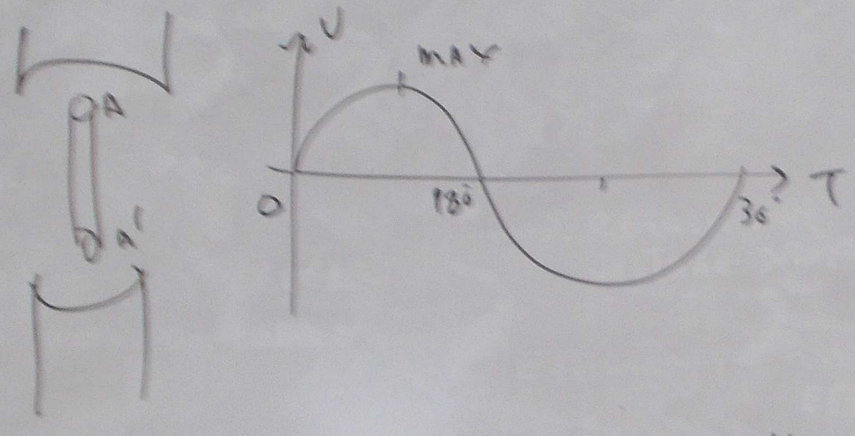


$E_{BA} = V_B - V_A$

GENERATION OF A THREE PHASE SET OF ELECTROMOTIVE FORCES

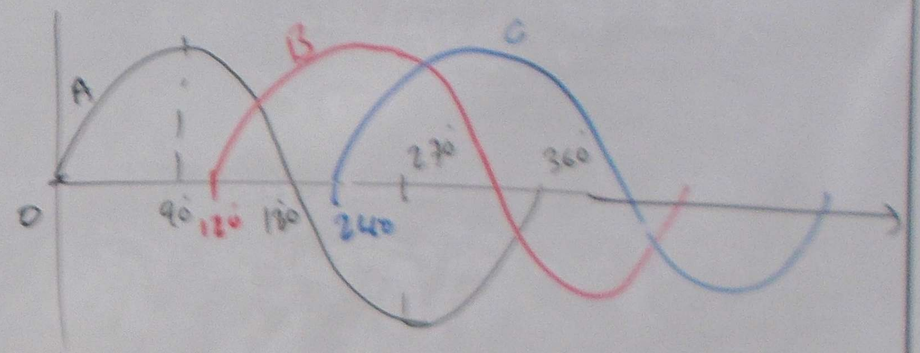


A MACHINE WITH A SINGLE ROTATING COIL IN A MAGNETIC FIELD GENERATES ONE CYCLE OF SINUSOIDAL EMF FOR REVOLUTION OF THE COIL.



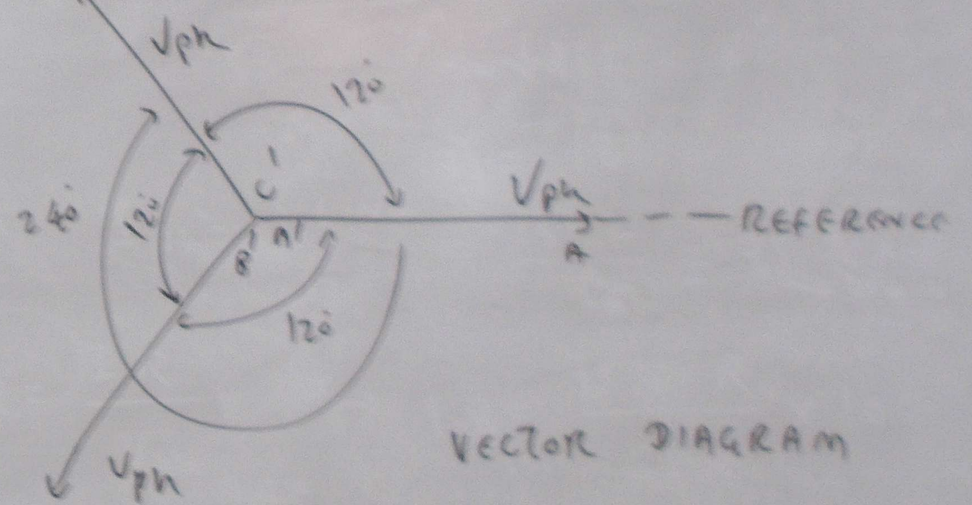
IF THREE COILS ARE SPACED EQUALLY 120° APART, AROUND THE MACHINE, THEN THE GENERATED EMF IN EACH COIL WILL PASS ZERO AND REACH PEAK AT DIFFERENT TIMES. THE THREE EMFS GENERATED ARE THREE SINGLE PHASE EMFS.

A - 1st, B - 2nd, C - 3rd



3φ AC WAVE FORMS

VECTOR DIAGRAM



VECTOR DIAGRAM

POLAR FORM OF PHASE VOLTAGES

$E_{AA'} = V_{ph} \angle 0°$

$E_{BB'} = V_{ph} \angle -120°$

$E_{CC'} = V_{ph} \angle -240°$

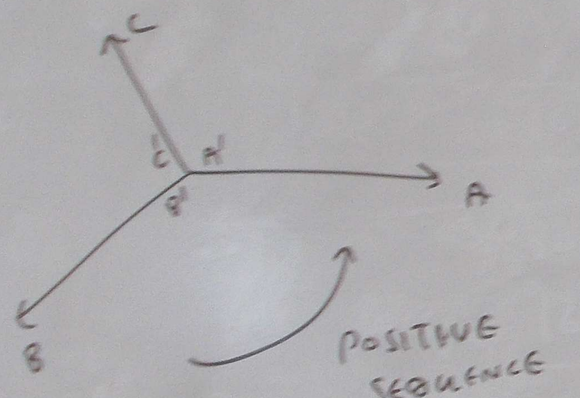
SEQUENCE

A - 1st, B - 2nd C - 3rd

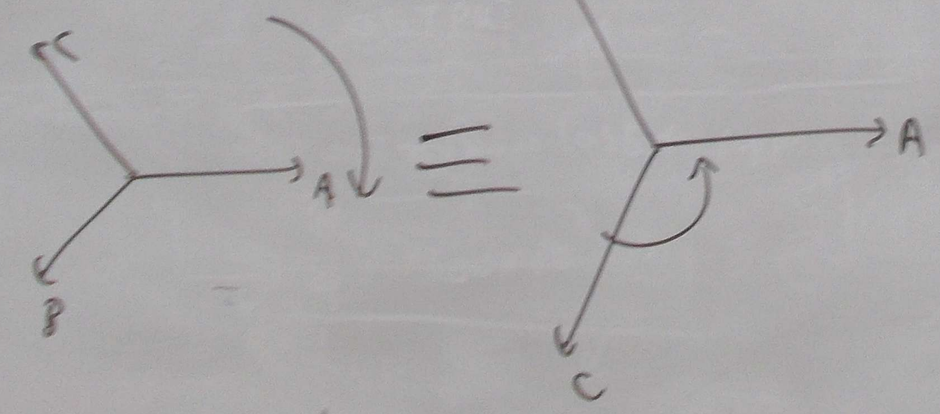
SEQUENCE ABC

SEQUENCE

ABC / 1 2 3 / R Y B / R W B — POSITIVE SEQUENCE



NEGATIVE SEQUENCE

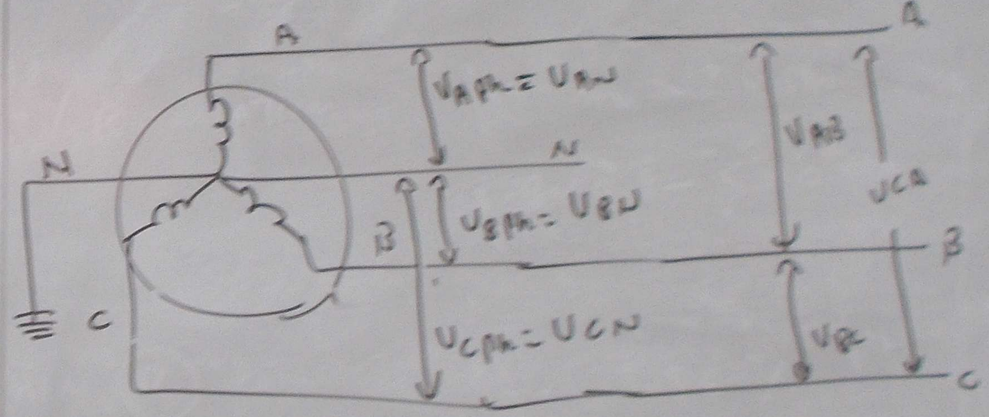


NEGATIVE SEQUENCE - ACB

$E_{AA}' = U_{ph} \angle 0$

$E_{CC}' = U_{ph} \angle 120$

$E_{BB}' = U_{ph} \angle -240$



3φ GENERATION

U_{AN} = A LINE TO NEUTRAL VOLTAGE = PHASE VOLTAGE

U_{BN} = B LINE TO NEUTRAL VOLTAGE

U_{CN} = C LINE TO NEUTRAL VOLTAGE

V_{AB} = A LINE TO B LINE VOLTAGE

V_{BC} = B LINE TO C LINE VOLTAGE

V_{CA} = C LINE TO A LINE VOLTAGE

} LINE TO LINE VOLTAGE (OR) LINE VOLTAGE

$V_{AN} = V_{ph} \angle 0$ A PHASE IS REFERENCE

$V_{BN} = V_{ph} \angle -120$

$V_{CN} = V_{ph} \angle -240$

$V_{AB} = \sqrt{3} V_{ph} \angle 30$

$V_{BC} = \sqrt{3} V_{ph} \angle -90$

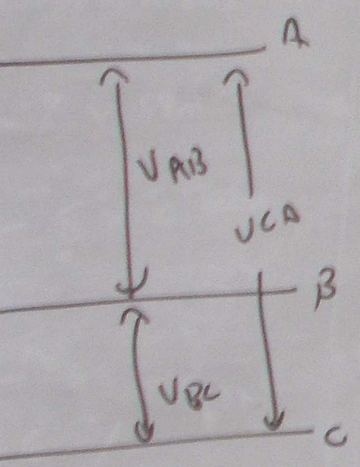
$V_{CA} = \sqrt{3} V_{ph} \angle 150$

(OR)

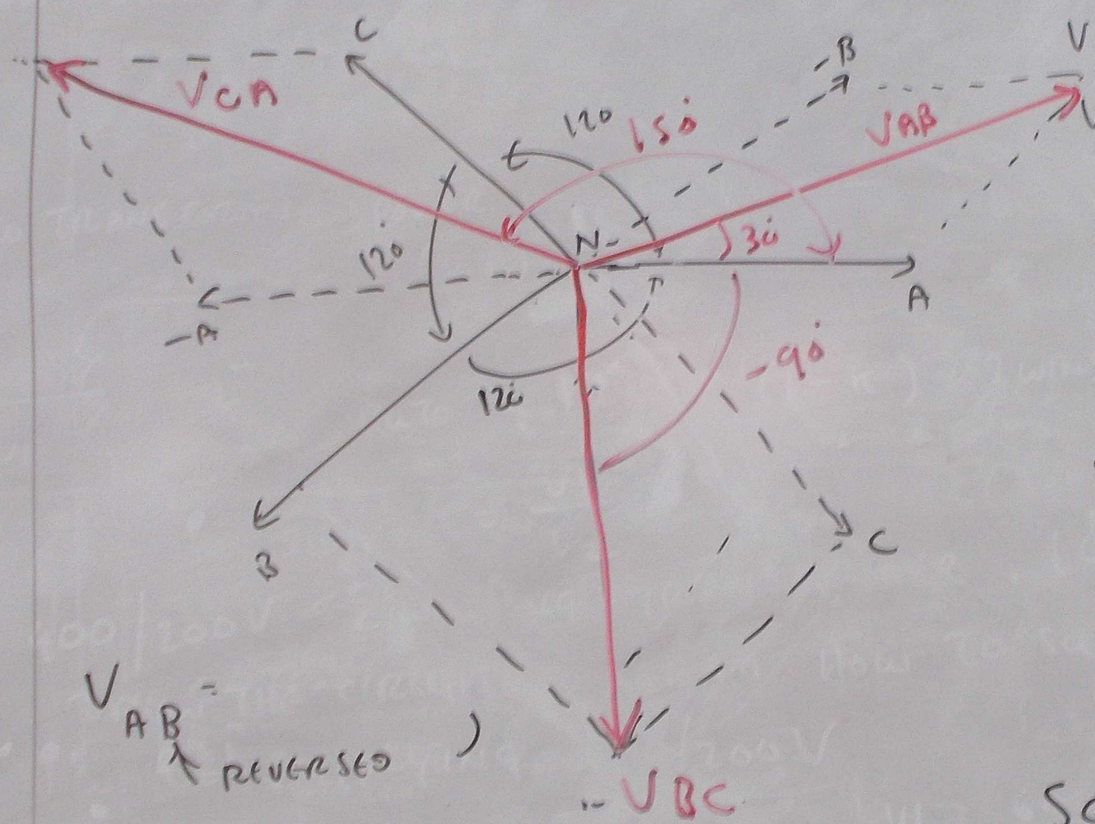
$\sqrt{3} V_{ph} \angle -210$

SEQUENCE A-B-C

PHASE AND LINE VOLTAGES



PHASE VOLTAGE



V_{AB} = REVERSED

V_{BC} REVERSE

V_{CA} REVERSE

LINE TO LINE VOLTAGE (OR) LINE VOLTAGE

$V_{AN} = V_{ph} \angle 0$ A PHASE IS REFERENCE

$V_{BN} = V_{ph} \angle -120^\circ$

$V_{CN} = V_{ph} \angle -240^\circ$

$V_{AB} = \sqrt{3} V_{ph} \angle 30^\circ$

$V_{BC} = \sqrt{3} V_{ph} \angle -90^\circ$

$V_{CA} = \sqrt{3} V_{ph} \angle 150^\circ$

(OR)

$\sqrt{3} V_{ph} \angle -210^\circ$

SEQUENCE A-B-C

PHASE AND LINE VOLTAGES

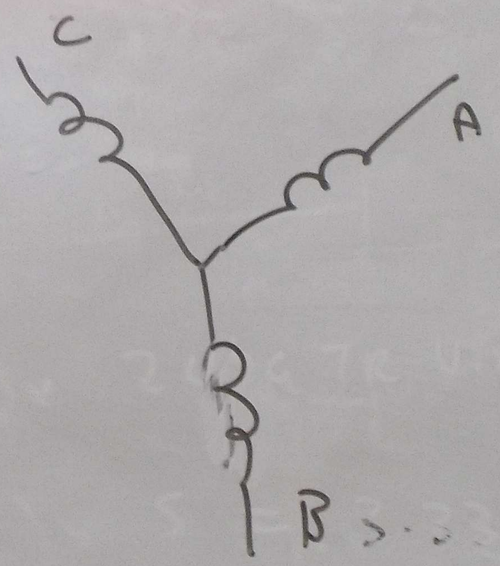
$\overrightarrow{V_{AB}} = \overrightarrow{V_A} + \overrightarrow{V_B}$

$\overrightarrow{V_{BC}} = \overrightarrow{V_B} + \overrightarrow{V_C}$

$\overrightarrow{V_{CA}} = \overrightarrow{V_C} + \overrightarrow{V_A}$

VECTOR SUM EQUATIONS

STAR CONNECTION $V_{ph} = V$



$V_{AB} = \sqrt{3} V$

$V_{BC} = \sqrt{3} V$

$V_{CA} = \sqrt{3} V$



NOTE

TO CARRY OUT THOSE VECTOR ADDITIONS ONE OF THE PHASE VOLTAGE MUST BE REVERSED

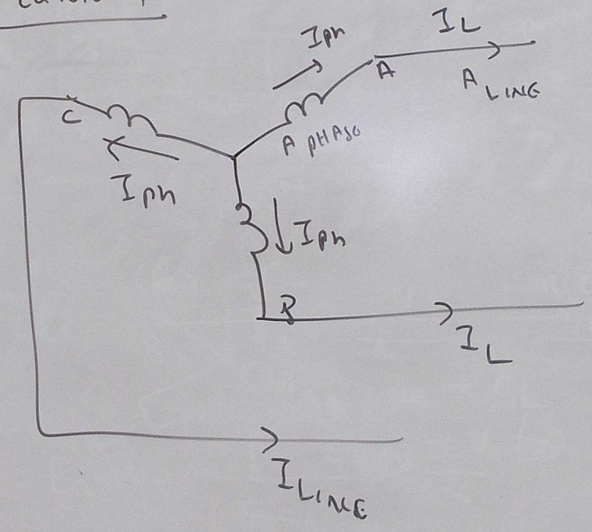
LINE VOLTAGES ARE ALL EQUAL IN MAGNITUDE

LINE VOLTAGES ARE $\sqrt{3}$ TIMES THE PHASE VOLTAGES

LINE VOLTAGE LEADS THE PHASE VOLTAGE BY 30

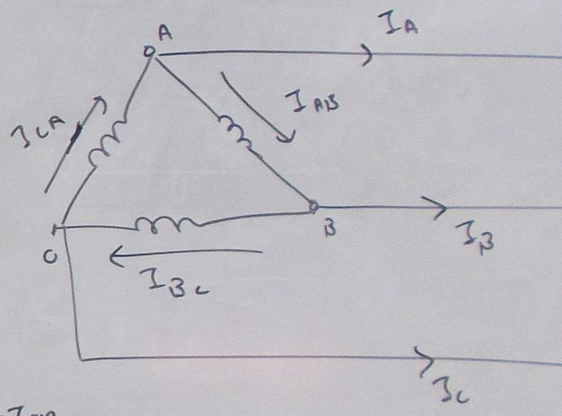
IT IS FOR STAR CONNECTION

CURRENT



LINE CURRENT = PHASE CURRENT

THREE PHASE DELTA CONNECTION (GENERA



GENERATION

SEQUENCE A B C (+ SEQUENCE)

VOLTAGE

A - 1st

B - 2nd

C - 3rd

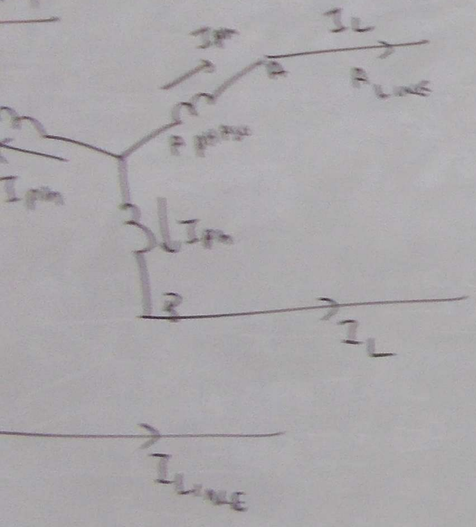
CURRENT

FLOW FROM A TO B

FLOW FROM B TO C

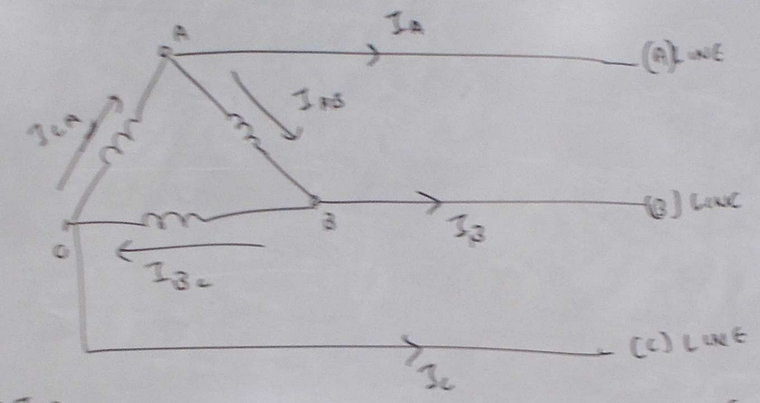
FLOW FROM C TO

OUT THESE VECTOR ADDITIONS ONE OF THE
TAGE MUST BE REVERSED
AGES ARE ALL EQUAL IN MAGNITUDE
TAGES ARE $\sqrt{3}$ TIMES THE PHASE VOLTAGES
TAGE LEADS THE PHASE VOLTAGE BY 30°
IT IS FOR STAR CONNECTION



LINE CURRENT = PHASE CURRENT

THREE PHASE DELTA CONNECTION (GENERATOR)



GENERATION

SEQUENCE A B C (+ SEQUENCE)

VOLTAGE — CURRENT

A - 1st
B - 2nd
C - 3rd

FLOW FROM A TO B
FLOW FROM B TO C
FLOW FROM C TO A

SEQUENCE (ACB)
NEGATIVE SEQUENCE

VOLTAGE	CURRENT
A - 1st	FROM A TO C
C - 2nd	FROM C TO B
B - 3rd	FROM B TO A

AT POINT (A)

FLOW IN = FLOW OUT

$I_{CA} = I_A + I_{AB} \rightarrow \vec{I}_A = \vec{I}_{CA} -$

AT POINT (B)

FLOW IN = FLOW OUT

$I_{AB} = I_B + I_{BC} \rightarrow \vec{I}_B = \vec{I}_{AB}$

AT POINT (C)

FLOW IN = FLOW OUT

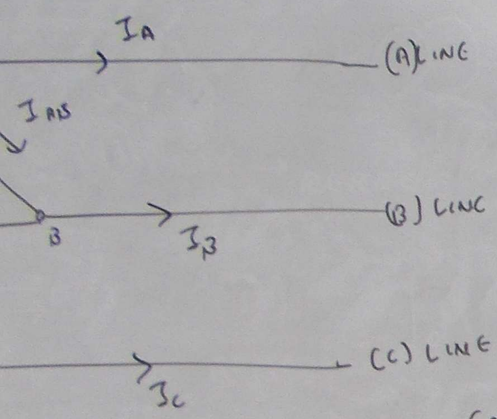
$I_{BC} = I_C + I_{CA} \rightarrow \vec{I}_C = \vec{I}_{BC} -$

$\vec{I}_A = \vec{I}_{CA} - \vec{I}_{AB} = i_c - i_a$

$\vec{I}_B = I_{AB} - I_{BC} = i_a - i_b$

$\vec{I}_C = I_{BC} - I_{CA} = i_b - i_c$

TA CONNECTION (GENERATOR)



+ SEQUENCE)

CURRENT

W FROM A TO B

LOW FROM B TO C

LOW FROM C TO A

SEQUENCE (ACB)

NGATIVE SEQUENCE

VOLTAGE	CURRENT
A - 1st	FROM A TO C
C - 2nd	FROM C TO B
B - 3rd	FROM B TO A

A.

AT POINT (A)

FLOW IN = FLOW OUT

$I_{CA} = I_A + I_{AB} \longrightarrow \vec{I}_A = \vec{I}_{CA} - \vec{I}_{AB}$

AT POINT (B)

FLOW IN = FLOW OUT

$I_{AB} = I_B + I_{BC} \longrightarrow \vec{I}_B = \vec{I}_{AB} - \vec{I}_{BC}$

AT POINT (C)

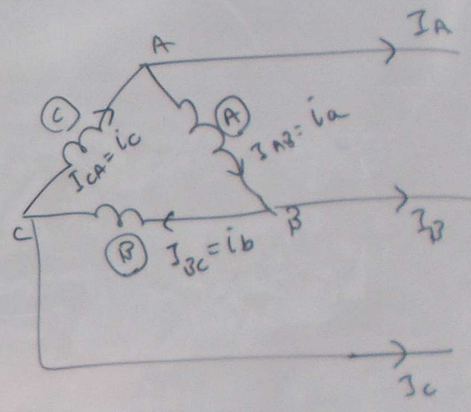
FLOW IN = FLOW OUT

$I_{BC} = I_C + I_{CA} \longrightarrow \vec{I}_C = \vec{I}_{BC} - \vec{I}_{CA}$

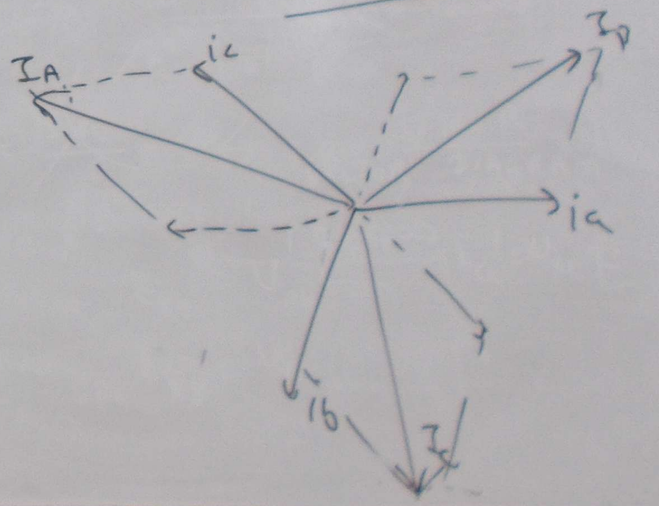
$\vec{I}_A = \vec{I}_{CA} - \vec{I}_{AB} = i_c - i_a$

$\vec{I}_B = I_{AB} - I_{BC} = i_a - i_b$

$\vec{I}_C = I_{BC} - I_{CA} = i_b - i_c$



CURRENT VECTOR DIAGRAM



BALANCE DELTA

$I_A = \sqrt{3}\, i_a$

$I_B = \sqrt{3}\, i_b$

$I_C = \sqrt{3}\, i_c$

LINE CURRENTS ARE

MAGNITUDE

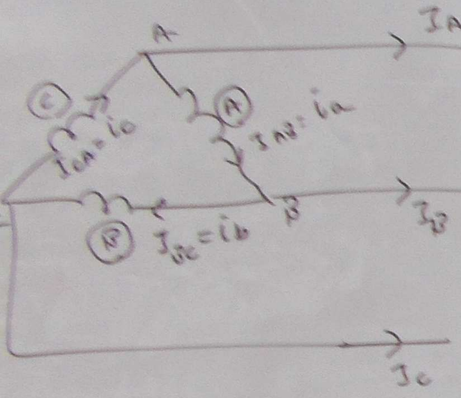
LINE CURRENTS AR

PHASE CUR

ELECTRICAL ENGINEERING

PLEASE DO NOT REMOVE

APPROPRIATE
FOOTWEAR
IN THIS BUILDING



BALANCE DELTA

$I_A = \sqrt{3}\, i_a$

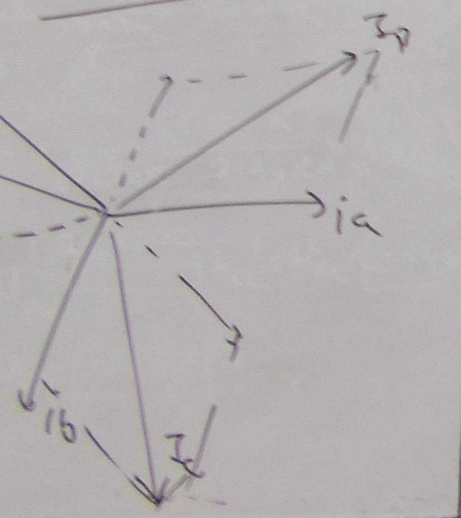
$I_B = \sqrt{3}\, i_b$

$I_C = \sqrt{3}\, i_c$

LINE CURRENTS ARE ALL EQUAL IN MAGNITUDE

LINE CURRENTS ARE $\sqrt{3}$ TIMES PHASE CURRENT

CURRENT VECTOR DIAGRAM



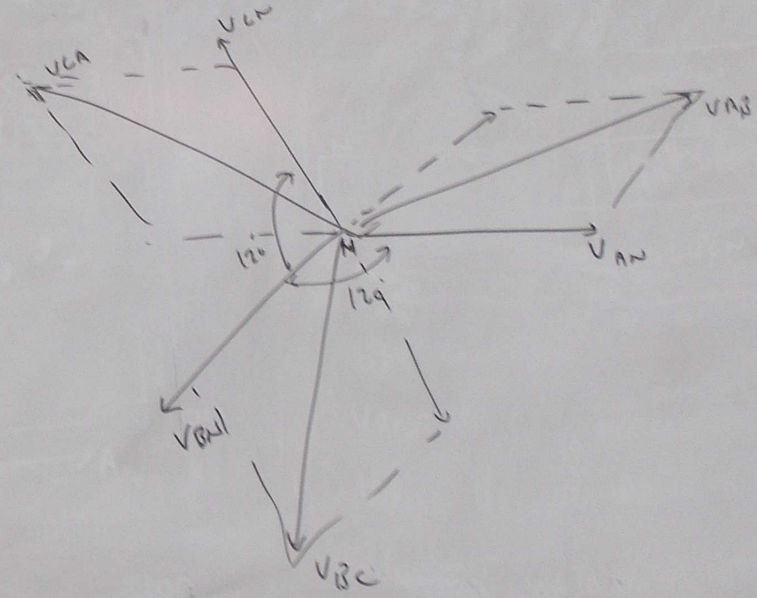
pb

$V_{A(ph)} = 10V$

$V_{B(ph)} = 10V$

$V_{C(ph)} = 10V$

SEQUENCE ABC, PLOT THE PHASE AND LINE VOLTAGE DIAGRAM BY SCALE

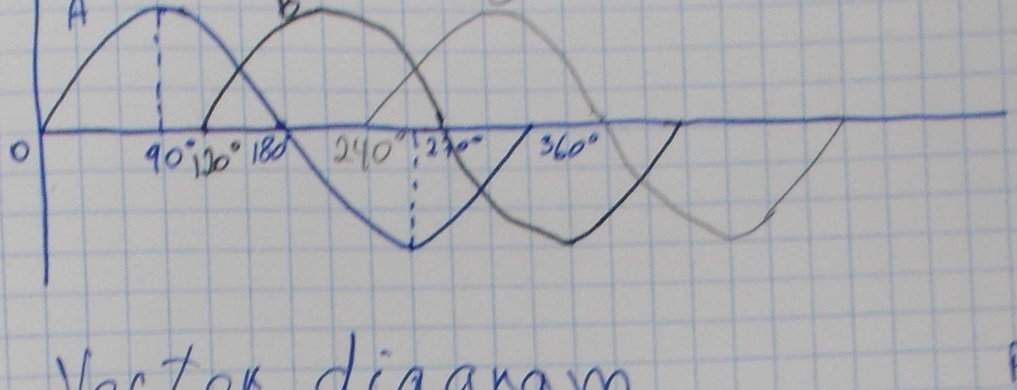


1V = 1cm

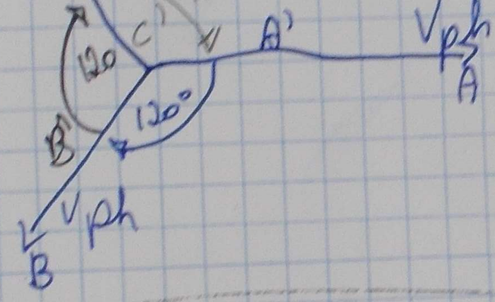
10V = 10cm

03/05/18

3Φ AC Supplies



Vector diagram



Polar form

$E_{AA'} = V_{ph} \angle 0$

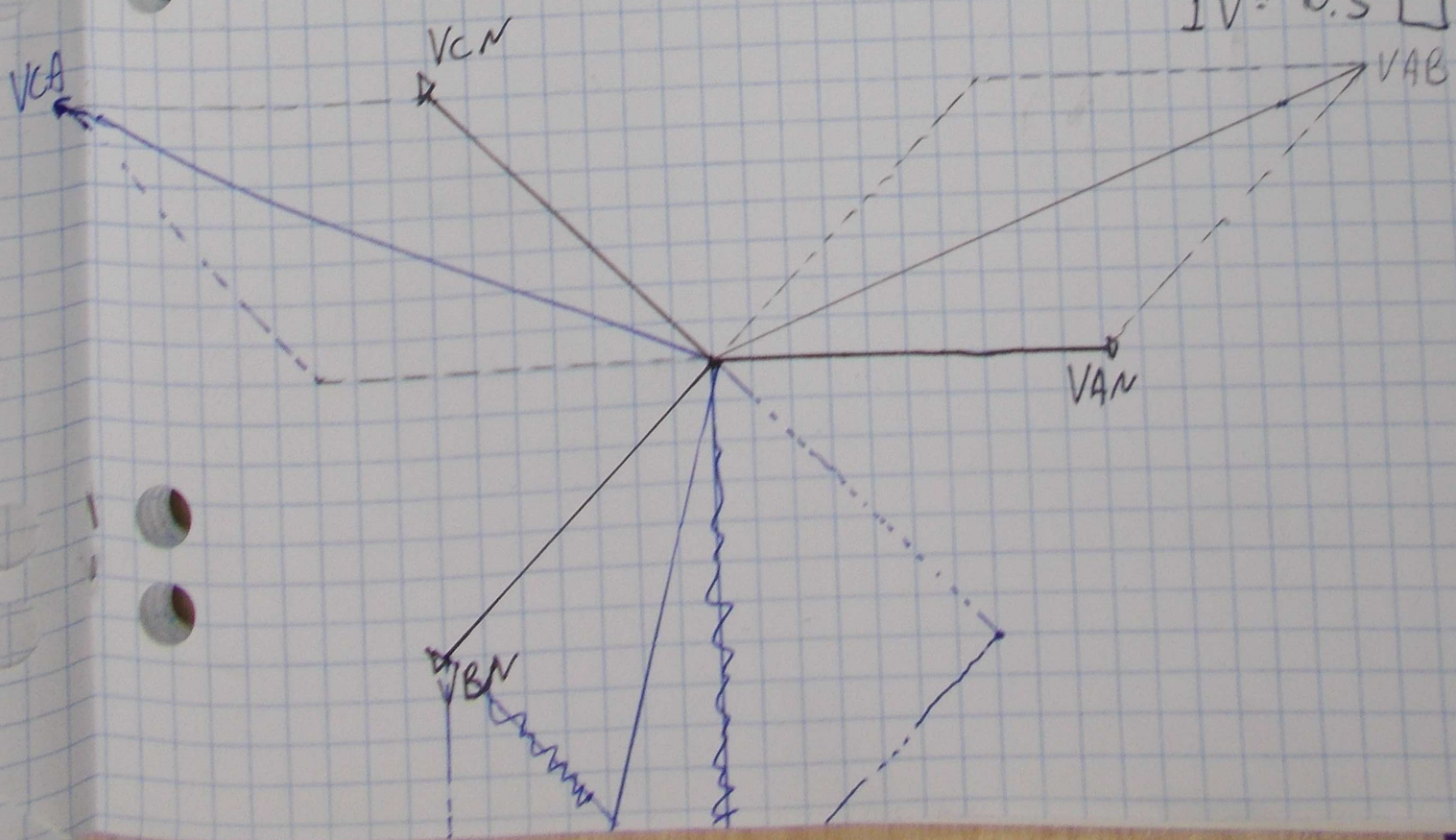
$E_{BB'} = V_{ph} \angle -120°$

$E_{CC'} = V_{ph} \angle 240$

Pb $V_{A(ph)} = 60V$
$V_{B(ph)} = 60V$
$V_{C(ph)} = 60V$

Sequence ABC, plot the phase and line V diagram by scale

1V = 0.5 □



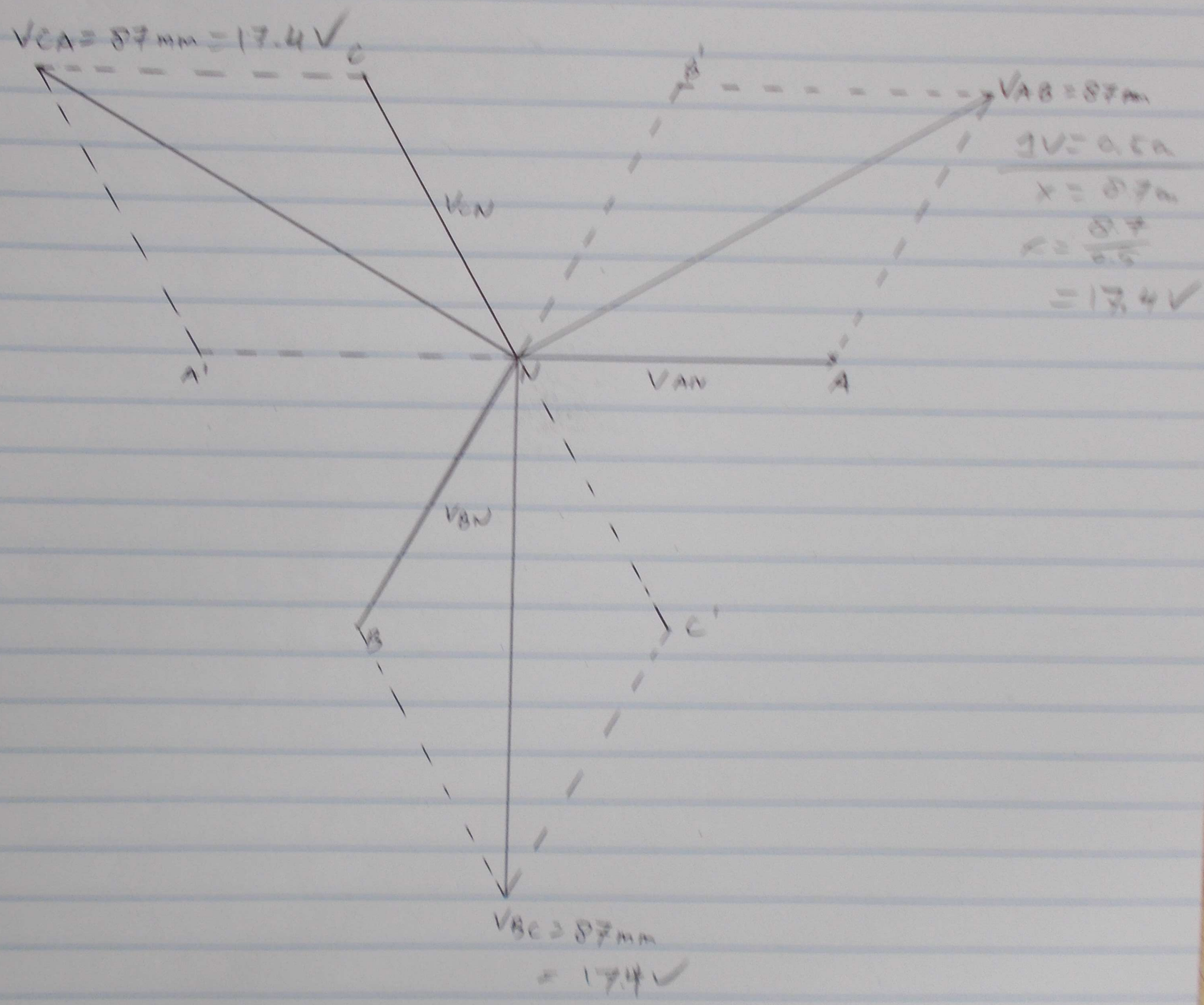
A.C

ERICK MATIAS 805737303

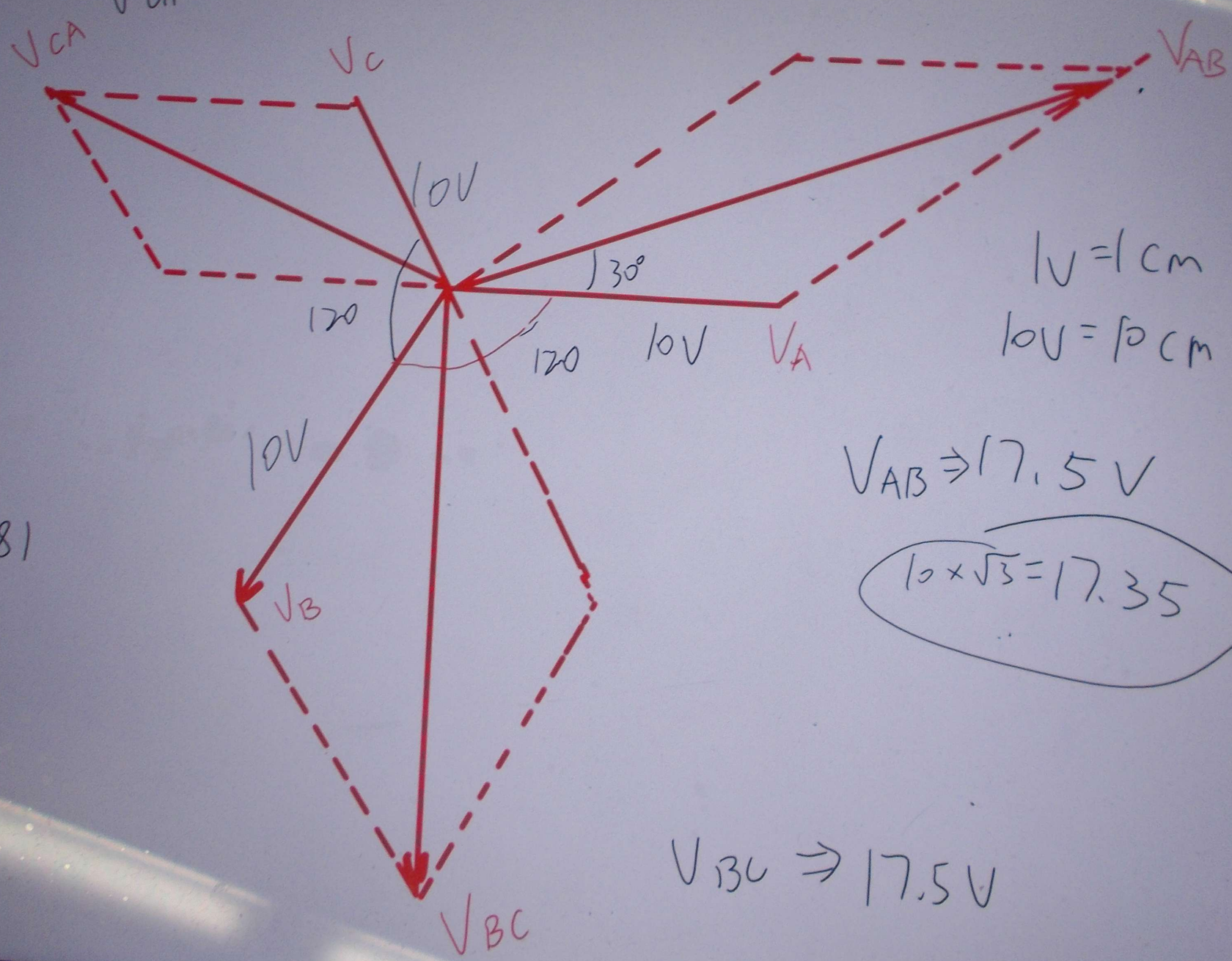
$V_{A(ph)} = 10V$ Scale 1V = 0.5cm

$V_{B(ph)} = 10V$ 10V = 5cm

$V_{C(ph)} = 10V$



V_{CA} $V_{CA}=17.5V$



1V = 1 cm

10V = 10 cm

Lang Li

802093781

$V_{AB} \Rightarrow 17.5\,V$

$10 \times \sqrt{3} = 17.35$

$V_{BC} \Rightarrow 17.5\,V$

$\vec{V}_{AB} = \vec{V}_A + \vec{V}_{AB}$

$\vec{V}_{BC} = \vec{V}_B + \vec{V}_{BC}$

$\vec{V}_{CA} = \vec{V}_C + \vec{V}_{CA}$

$\vec{I}_A = I \angle -30°$ amp, $\vec{I}_B = I \angle -150°$ amp, $\vec{I}_C = I \angle -270°$ amp

$\vec{I}_{AB}$, $\vec{I}_{BC}$, $\vec{I}_{CA}$ by vector method

$\vec{I}_{AB} = \vec{I}_A - \vec{I}_B$, $\vec{I}_{BC} = \vec{I}_B - \vec{I}_C$, $\vec{I}_{CA} = \vec{I}_C - \vec{I}_A$

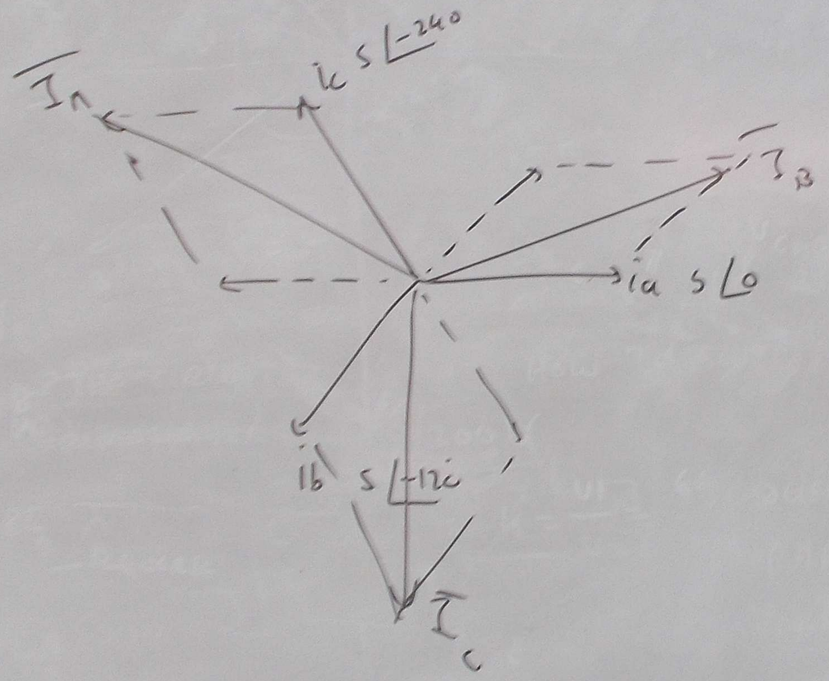
VOLTAGE

Ph

$i_a = 5 \angle 0^\circ$ amp, $i_b = 5 \angle -120^\circ$ amp, $i_c = 5 \angle -240^\circ$ amp

FIND $\overline{I_A}$, $\overline{I_B}$, $\overline{I_C}$ BY VECTOR METHOD

$\overline{I_A} = i_c - i_a$, $\overline{I_B} = i_a - i_b$, $\overline{I_C} = i_b - i_c$



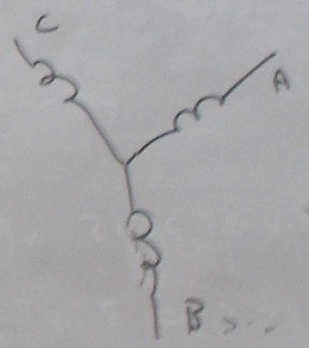
$\overrightarrow{V_{AB}} = \overrightarrow{V_A} + \overrightarrow{V_B}$

$\overrightarrow{V_{BC}} = \overrightarrow{V_B} + \overrightarrow{V_C}$

$\overrightarrow{V_{CA}} = \overrightarrow{V_C} + \overrightarrow{V_A}$

VECTOR SUM EQUATIONS

STAR CONNECTION $V_{ph} = V$



$V_{AB} = \sqrt{3}\ V$

$V_{BC} = \sqrt{3}\ V$

$V_{CA} = \sqrt{3}\ V$

A. C

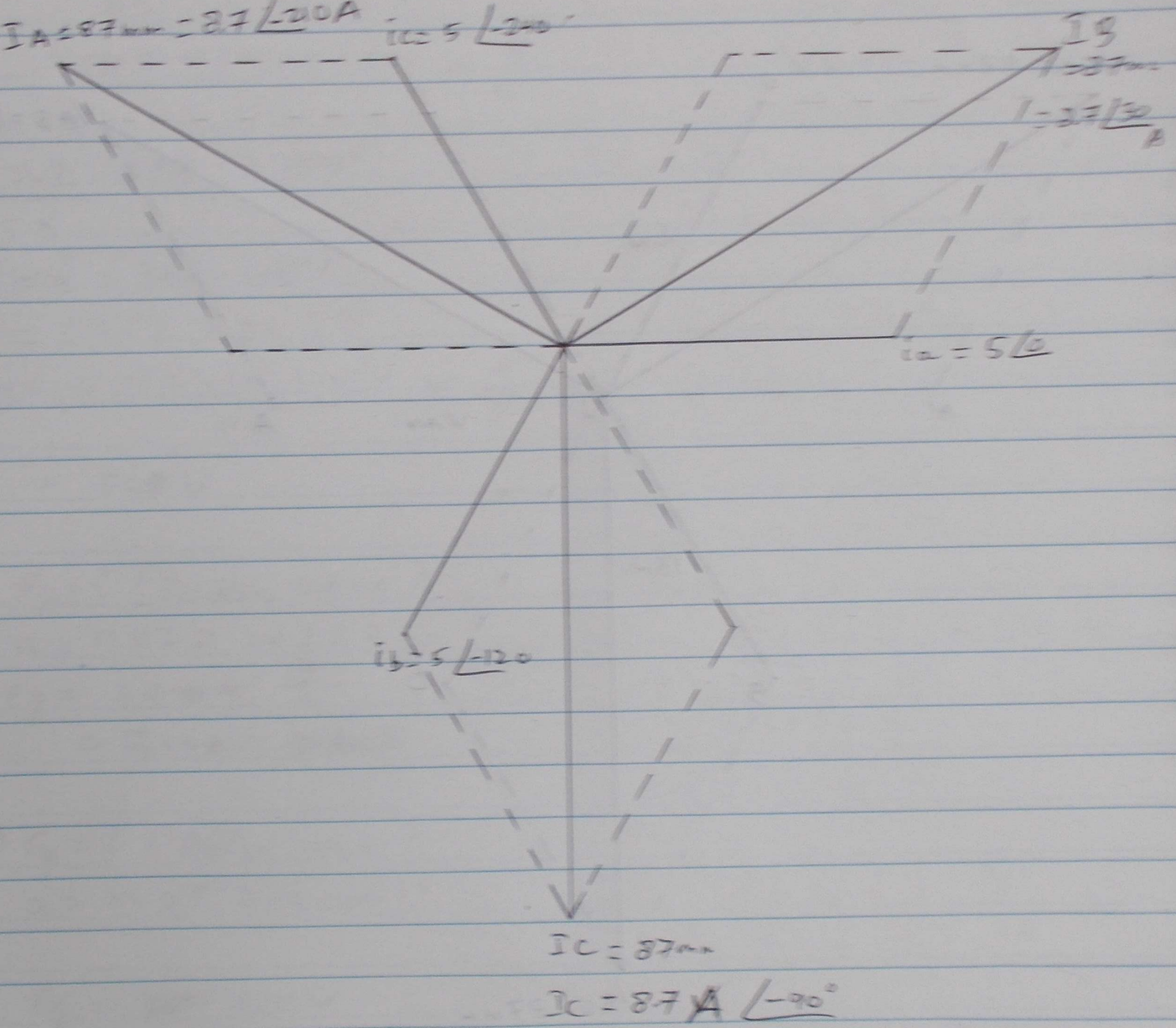
ERICK MATIAS 80373707

$i_a = 5 \angle 0°\ A$, $i_b = 5 \angle -120$, $i_c = 5 \angle -240$

$\bar{I}_A$, $\bar{I}_B$, $\bar{I}_C$

$I_A = i_c - i_a$, $I_B = i_a - i_b$, $I_C = i_b - i_c$

Scale = 1V : 1cm



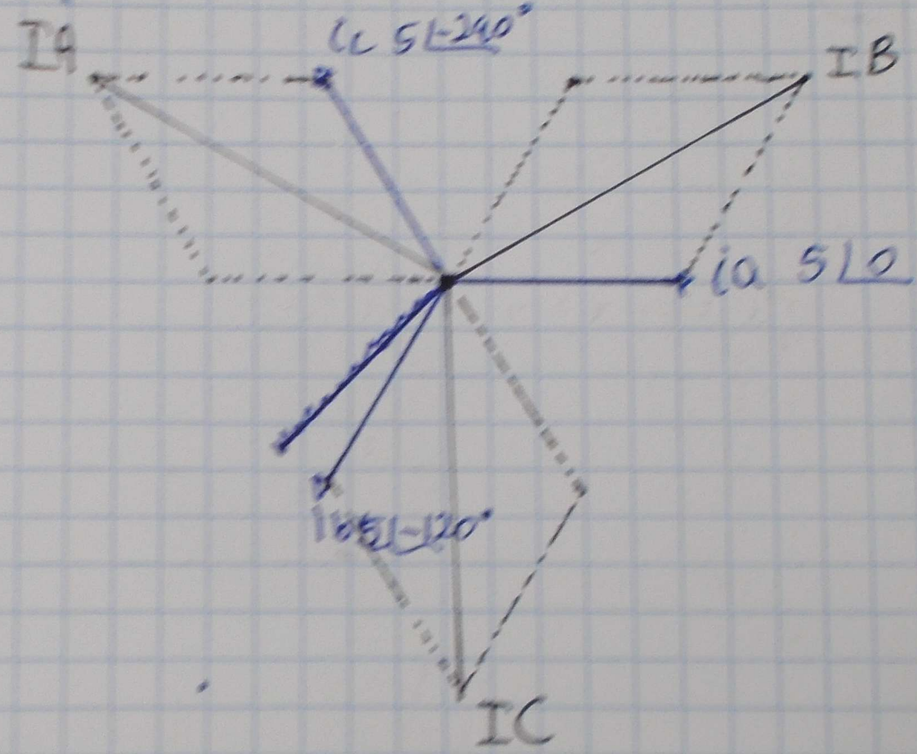
Pb $i_a = 5\angle 0$ $I_b = 5\angle -120°$ $I_c = 5\angle -240$

find $\overline{IA}$, $\overline{IB}$, $\overline{IC}$ by Vector method

$\overline{IA} = ic - ia$ $IB = ia - ib$ $\overline{Ic} = ib - ic$

1A · 1 □ = 0,5 cm

MATEUS G
8033737657



4,5 × 0,5

9 cm
9 B

Pb

$V_{A(pn)} = 10V$

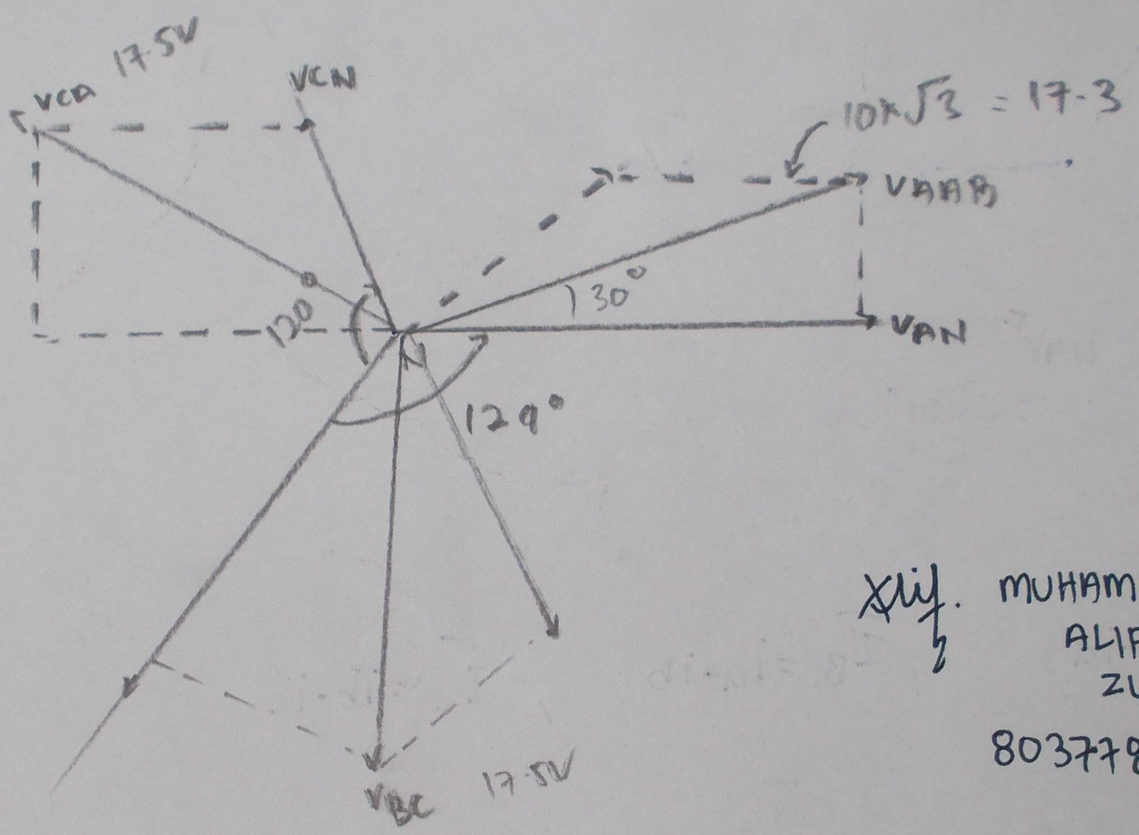
$V_{B(pn)} = 10V$

$V_{C(pn)} = 10V$

sequence ABC, Plot the phase and line voltage diagram by scale.

1V = 1cm

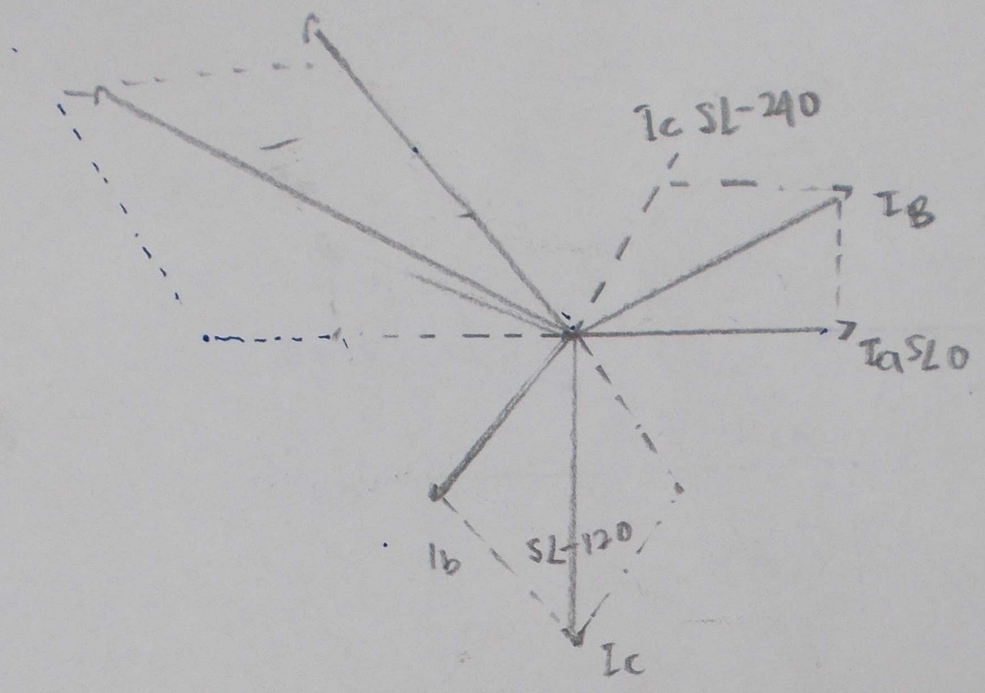
10V = 10cm



Alif. MUHAMMAD
ALIF
ZULKARNAINI
803778051

Pb $i_a = 5\angle 0^\circ$ Amp, $i_b = 5\angle -120^\circ$ Amp, $i_c = 5\angle -240^\circ$ Amp

Find $\bar{I}_A$, $\bar{I}_B$, $\bar{I}_c$ By vector method.



$\bar{I}_A = ic - ia$, $\bar{I}_B = ia - ib$, $\bar{I}_c = ib - ic$

$\bar{I}_A = 5\angle -240 - 5\angle 0$

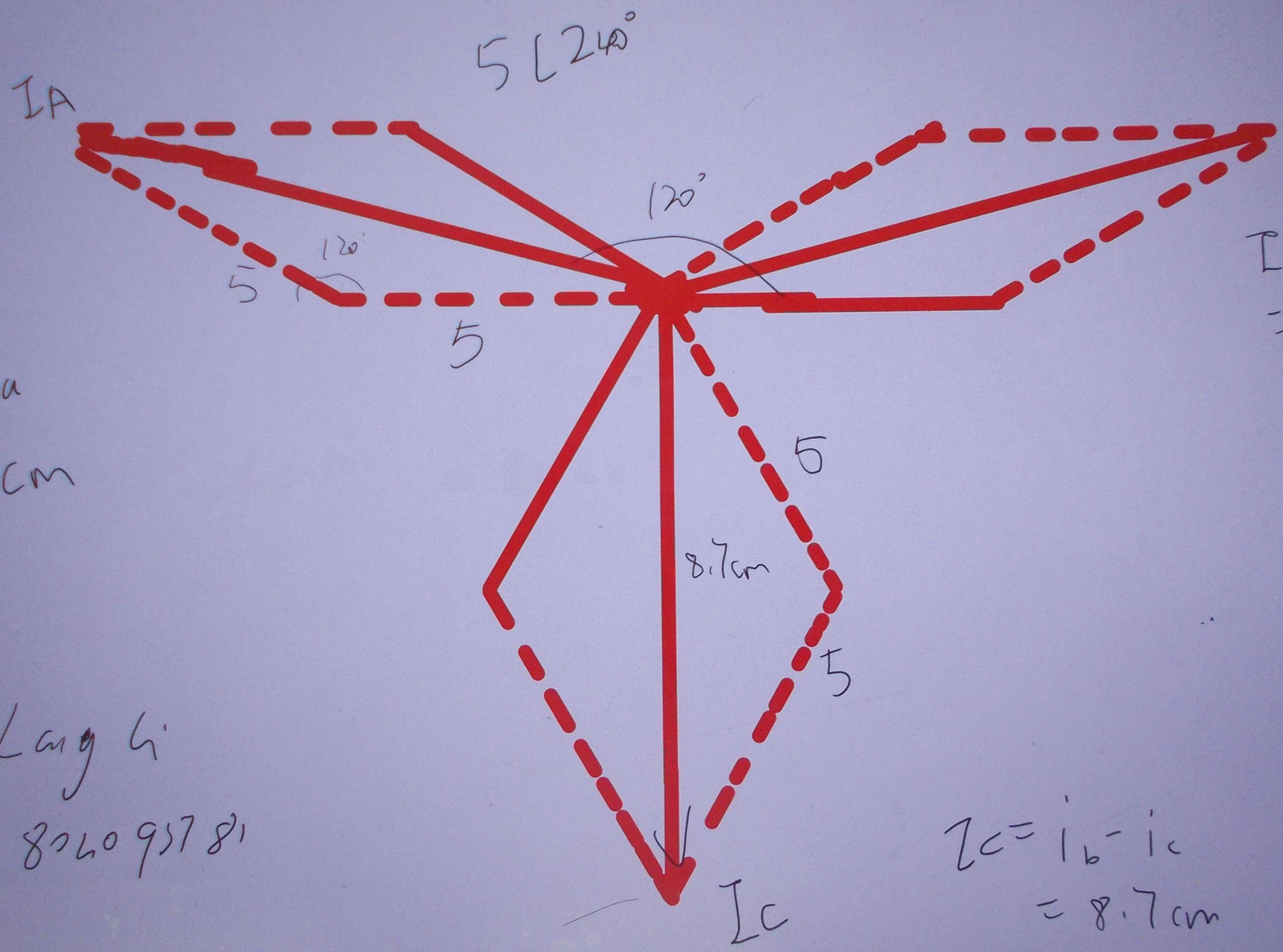
$= 5\angle -240$

$\bar{I}_B = 5\angle 0 - 5\angle -120$

$= 5\angle 120$

$\bar{I}_c = 5\angle -120 - 5\angle -240$

$= 5\angle 120$



$I_A = i_c - i_a$

$= 8.7\ cm$

$I_B = i_a - i_b$

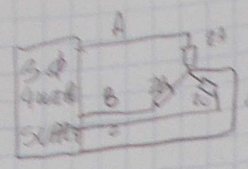
$= 8.7\ m$

Lag 4

8.7 0 9.7 8.1

$I_c = i_b - i_c$

$= 8.7\ cm$

a) 

$E_{AN} = 240V = 240\angle 0$
$E_{BN} = 240\ V = 240\angle -120$
$E_{CN} = 240V = 240\angle -240$

a) $E_{AB} = \sqrt{3} \times 240\angle 30° = 415.7\angle 30\ V$
$E_{BC} = \sqrt{3} \times 240\angle -90 = 415.7\angle -90V$
$E_{CA} = \sqrt{3} \times 240\angle 150$ or $-210 = 415.7\angle -210$

b) I_A = line = phase $= \frac{E_{AN}}{Z_A} = \frac{240\angle 0}{20\Omega\angle 0} = 1.2\angle 0\ A$

$I_B = \frac{E_{BN}}{Z_B} = \frac{240\angle -120}{20\Omega\angle 0}$ $1.2\angle -120\ A$

$I_C = \frac{E_{CN}}{Z_C} = \frac{240\angle -240}{20\Omega\angle 0}$ $712\angle -240\ A$

c) $I_N = I_A + I_B + I_C$
$= 12\angle 0 + 12\angle -120 + 12\angle -240$ convert to rectangular form

$= 12(\cos 0 + j\sin 0) + 12(\cos -120 + j\sin -120) + 12(\cos -240 + j\sin -240)$
$12(1 + j0) + 12(-0.5 + j0.86) + 12(-0.5 + j0.86)$
$12 + (-6$ $I_N = 0A$

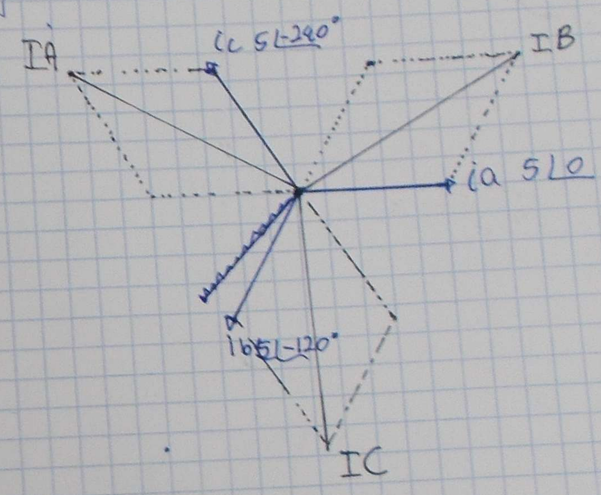
MATEUS G
803737657

Pb $i_a = 5\angle 0$ $I_b = 5\angle -120°$ $I_c = 5\angle -240$
find $\overline{IA}$, $\overline{IB}$, $\overline{IC}$ by Vector method

$\overline{IA} = ic - ia$ $IB = ia - ib$ $\overline{Ic} = Ib - ic$

1A · 1 □ = 0,5 cm

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4,5 × 0,5

9 cm
9 A

Exercise A Balanced 3φ1 connected load consists of three 200Ω resistors connected via 3φ4 wire load line to neutral voltage 240V.

Calculate a) line voltage in polar form
b) line current in " "
c) neutral current.

A.C

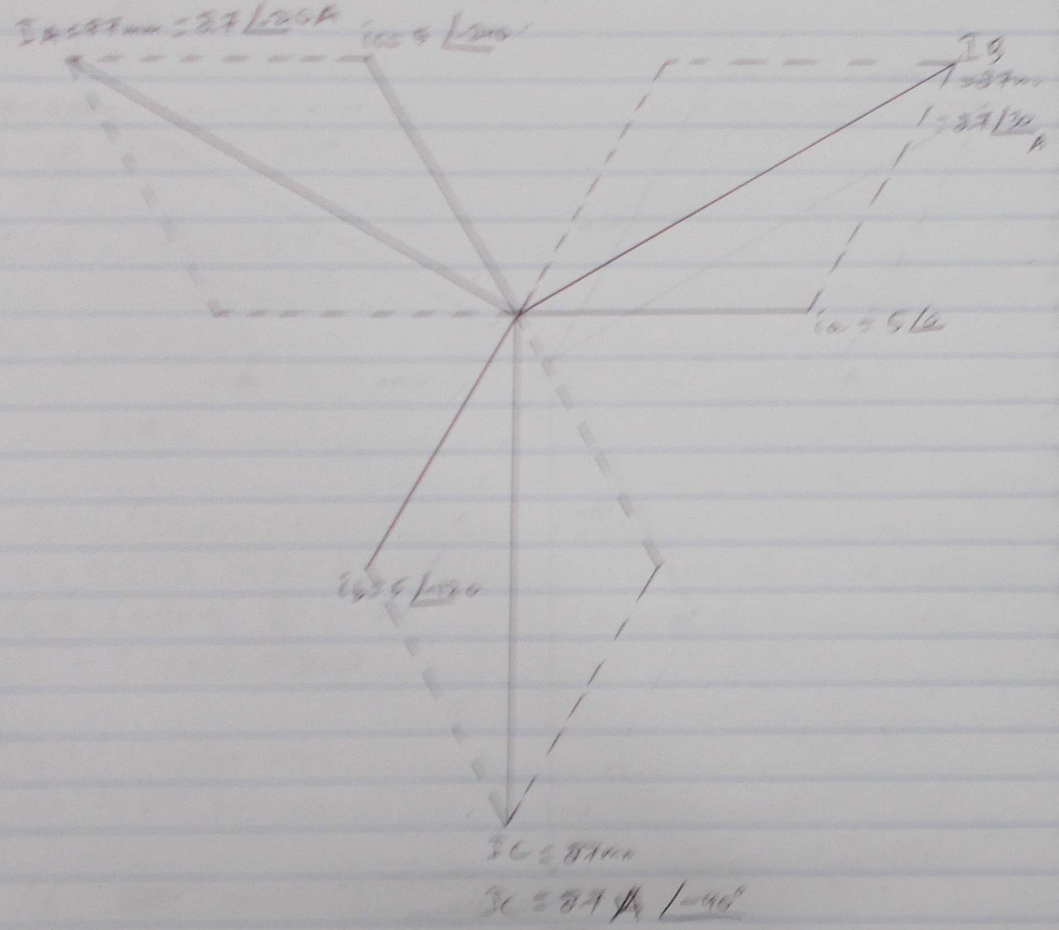
ERICK MATIAS 80373707

$i_a = 5\angle 0°\,A$, $i_b = 5\angle -120$, $i_c = 5\angle -240$

$\bar{I}_A, \bar{I}_B, \bar{I}_C$

$I_A = I_c - I_a$, $I_B = I_a - I_b$, $I_c = I_b - I_c$

Scale: 1 V = 2 cm



A.C

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3φ Y with zoz

$E_{AN} = 240\,V\angle 0$

$E_{BN} = 240\angle -120\,V$

$E_{CN} = 240\angle -240\,V$

(a) $E_{ab} = ?$, $E_{bc} = ?$, $E_{ca} = ?$

$E_{AB} = \sqrt{3} \times 240\angle 30° = 415.7\angle 30\,V$

$E_{BC} = \sqrt{3} \times 240\angle -120 + 30 = 415.7\angle -90\,V$

$E_{CA} = \sqrt{3} \times 240\angle -240 + 30 = 415.7\angle -210\,V$

(b) $I_A = \dfrac{E_{AN}}{Z_A} = \dfrac{240\angle 0\,V}{20\angle 0\,\Omega} = 12\,A\angle 0$

$I_B = \dfrac{E_{BN}}{Z_A} = \dfrac{240\angle -120\,V}{20\angle 0\,\Omega} = 12\,A\angle -120°$

$I_C = \dfrac{E_{CN}}{Z_A} = \dfrac{240\angle -240\,V}{20\angle 0\,\Omega} = 12\angle -240\,A$

(c) $I_n = I_A + I_B + I_C$

$= 12\angle 0 + 12\angle -120 + 12\angle -240$

$= 12(\cos 0 + j\sin 0) + 12(\cos -120 + j\sin(-120)) + 12(\cos -240 + j\sin(-240))$

$= 12(1 + j0) + 12(-0.5 - j0.866) + 12(-0.5 + j0.866)$

$= 0\,A$

a) $E_{AB} = \sqrt{3} \times 240\angle 30$

$= 415.7\angle 30$

$E_{AC} = \sqrt{3} \times 240\angle -90 = 415.7\angle -90$

$E_{CA} = \sqrt{3} \times 240\angle 150 = 415.7\angle 150$ V

Lang Li

8029378

b) $I_A = \frac{E_{AN}}{Z_A} = \frac{240\angle 0}{20\angle 0} = 12\angle 0$ A

$I_B = \frac{E_{BN}}{Z_B} = \frac{240\angle -120}{20\angle 0} = 12\angle -120$ A

$I_C = \frac{E_{CN}}{Z_C} = \frac{240\angle 120}{20\angle 0} = 12\angle 120$ A

c) $I_N = \bar{I}_A + \bar{I}_B + \bar{I}_C$

$= 12\angle 0 + 12\angle -120 + 12\angle 120$

$= 12(\cos 0 + j\sin 0) + 12[\cos(-120) + j\sin(-120)] + 12[\cos 120 + j\sin 120$

$= 12(1+0) + 12(-0.5 - 0.87j) + 12(-0.5 + 0.87j)$

$= 12 - 6 - 6$

$= 0$

11:26 AM
3/05/2018

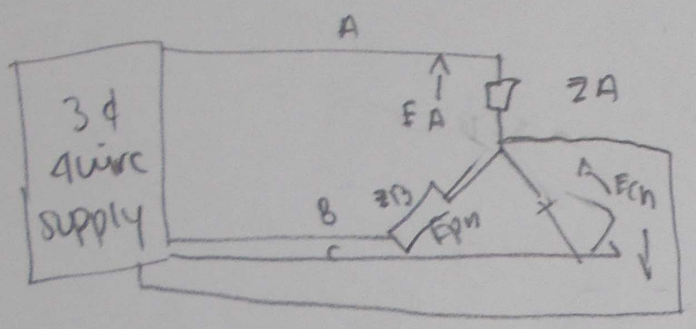
Exercise

A Balanced three phase star connected load consists of three 20Ω resistor connected via 3 & 4 wire load. Line to neutral voltage 240V.

Calculate a) Line voltage in polar form

b) Line current in polar form

c) Neutral current.



$E_{AN} = 240V$ $E_{AN} = 240 \angle 0$

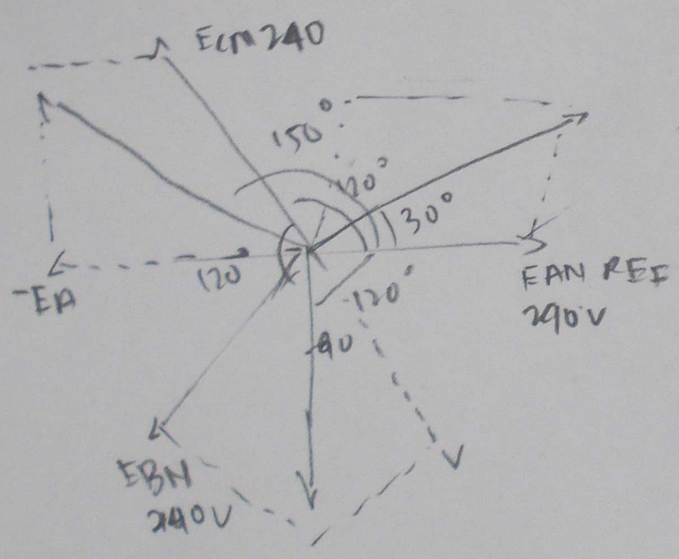
$E_{BN} = 240V$ $E_{AN} = 240 \angle -120$

$E_{CN} = 240V$ $E_{AN} = 240 \angle -240$

$E_{CN} = 240 \angle -240$

or

$240 \angle +120$



(a) $E_{AB} = \sqrt{3} \times 240 \angle 30^\circ = 415.7 \angle 30^\circ$

$E_{BC} = \sqrt{3} \times 240 \angle -90^\circ = 415.7 \angle -90^\circ$

$E_{CA} = \sqrt{3} \times 240 \angle 150^\circ = 415.7 \angle 150^\circ$

$Z_A = Z_B = Z_C = 20\Omega$

(b)

$I_A = \text{Line} = \text{phase} = \frac{E_{AN}}{Z_A} = \frac{240 \angle 0^\circ}{20 \angle 0} = 12 \angle 0 \text{ AMP}$

$I_B = \frac{E_{BN}}{Z_B} = \frac{240 \angle -120}{20 \angle 0} = 12 \angle -120 \text{ AMP}$

$I_C = \frac{E_{CN}}{Z_C} = \frac{240 \angle +120}{20 \angle 0} = 12 \angle +120 \text{ AMP}$

(c) $I_N = \bar{I}_A + \bar{I}_B + \bar{I}_C$

$= 12 \angle 0 + 12 \angle -120 + 12 \angle 120$

$= 12(\cos 0 + j \sin 0) + 12(\cos(-120) + j \sin(-120)) + 12(\cos 120 + j \sin 120)$

$= 12(1 + j0) + 12(-0.5 - j0.866) + (-0.5 + j0.866)$

$= 0$

MUHAMMAD ALIF ZULKARNAINI 803778051

A. C

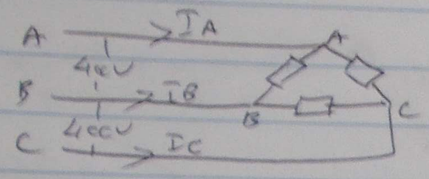
ERICK MATIAS 80373703

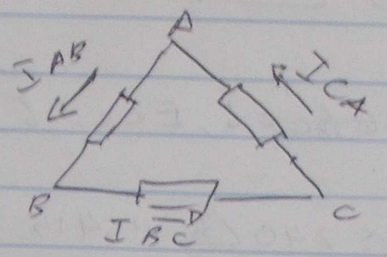
$E_{AB} = 400\,V\angle 0$ △ R = 10Ω/phase

$E_{BC} = 400\,V\angle -120$

$E_{CA} = 400\,V\angle -240$

@





$$I_{AB} = \frac{E_{AB}}{Z_{AB}} = \frac{400\angle 0}{10\angle 0} = 40\angle 0\,A$$

$$I_{BC} = \frac{E_{BC}}{Z_{BC}} = \frac{400\angle -120}{10\angle 0} = 40\angle -120\,A$$

$$I_{CA} = \frac{E_{CA}}{Z_{CA}} = \frac{400\angle -240}{100\angle 0} = 40\angle -240\,A$$

~~$I_A = I_{CA}$~~ $I_A + I_{CA} = I_{AB}$

$I_A = I_{AB} - I_{CA}$

$= 40\angle 0 - 40\angle -240$

$= 40 + j0 - (-20 + j34.64)$

$= 40 + j0 + 20 - j34.64$

$= 60 - j34.64$

$= 69.28\angle -30°$

$I_B = I_{BC} - I_{AB}$

$= 40\angle -120 - 40\angle 0$

$= -20 - j34.64 - 40$

$= -60 - j34.64$

$= 69.28\angle -150$

$I_C = I_{CA} - I_{BC}$

$= 40\angle -240 - 40\angle -120$

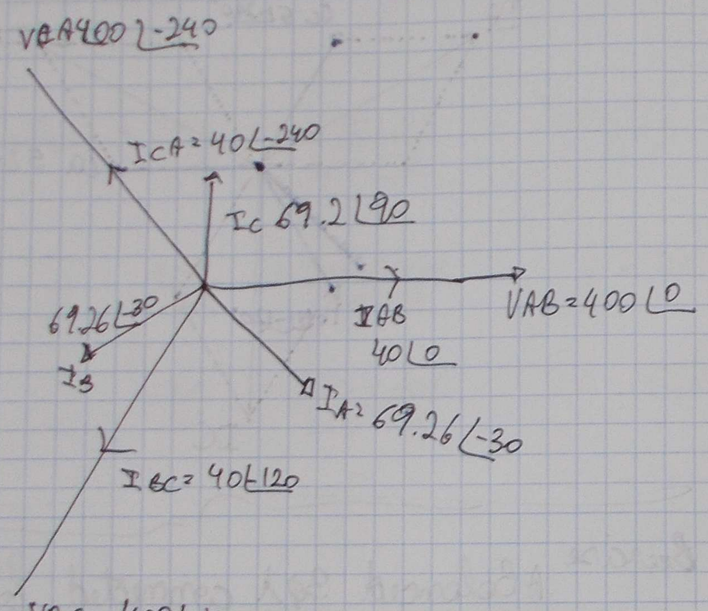
$= -20 + j34.64 - (-20 - j34.64)$

$= -20 + j34.64 + 20 + j34.64$

$= 0 + j69.28$

$= 69.28\angle 90°$

c)

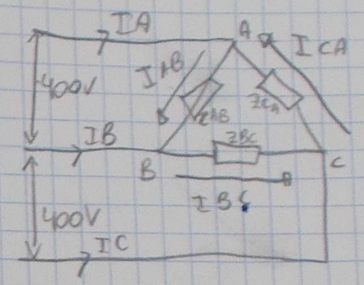


MATEUS G
803737657

Exercise

Balanced Δ load R=10Ω/ϕ, supply V=400V

find a) all phase current in polar form
b) all line I
c) phasor diagram



EAB = 400∠0
EBC = 400∠-120
ECA = 400∠-240

a) $I_{AB} = \frac{EAB}{ZAB} = \frac{400\angle 0}{10\angle 0}$

$I_{BC} = \frac{EBC}{ZBC} = \frac{40\phi\angle -120}{1\phi\angle 0}$

$I_{CA} = \frac{ECA}{ZCA} = \frac{40\phi\angle -240}{10\angle 0}$

IAB = 40∠0
IBC = 40∠-120
ICA = 40∠-240

40+j0
-20-j34.6
-20+j34.6

b) PT Ⓐ flow in = flow out

$I_A = I_{AB} - I_{CA}$

$I_A = 40\angle 0 - 40\angle -240$

Ⓑ $I_B = I_{BC} - I_{AB}$

$I_B = 40\angle -120 - 40\angle 0$

Ⓒ $I_C = I_{CA} - I_{BC}$

$I_C = 40\angle -240 - 40\angle -120$

convert to rectangular

$40 - (-20 + j34.6)$

$60 - j34.6$

$\sqrt{60^2 + 34.6^2}$ $\tan^{-1}\frac{-34.6}{60}$

$I_A = 69.26\angle -30$

$I_B = (-20 - j34.6) - (40)$

$-60 - j34.6$

$\sqrt{+60 + j34.6}$ $+\tan^{-1}\frac{+34.6}{+60}$

$I_B = 69.26\angle -150$

$I_C = (-20 + j34.6) - (-20 - j34.6)$

$0 + j69.2$

$\sqrt{69.2^2}$ $\tan^{-1}\frac{69.2}{0}$

$I_C = 69.2\angle 90$

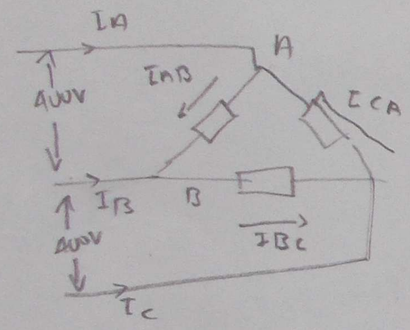
Exercise

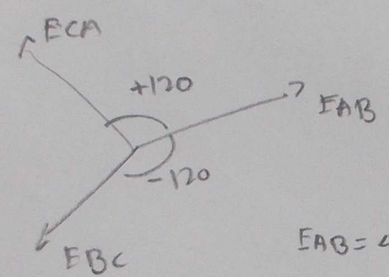
A balanced delta load R = 10Ω/phase is connected to 3 ϕ Balanced supply 400V rms line

Calculate a) All phase currents in polar form

b) All line currents in polar form

c) Draw the phasor diggram





$E_{AB} = 400\angle 0^\circ V$

$E_{BC} = 400\angle -120^\circ V$

$E_{CA} = 400\angle +120^\circ V$

$I_{AB} = \frac{E_{AB}}{Z_{AB}} = \frac{400\angle 0}{10\angle 0} = 40\angle 0^\circ A$

$I_{BC} = \frac{E_{BC}}{Z_{BC}} = \frac{400\angle -120}{10\angle 0} = 40\angle -120^\circ A$

$I_{CA} = \frac{E_{CA}}{Z_{CA}} = \frac{400\angle 120}{10\angle 0} = 40\angle 120^\circ A$

PT (A) Flow in = Flow out

$I_A + I_{CA} = I_{AB}$

$I_A = I_{AB} - I_{CA}$

$= 40\angle 0 - 40\angle 120$

$= 40(\cos 0 + j\sin 0) - 40\angle(\cos 120^\circ + j\sin 120)$

$I_A = 69.36\angle -30^\circ$

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PT (B) Flow in Flow out

$I_B + I_{AB} = I_{BC}$

$I_B = I_{BC} - I_{AB}$

$= 40\angle -120 - 40\angle 0$

$= 40[\cos(-120) + j\sin(-120)] - 40(\cos 0 + j\sin 0)$

$I_B = 69.36 \quad \angle -150$

$60^2 + 34.8^2$

-150

PT (C) Flow in = Flow Out

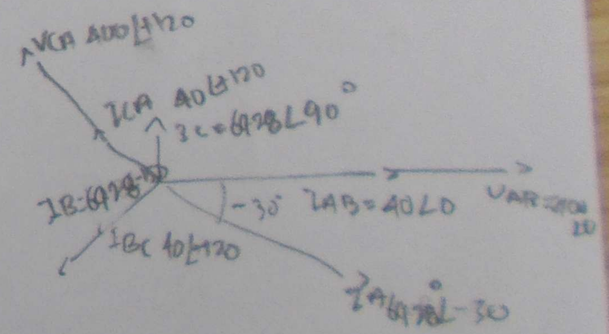
$I_C + I_{BC} = I_{CA}$

$I_C = I_{CA} - I_{BC}$

$= 40\angle 120 - 40\angle -120$

$= 40\angle(\cos 120 + j\sin 120) - 40(\cos(-120) + j\sin(-120))$

$= 69.28\angle 90^\circ$



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$E_{AB} = 400 \angle 0°\ V$

$E_{BC} = 400 \angle -120\ V$

$E_{CA} = 400 \angle 120\ V$

$I_{AB} = \frac{400 \angle 0}{10 \angle 0} = 40 \angle 0\ A$

$I_{BC} = \frac{400 \angle -120}{10 \angle 0} = 40 \angle -120\ A$

$I_{CA} = \frac{400 \angle 120}{10 \angle 0} = 40 \angle 120\ A$

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a) Flow in = Flow out

$I_A + I_{CA} = I_{AB}$

$I_A = I_{AB} - I_{CA}$

$= 40 \angle 0 - 40 \angle 120$

$= 40(\cos 0 + j \sin 0) - 40(\cos 120 + j \sin 120)$

$= 40(1 + 0) - 40(-0.5 + 0.87j)$

$= 40 + 20 - 34.8j$

$= 60 - 34.8j$

$I_A = \sqrt{60^2 + 34.8^2} \angle -\tan^{-1} \frac{34.8}{60}$

$= 69.36 \angle -30.1$

b) $I_B + I_{AB} = I_{BC}$

$I_B = I_{BC} - I_{AB}$

$= 40 \angle -120 - 40 \angle 0$

$= 40[\cos(-120) + j \sin(-120)] - 40$

$= 40(-0.5 - 0.87j) - 40$

$= -60 - 34.8j$

$I_B = \sqrt{60^2 + 34.8^2} \angle -(180 - \tan^{-1} \frac{34.8}{60})$

$= 69.36 \angle -150$

c) $I_C = I_{CA} - I_{BC}$

$= 40 \angle 120 - 40 \angle -120$

$= 20 - 34.8j - [40(-0.5 - 0.87j)]$

$= 20 + 34.8j - [-20 - 34.8j]$

$= 69.2 \angle 90j$