MOONTLIKE ANTWOORDE VIR:

Elektrisiënswerk SG / ELECTRICIANS WORK

Vraag 1. / Question 1.

1.1.1. Voltage drop across 150Ω = 5V

$I = \frac{V}{R}$

$= 5/150$

$= 0,033$

$= 33mA.$ **(3)**

1.1.2. $I = V/X_L$

$= 27,5/137,5Ω$

$= 0,2$ Amp **(3)**

of/or

$I_{30Ω} = V/R$

$= 5/30$

$= 0,1666$

$\therefore I_{150Ω} + I_{30Ω} = 0,0333 + 0,1666$

$= 0,199$ Amp

$\approx 0,2$ Amp.

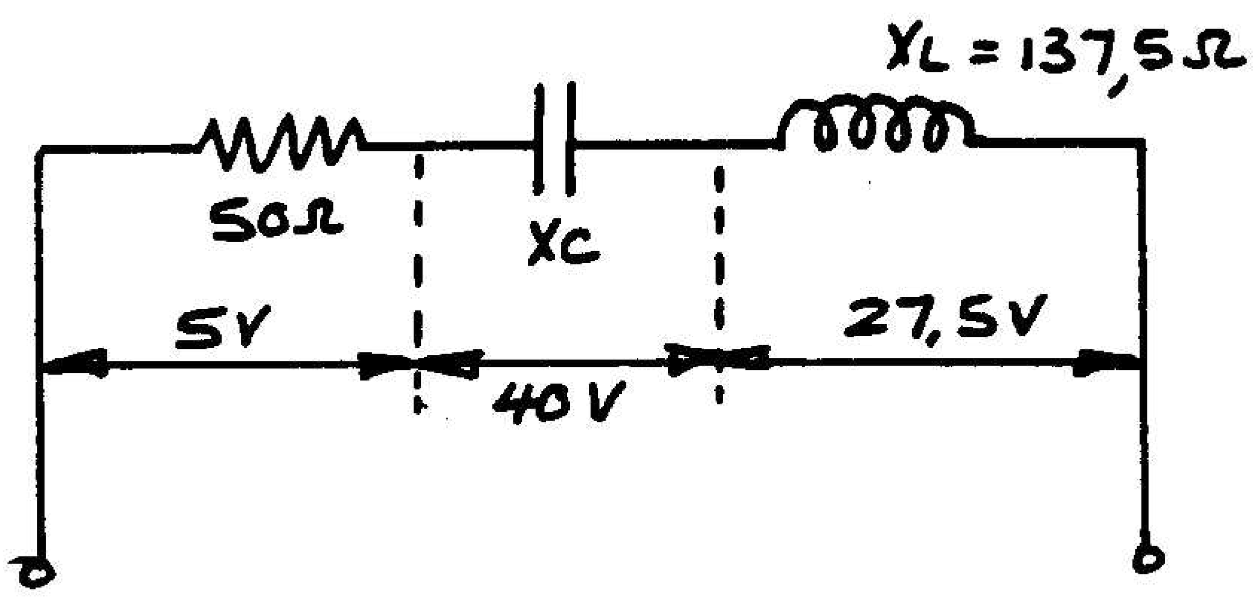
1.1.3. $\frac{1}{R_p} = \frac{1}{R_{150Ω}} + \frac{1}{R_{30Ω}}$

$= \frac{1}{150} + \frac{1}{30}$

$= 25Ω$

$R_T = 25 + 25$

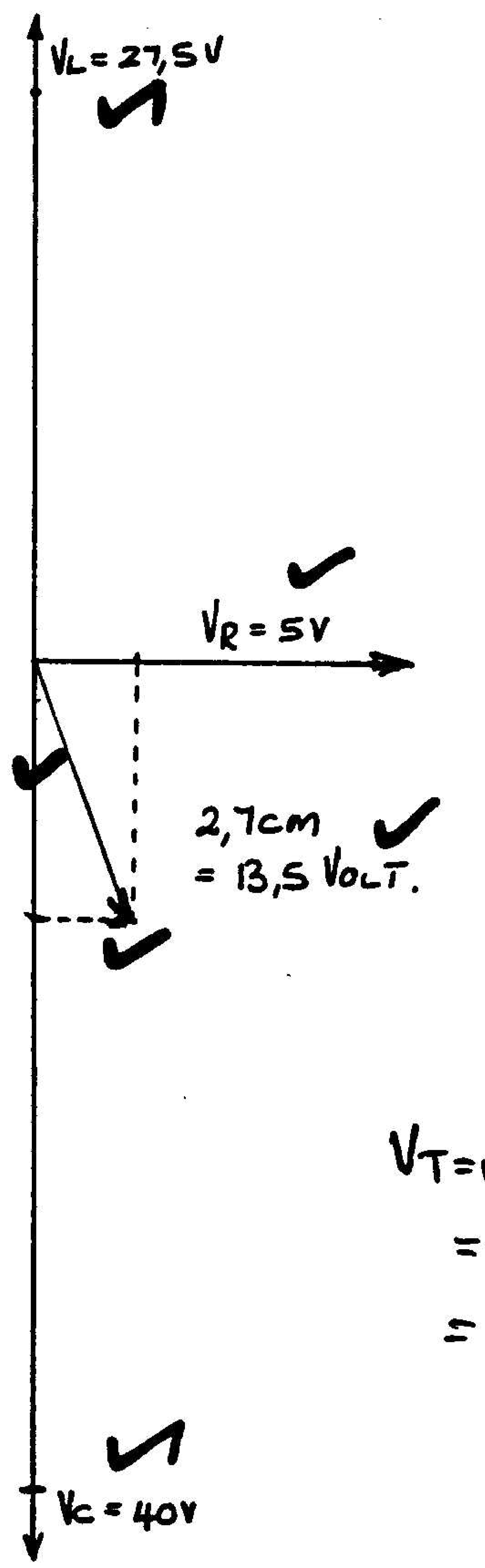
$= 50Ω$ **(2)**



1.1.4. $V_R = I_T \times R$

$= 0,2 \times 25$

$= 5V$



1.1.5. Vanaf die fasordiagram lyk dit of Cos θ ongeveer 0,6 is, dit is minder as 1 en meer as 0.

Maar die stroom is voorlopend. **(2)**

- from phasordiagram it looks like if Cos θ is ± 0,6. ∴ less than 1 and more than 0. The current is leading.

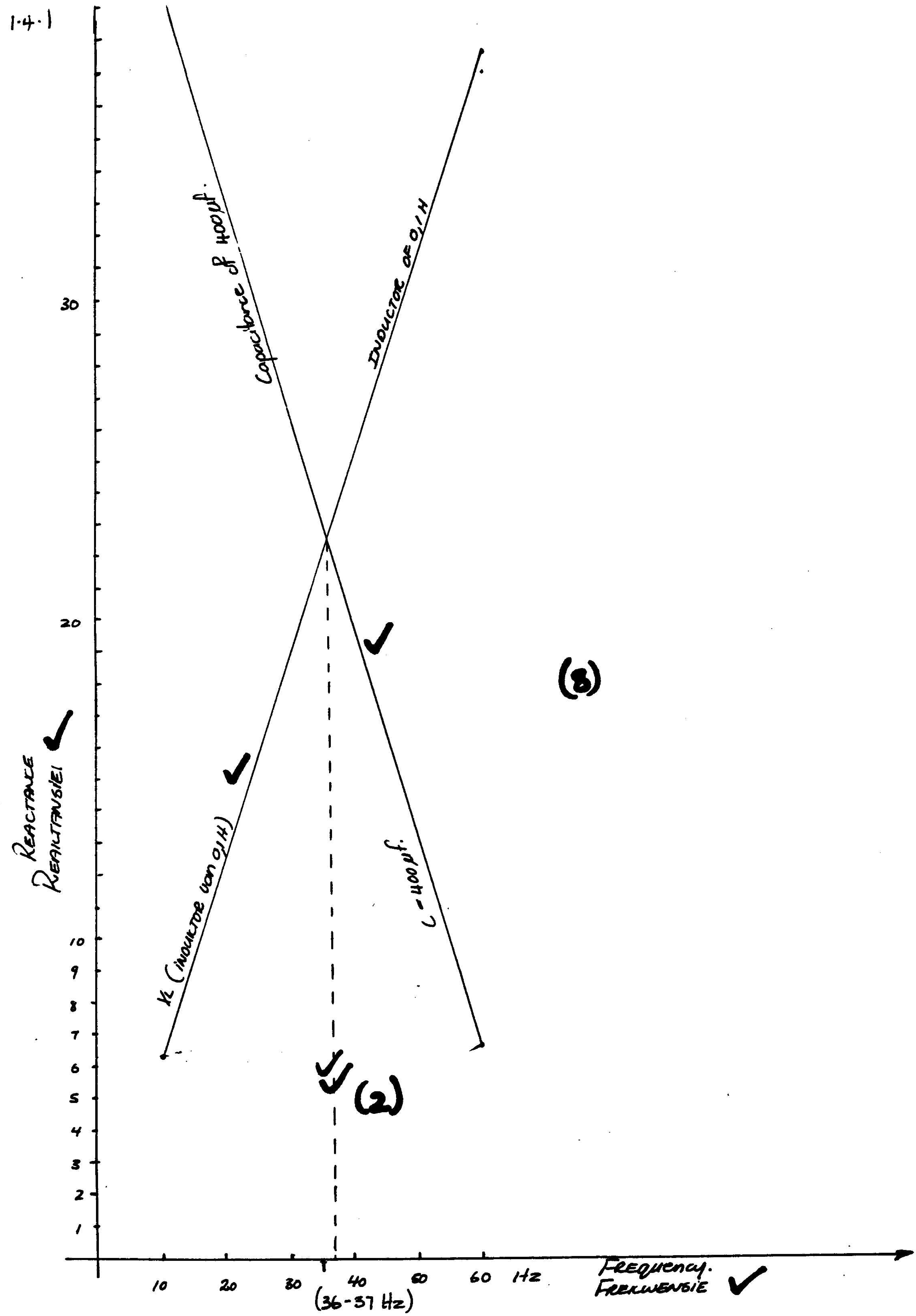
Toets:

$V_T = \sqrt{V_R^2 + (V_C - V_C)^2}$

$= \sqrt{181,25}$

$= 13,462$ Volt.

1.4.1



Capacitance of 400µF.
INDUCTOR OF 0,1 H
Reactance
Reaktansie
XL (inductor van 0,1 H)
C = 400 µF.
(8)
(2)
30
20
10
9
8
7
6
5
4
3
2
1
10
20
30
40
50
60
Hz
(36-37 Hz)
Frequency.
Frekwensie

1.1.6. $X_C = V/I$ ✓ $\therefore X_C = \frac{1}{2\pi f C}$ ✓

$= 40/0{,}2$ $\frac{1}{2\pi f C} = X_C \Rightarrow 2\pi f C = \frac{1}{X_C} \Rightarrow C = \frac{1}{2\pi f X_C}$ ✓

$= 200$ ohm. ✓

$C = \frac{1}{2\pi(40\,Hz)(200)}$

$= 19{,}89\,\mu F$. ✓ **(5)**

1.1.7. $Z = V/I$. ✓

$= 13{,}5/0{,}2$ ✓

$= 67{,}5$ ohm. ✓ **(3)**

(1.2)

$e = E_m \sin 2\pi f t$ ✓✓ **(2)**

(1.3) $i = 5$ amp

$t = 5 \times 10^{-3}$ $i = I_m \sin 2\pi f t$

$I_m = ?$ $I_m \sin 2\pi f t = i$ ✓

$f = \frac{1}{T}$ ✓ $I_m \sin (2\pi)(50) \times (5\times10^{-3}) \times 57{,}3 = 5$. ✓

$= \frac{1}{20\times10^{-3}}$ $I_m \sin 90° = 5$ **(5)**

$= \underline{50\,Hz.}$ ✓ $\underline{I_m = 5\,amp.}$ ✓ (omeede die hoek 90° is)

(because the phaseangle is 9[0°]

1.4.2 <u>At 10 Hz</u> <u>At 60 Hz</u>

$X_L = 2\pi f L$ $X_L = 2\pi f L$

$= 2\pi(10)0{,}1$ $= 2\pi(60)0{,}1$

$= 6{,}283\,\Omega$ ✓ $= 37{,}699\,\Omega$ ✓

$X_C = \frac{1}{2\pi f C}$ $X_C = \frac{1}{2\pi f C}$

$= \frac{1}{2\pi(10)(400\times10^{-6})}$ $= \frac{1}{2\pi(60)(400\times10^{-6})}$

$= 39{,}788\,\Omega$ ✓ $= 6{,}631\,\Omega$ ✓

1.5. $X_L = 2\pi f L$ ✓ $X_C = \frac{1}{2\pi f C}$ ✓

1.5.1 $= 2\pi(50)0,3$ $= \frac{1}{2\pi(50)150\times10^{-6}}$

$= 94,247$ ohm. ✓ $= 21,220$ ohm. ✓

$I_R = V/R$ $I_L = V/X_L$ $I_C = V/X_C$

$= 110/45$ $= 110/94,247$ $= 110/21,22$

$= 2,44$ Amp ✓ $= 1,167$ Amp ✓ $= 5,183$ Amp. ✓ **(7)**

1.5.2 Total current / Totale stroom

$I_T = \sqrt{I_R^2 + (I_C - I_L)^2}$ ✓

$= \sqrt{2,44^2 + (5,183 - 1,167)^2}$

$= \sqrt{22,088}$ ✓

$= 4,7$ Amp. ✓ **(3)**

1.5.3 Impedance / Impedansie:

$Z = \frac{V}{I}$ ✓

$= 110/4,7$

$= 23,405$ ohm. ✓ **(2)**

1.5.4 Phase angle / Fasehoek

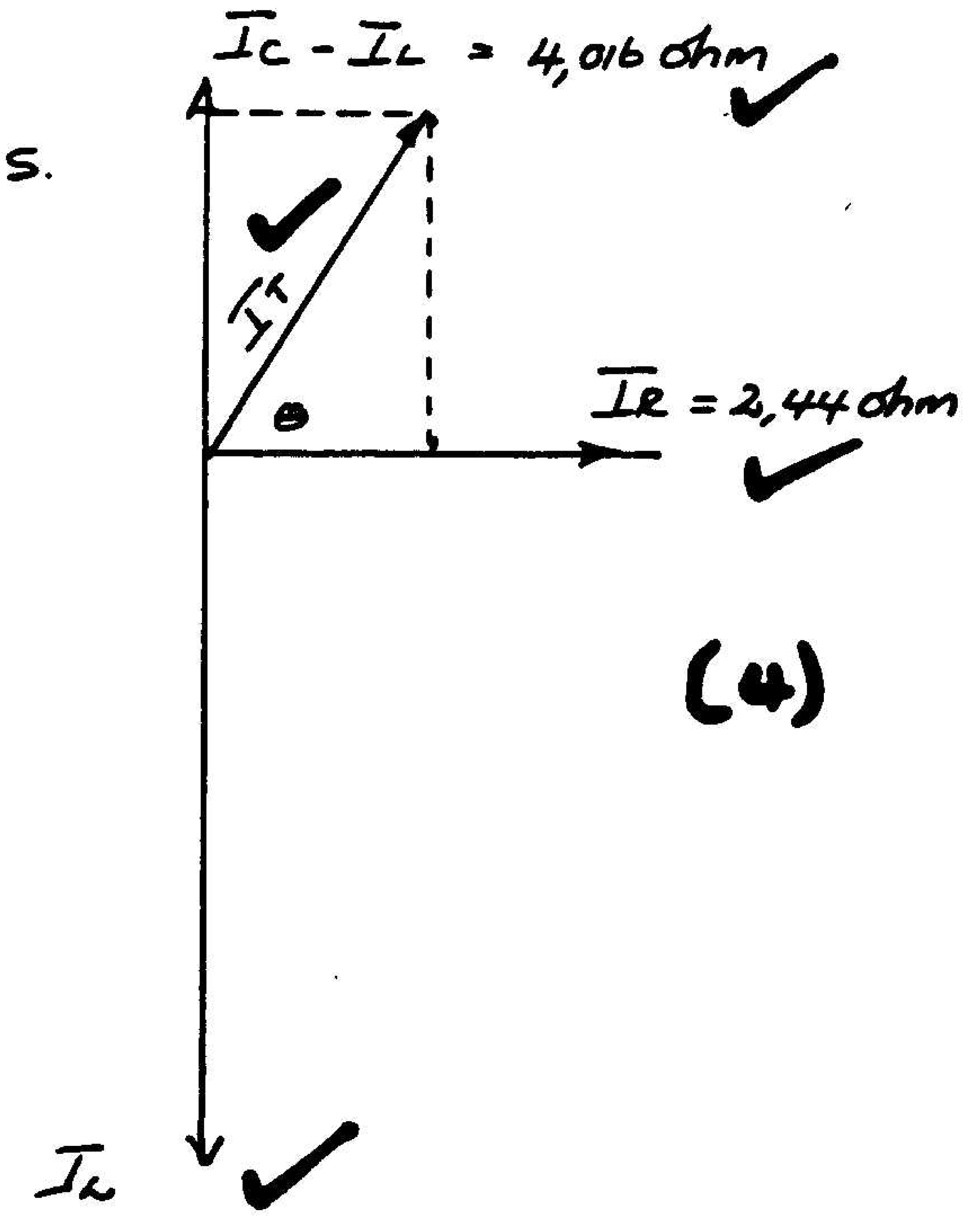
$\tan\theta = \frac{I_C - I_L}{I_R}$ ✓

$= \frac{4,016}{2,44}$ ✓

$\theta = \tan^{-1} 1,6459$

$\theta = 58,718°$ ✓ **(3)**

1.5.5.



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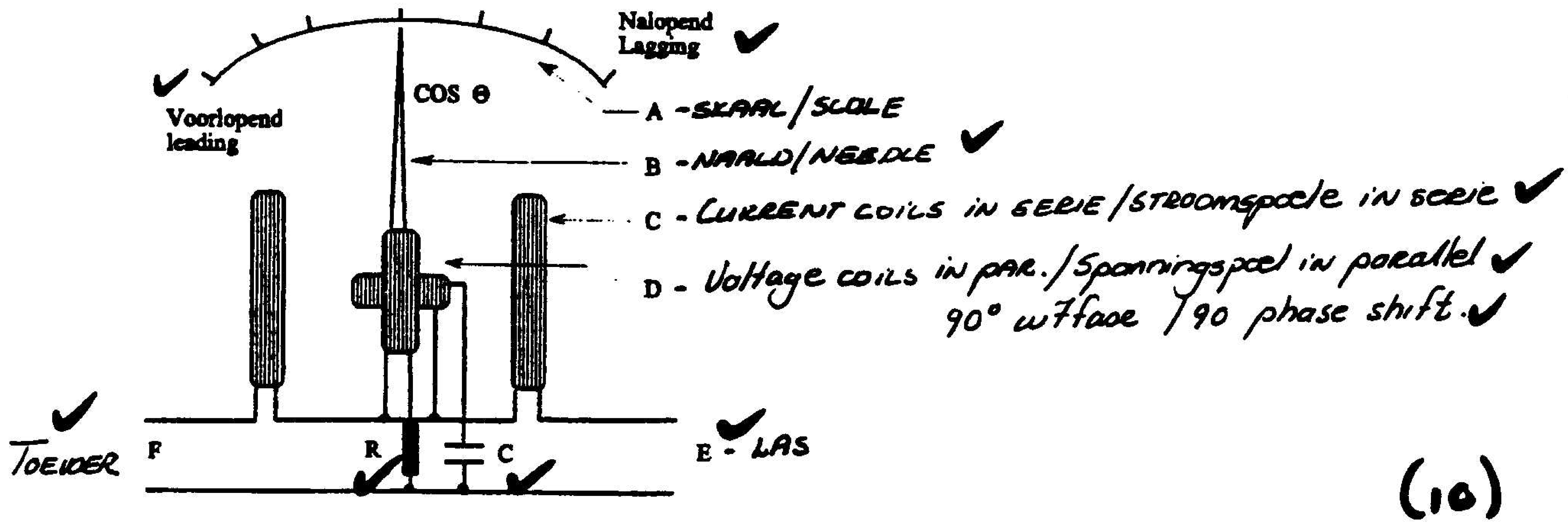
Vraag 2 / Question 2.

2.1.



(10)

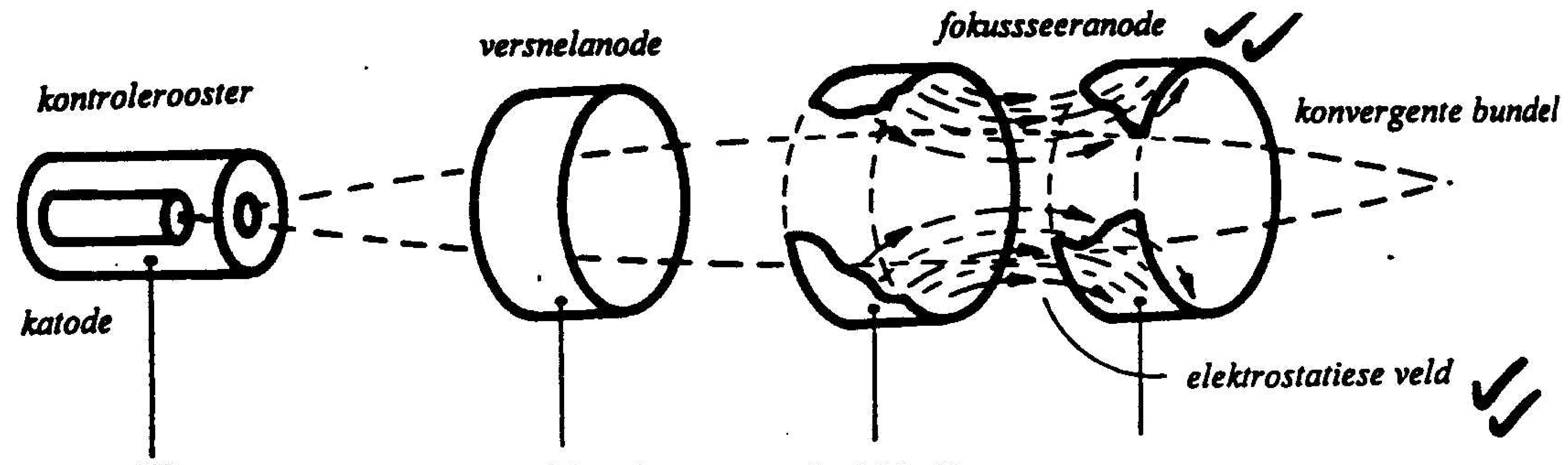
2.2. Dit sal nie prakties wees om hoëstroom- en hoëspanningsmeetinstrumente te vervaardig nie aangesien die dikte van die isolasie en die grootte van die geleiers dit prakties onmoontlik sal maak om mee te werk. Instrumenttransformators word dikwels by ws-stroombane gebruik om die strome en spannings tot veilige en praktiese waardes te verminder. (4)

It would not be practical to construct high current and high voltage measuring instruments since the insulation and conductor sizes would become practically impossible to work with. Instrument transformers are often used with ac circuits to reduce the currents and voltages to safe practical values.

2.3. Demping word d.m.v werwelstrome, wat opgewek word wanneer die skyf deur die vloed van die dempmagneet beweeg, verkry. (2)

Damping is obtain by eddy currents, which is induce when the disc moves throw the flux of the damping magnet.

2.4.



(4)

2.5. $V_L = 380$ VOLT

$P_{OUT} = 12\,kW$

$\eta = 85\%$

$\cos\theta = 0,8$

2.5.1 $\text{Efficiency} = \frac{\text{OUTPUT}}{\text{INPUT}}$ ✓

$\frac{\text{OUTPUT}}{\text{INPUT}} = \text{EFFICIENCY}.$

$\text{INPUT} = \frac{\text{OUTPUT}}{\text{EFFICIENCY}}$ ✓

$= \frac{12\,000}{0,85}$ ✓

$= 14117,647\ W$

$= 14,176\ kW.$ ✓ (4)

2.5.2. $P = \sqrt{3}\, V_L I_L \cos\theta\, \eta$

$I_L = \frac{P}{\sqrt{3}\, V_L \cos\theta\, \eta}.$ ✓

$= \frac{14117,647}{\sqrt{3}(380)\, 0,8 \times 0,85}$ ✓

$= 31,543$ Amp ✓ (3)

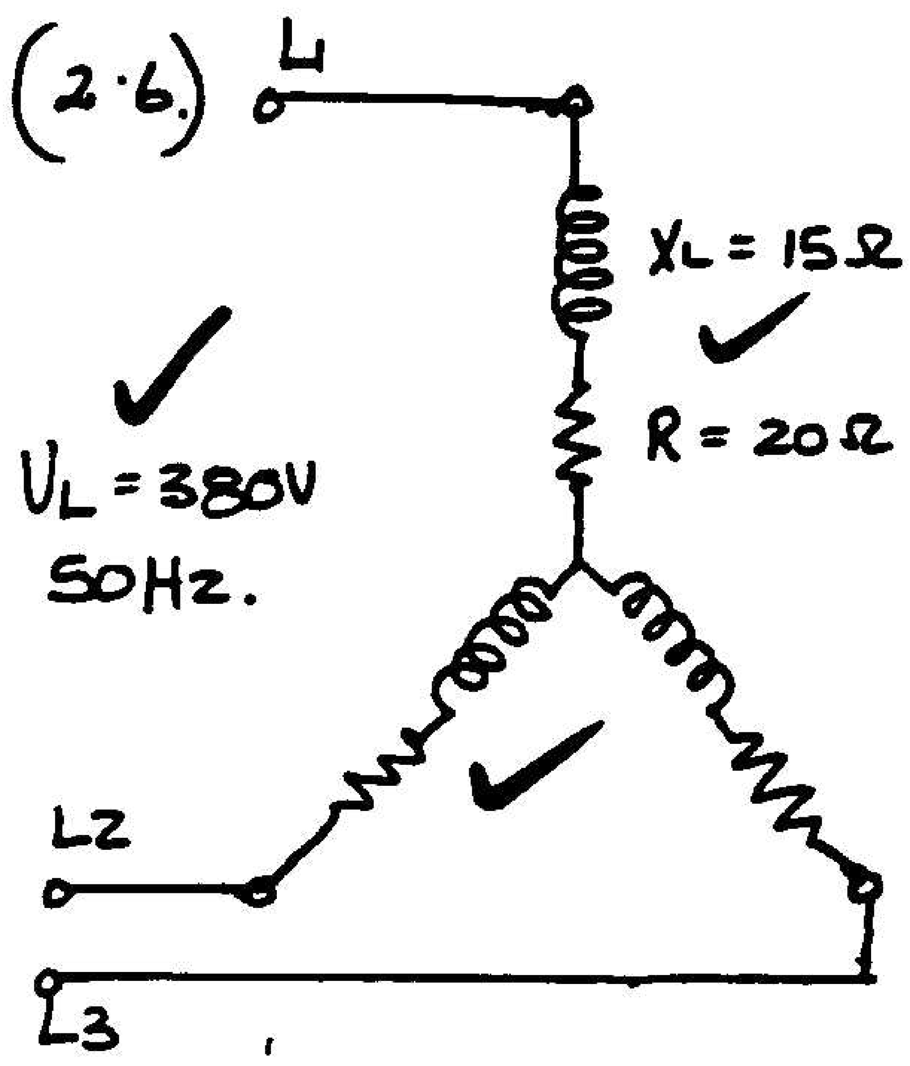
2.5.3. Delta-verbind

$I_L = \sqrt{3}\, I_{ph}$ ✓

$I_{ph} = \frac{I_L}{\sqrt{3}} = \frac{31,543}{\sqrt{3}}$ ✓

$= 18,211$ Amp ✓ (3)

(2.6)



(3)

STER / STAR

$V_L = \sqrt{3}\, V_{ph}$

$V_{ph} = \frac{V_L}{\sqrt{3}}$

$= \frac{380}{\sqrt{3}}$

$= 219{,}393$ VOLT

IMPEDANCE OF THE COIL
Impedansie v.d Spoel:

$Z = \sqrt{R^2 + X_L^2}$

$= \sqrt{20^2 + 15^2}$

$= \sqrt{625}$

$= 25\,\Omega$

$\therefore\ I_{ph} = V_{ph}/Z.$

$= 219{,}393/25$

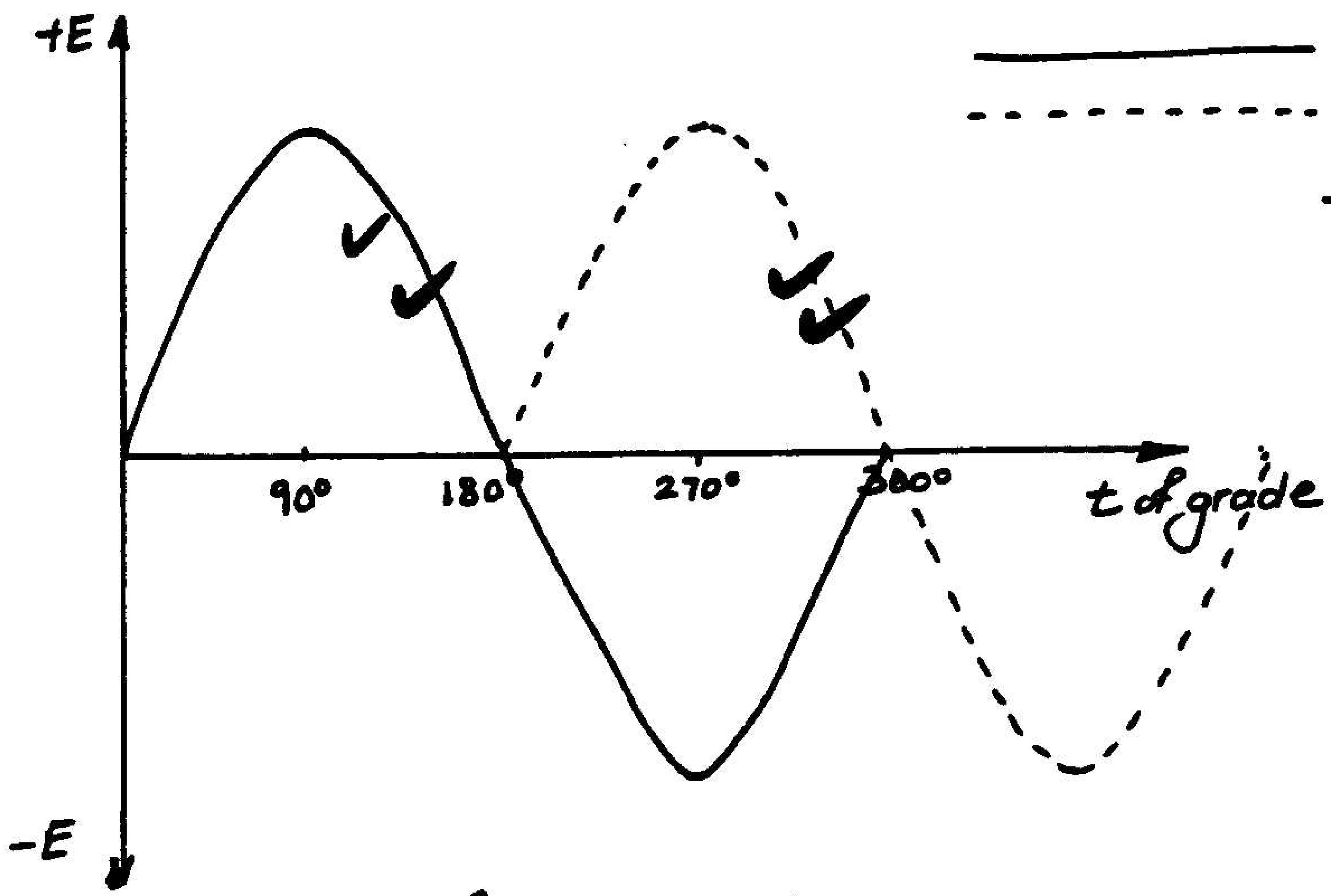
$= 8{,}775$ Amp.

(7)

$I_{ph} = I_L = 8{,}775\,A.$

Vraag 3 / Question 3

3.1



——— Primêrespanning

- - - - Sekondêrespanning met 180° versku.

- die sekondêrekant se golf kan klein wees, verlagingstransformator.

(4)

——— Primary voltage

- - - - Secondary voltage with 180° phase shift

NOTE: the secondary voltage ~~will~~ must be smaller: stepdown transforme

3.2 Stoortenk:

Olietenks kan 'n gladde oppervlakte hê - stoor die verkoelingsolie of verkoelervinne of verkoelerbuise. (2)

Storage tank:

Oil tanks can have a smooth area. - store the oil for cooling in tank or cooling fins or cooling pipes.

Asemhaler: / Breather.

Is daar om die vog uit die olie te hou (2)

Is there to keep the damp out of the oil.

Olie / Oil

· Word gebruik vir verkoeling en isolasie (2)

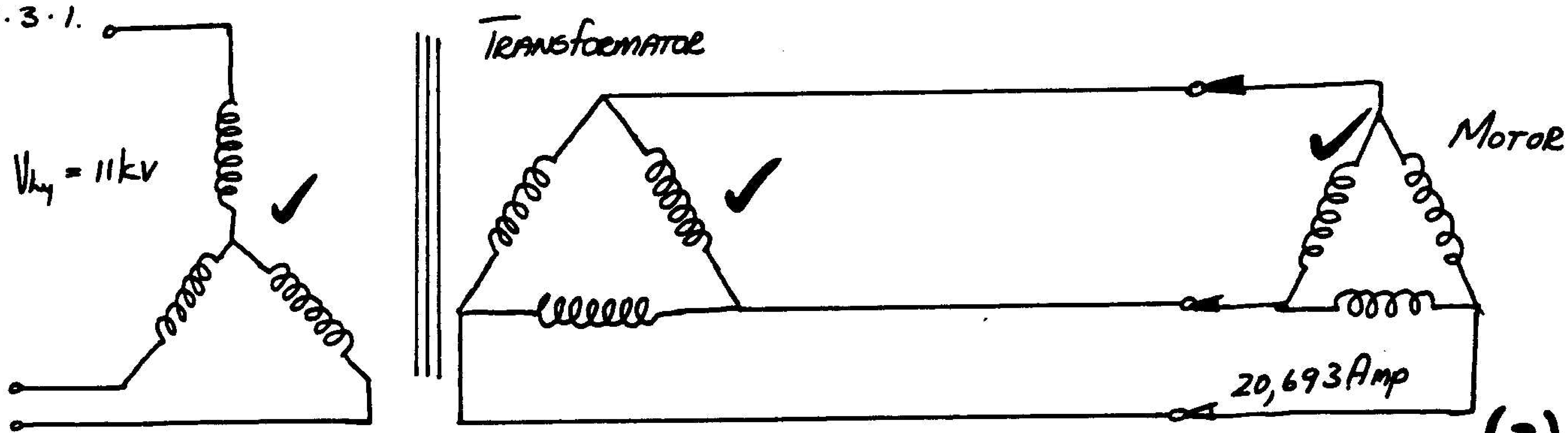
Is used for cooling and isolation.

3.3. $N_1 = 12,7$ | $\eta = 93\%$

$N_2 = 1$ | $\cos\theta = 0,9$

$V_{L_1} = 11kV$ | $P = 15kW$

3.3.1.



(3)

3.3.2. STER

$V_L = \sqrt{3}\, V_{ph}$ ✓

$V_{ph} = \frac{V_L}{\sqrt{3}} = 6350,852$ Volt ✓

$\therefore \frac{N_1}{N_2} = \frac{V_1}{V_2}$ ✓

(4)

$\frac{12,7}{1} = \frac{6350,852}{V_2}$

$V_2 = 500$ Volt. (spanning waaronder motorewindings verkeer) ✓

3.3.3.

$P = \sqrt{3}\, V_L I_L \times \cos\theta \times \eta$ ✓

$\sqrt{3}\, V_L I_L \cos\theta\, \eta = P$

$I_L = \frac{15000}{\sqrt{3} \times 500 \times 0,9 \times 0,93}$ ✓

$= \frac{15000}{724,863}$

$= 20,693$ Amp ✓ (3)

3.3.4 $I_{ph} = \frac{I_L}{\sqrt{3}}$ ✓

$= \frac{20,693}{\sqrt{3}}$ ✓

$I_{ph_2} = 11,947$ Amp. (sekondêre fasestroom) ✓ (3)

3.3.5 $\frac{I_1}{I_2} = \frac{N_2}{N_1}$ ✓

$I_1 = \frac{11,947}{12,7}$

$I_1 = 0,94$ Amp. ✓

$I_1 = I_{L_1} = 0,94A$ ✓ (3)

3.3.6 $P = \sqrt{3}\, V_L I_L \times 1$ ✓ $\cos\theta = 1$ ✓

$= \sqrt{3} \times 11000 \times 0,94$ ✓

$= 17,922$ kW ✓✓

KVA = 17,922 VA ✓ (6)

Vraag 4 / Question 4.

Singlephase motor / Enkelfase motor

4.1. $KVA = V \times I$

$= 380 \times 10$

$= 3800\ VA$

$= 3{,}8\ kVA$

Three-phase motor / Driefasemotor

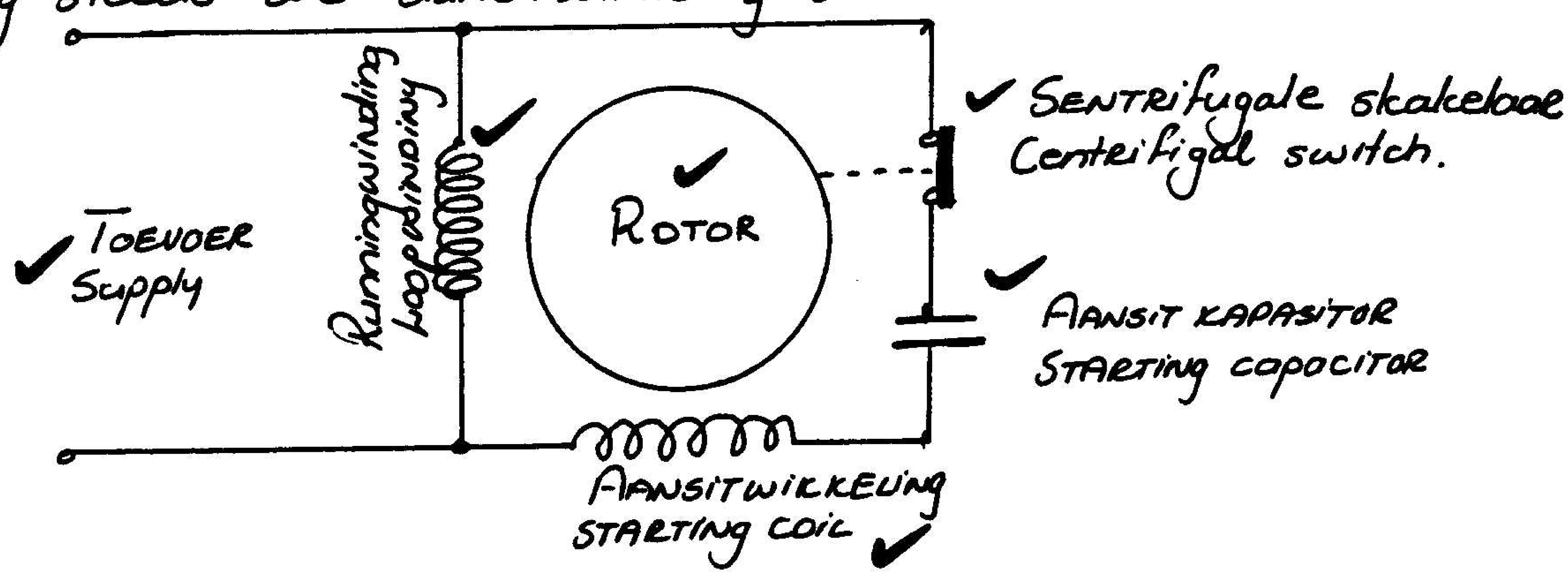
$KVA = \sqrt{3}\ V_L I_L$

$= \sqrt{3} \times 380 \times 10$

$= 6581{,}79 = 6{,}581\ kVA$

4.2. 'n Verbetering kan op die splitfasemotor se aansitweringkrag gemaak word deur 'n kapasitor in serie met die aansitwikkeling te koppel

Die stroom deur die loopwikkeling loop die spanning met 'n sekere hoek na. Deur 'n geskikte kapasitor te kies, kan die strome tussen die twee wikkelings nagenoeg 90° gemaak word. Dit veroorsaak nou dat die aansitweringkrag hoër is. Die sentrifugale skakelaar skakel nog steeds die aansitwikkeling uit.



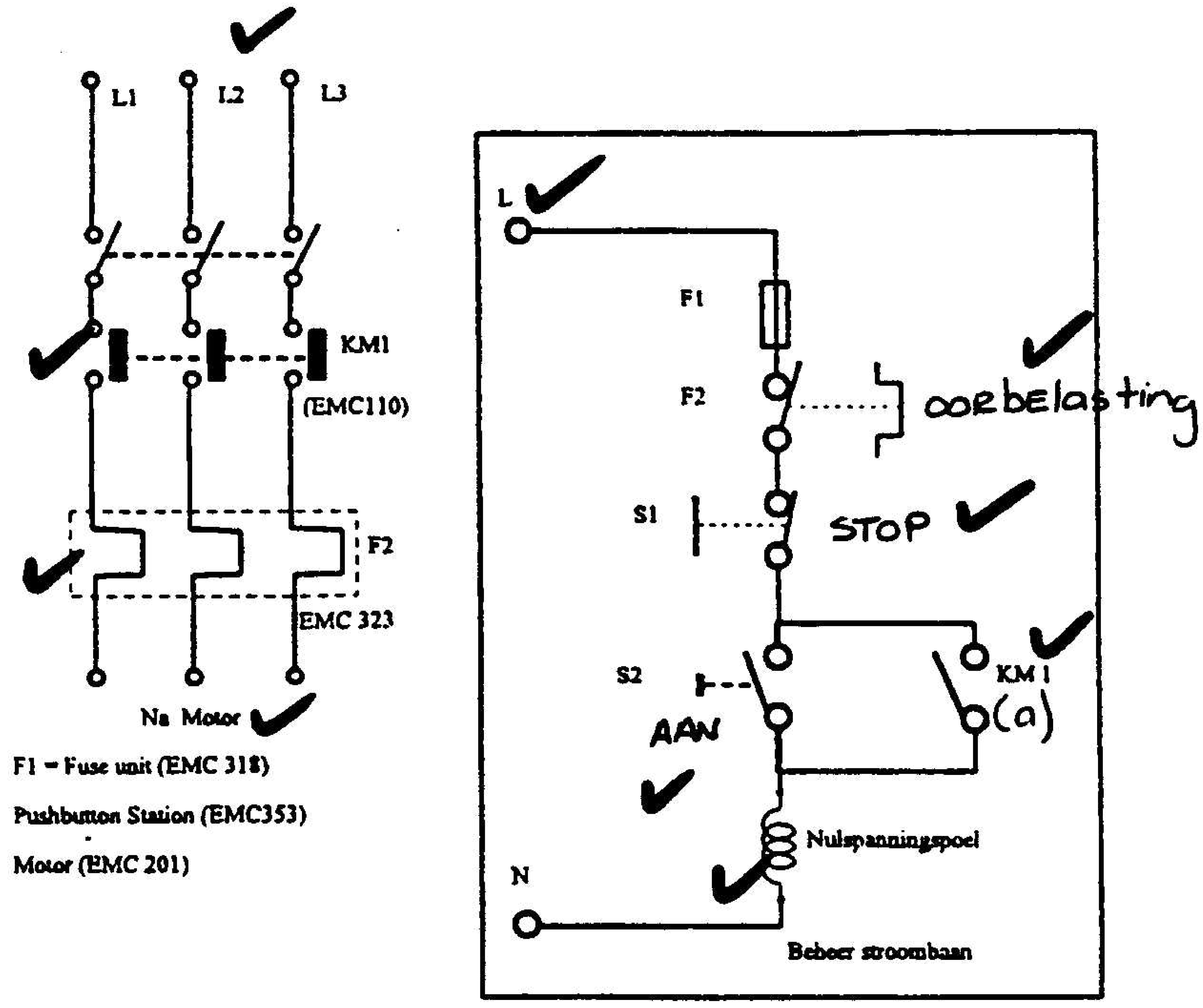
(12)

An improvement can be made on the starting torque of a split-phase motor by connecting a capacitor in serie with the starting coil. The current is lagging by a certain angle. To choose a suitable capacitor the phase angle can be improve up to 90°. This will cause a beter starting torque. The centrifigule switch still switch of the starting coil at a certain speed. The change of direction can be done by changing either the starting- or the running windings connection.

Draairigting kan verander word deur of die loopwinding of aansit-winding se verbindings om te ruil.

4.3. Die motor word in ster vir aansit verbind wat die motorwikkelings teen 'n laer spanning voorsien.
In ster word die spanning oor elke fase tot $1/\sqrt{3}$ of 58% van die lynspanning verminder. m.a.w die stroom gaan dan ook verminder word.
The motor is connected in star for start which will reduce a lower voltage. In star the voltage over each phase is reduce by $1/\sqrt{3}$ or 58% line voltage. thus also the current. **(3)**

4.4.



(10)

4.5. - Bi-metaalstrook. - Bi-metalstrip
- Oorstroomrelê. - Overload relay **(2)**

4.6 pare pole = 2

$V_L = 380V$

$f = 50Hz$

$N_R = 1440$ r/m

$f = \frac{pN_s}{60}$

$N_s = \frac{f \times 60}{2}$

$N_s = 1500$ r/m

$N_s - N_R = 1500 - 1440$

$= 60$ r/m $\therefore$ $60 \div 60 = 1$ Hz

$\therefore$ frekwensie in Rotorgeleiers = 1 Hz **(7)**

4.7. $\eta = ?$

$P = 1{,}7\ kW$ (Afvoer)

$P = 2\ kw$ (Invoer)

$\eta = \dfrac{\text{Afvoer}}{\text{Invoer}}$ ✓

$= \dfrac{1700}{2000}$ ✓ ✓

$= 0{,}85 \times 100\ \%$ ✓

$= 85\ \%$ ✓ **(5)**

4.8 Om die kontaktors aan te skakel. ✓✓

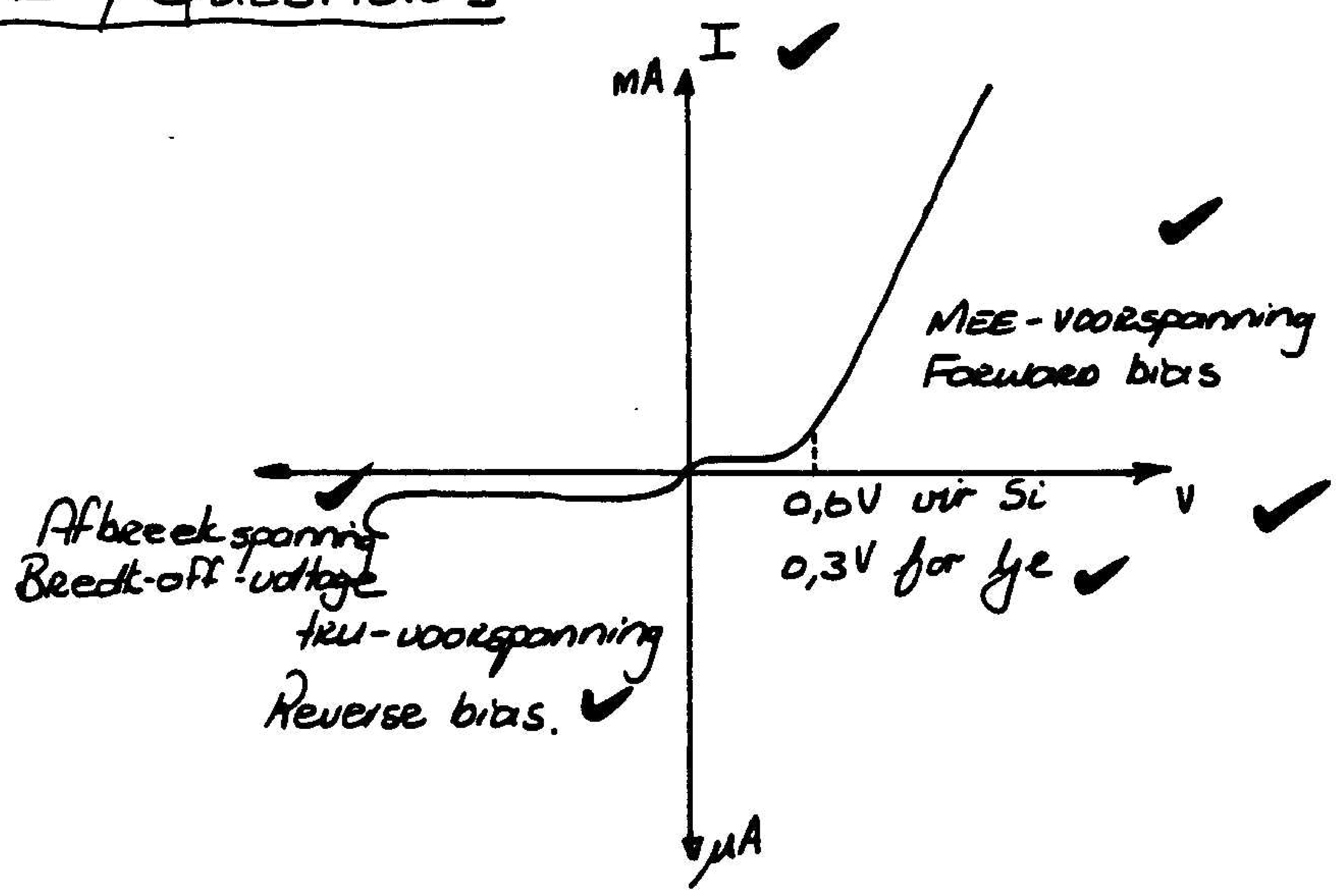
Vir veiligheidsdoeleindes. ✓✓ (Verduidelik kortliks) **(4)**

To switch on the contactors. (activate contactors).

for safety purposes. (Explain briefly.)

Vraag 5 / Questions 5

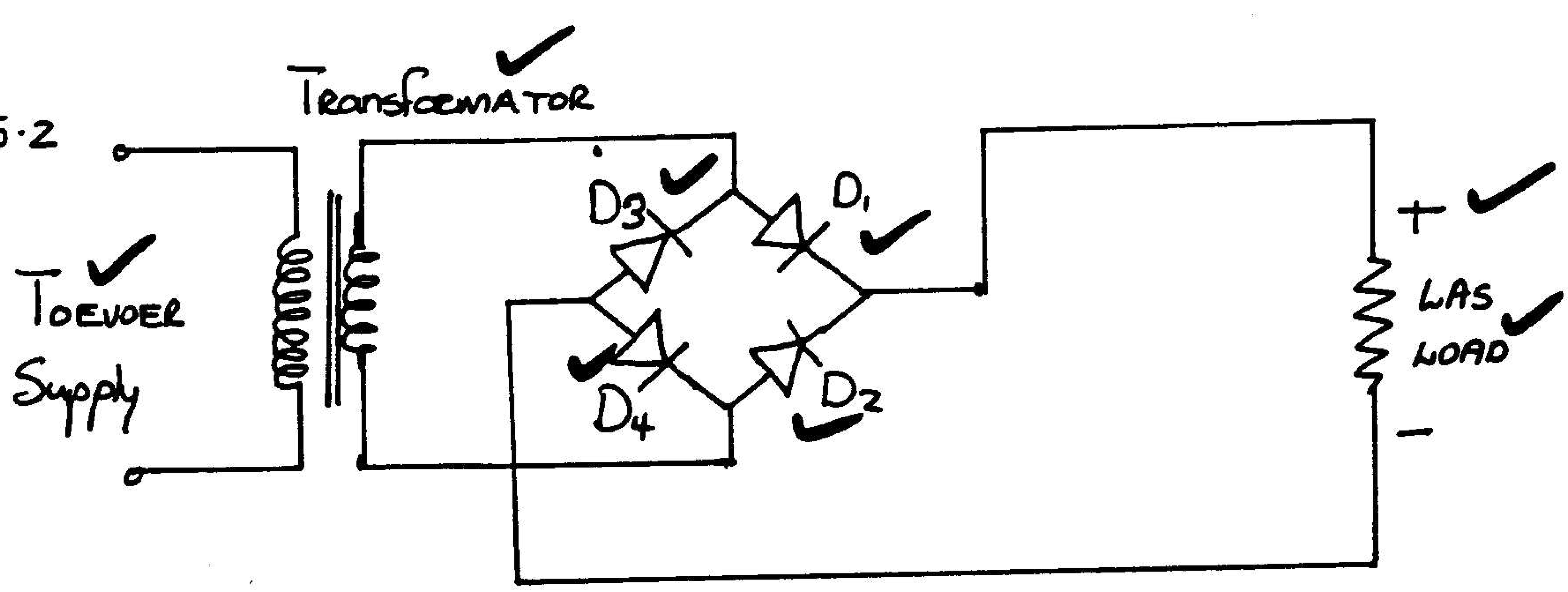
5.1



*Pls. use both 5.1 answers. (next to each other / below each other) Thank you.

(6)

5.2



(8)

5·3 (i) Versterker ✓ (i) Amplifier (2)

(ii) Skakelaar (elektronies) ✓ (ii) Electronic switch.

5·4.

N-Tipe Byvoeging

Die basiese kristalstruktuur bestaan uit atome met 4 valensie-elektrone (tetravalente). Indien 'n atoom wat 5 valensie-elektrone (pentavalente) bevat tot die kristalstruktuur bygevoeg word sal 4 van hierdie elektrone kovalente bindings binnedring terwyl die oorblywende elektron vry sal wees en word slegs deur aantrekking van die moederatoom (positiewe lading) in die omgewing gehou, fig. 6.4

OF DIE N-TIPE OF DIE P-TIPE

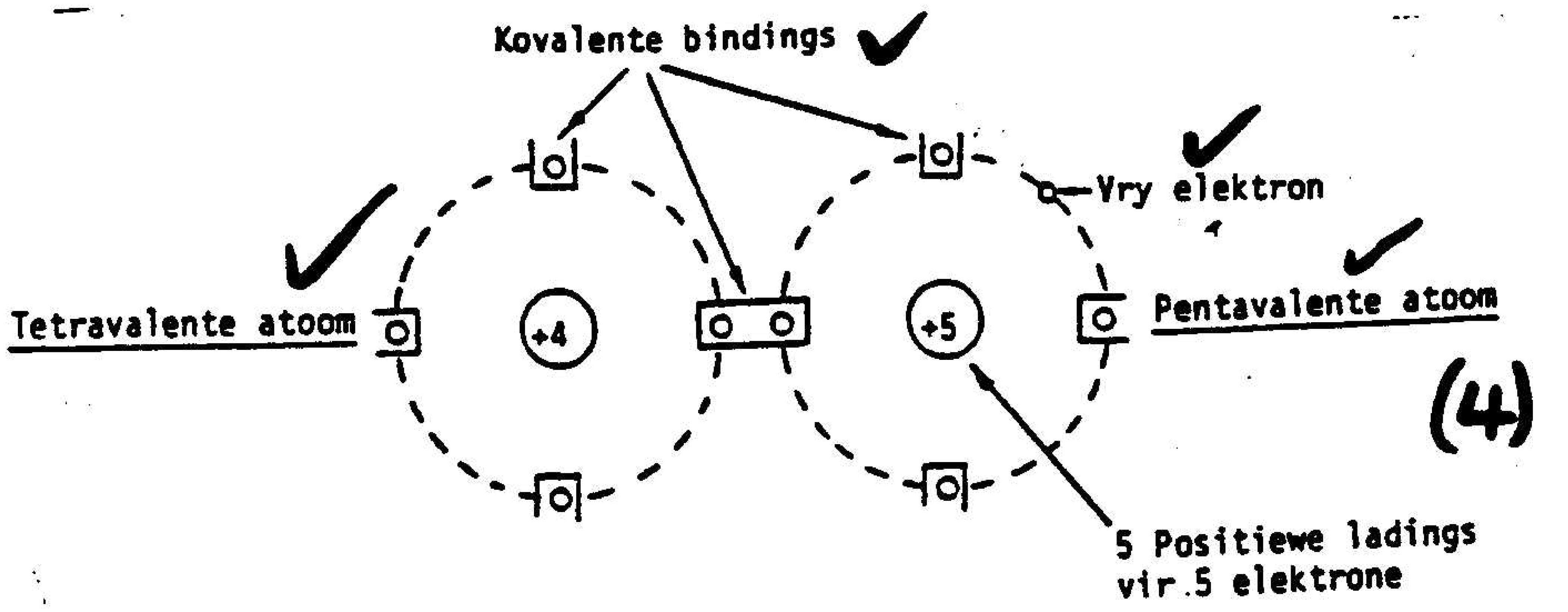
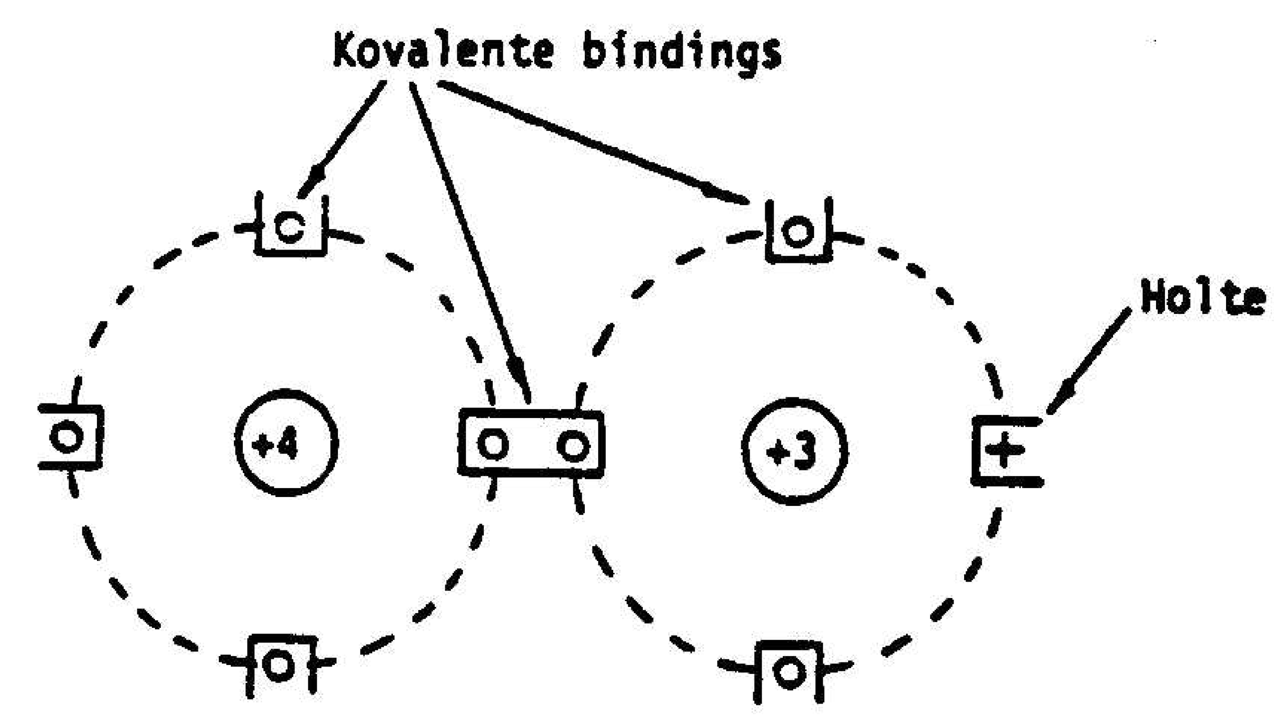


Fig. 6.4 N-TIPE BYVOEGING

P-Tipe Byvoeging

'n Trivalente onsuiwerheid, d.w.s. 'n atoom met 3 valensie-elektrone word tot die kristalstruktuur bygevoeg en slegs 3 kovalente bindings kan voltooi word, wat 'n holte in die oorblywende binding laat. Hierdie holte kan 'n vry elektron in die struktuur opneem alhoewel dit nie deel van die binding kan word nie aangesien daar geen begeleidende positiewe lading in die atoom is nie, fig. 6.5.

'n Elektron wat die binding voltooi veroorsaak 'n elektriese wanbalans en beweeg maklik weer daaruit. Die holte is in hierdie geval die ladingdraer.



5·1.