POSSIBLE ANSWERS FOR:

TECHNICA ELECTRONICS HG
TECHNIKA ELEKTRONIES HG

TIME / *TYD* : 3 hours

MARKS / *PUNTE* : 300

QUESTION 1 / *VRAAG 1*

1.1.1

$X_L = 2\pi f L$

$= 2\pi 5\text{x}10^{+6} \text{ x } 9 \text{ x } 10^{-6}$

$= \underline{282{,}74\Omega}$

$X_C = \dfrac{1}{2\pi fc}$

$= \dfrac{1}{2\pi .5x10^{+6} x100x10^{-12}}$

$= \underline{318{,}3\Omega}$

$I_L = {}^{V}\!/_{XL}$

$= \dfrac{100}{282{,}74}$

$= \underline{0{,}353}$ Amp

$I_C = {}^{V}\!/_{XC}$

$= \dfrac{100}{318{,}3}$

$= \underline{0{,}314}$ Amp

$I_R = {}^{V}\!/_{R}$

$= \dfrac{100}{2000}$

$= \underline{0{,}05}$ Amp

1.1.2

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

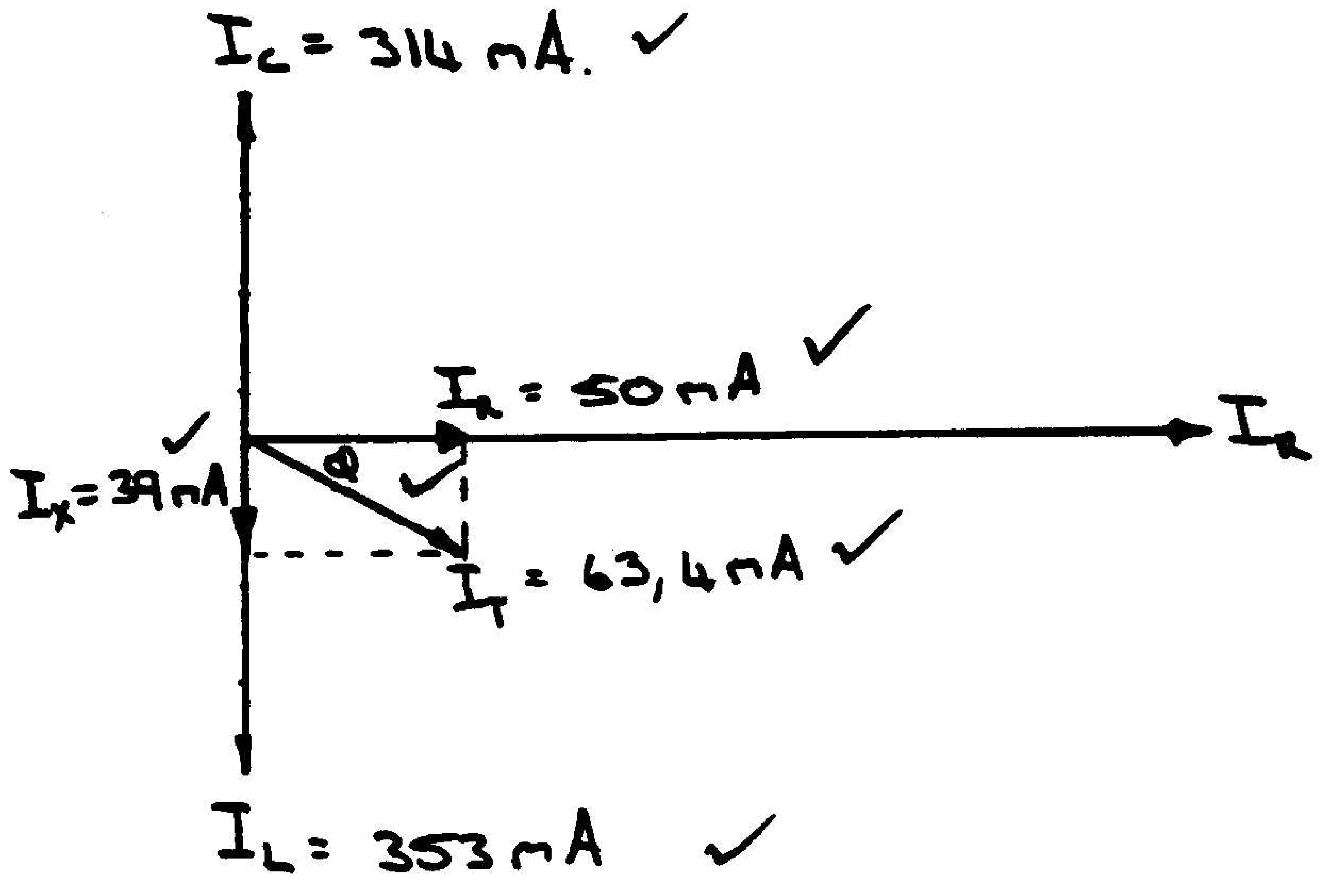
$= \sqrt{0{,}05^2 + (0{,}353 - 0{,}314)^2}$

$= 0{,}063{,}4\text{A}$

$= 63{,}4\text{mA}$

(3)

1.1.3



$$\cos\Phi = \frac{IR}{Ir} = \frac{50}{63{,}4} = 0{,}788$$

Φ = 37,9° (lagging) (9)

1.1.4 $Z_T = \frac{VT}{Ir} = \frac{100}{63{,}4x10^{-3}} = 1577\Omega$ (3)

1.2 When the external impedance of a connected load is equal to the internal impedance of the source, thereby giving maximum transfer of energy: For example connecting a loudspeaker to a given amplifier.

Wanneer die eksterne impedansie van 'n verbinde las gelyk is aan die interne impedansie van 'n bron, om sodoende maksimum energie oordrag te verseker. Byvoorbeeld om 'n luidspreker aan 'n gegewe versterker te koppel.

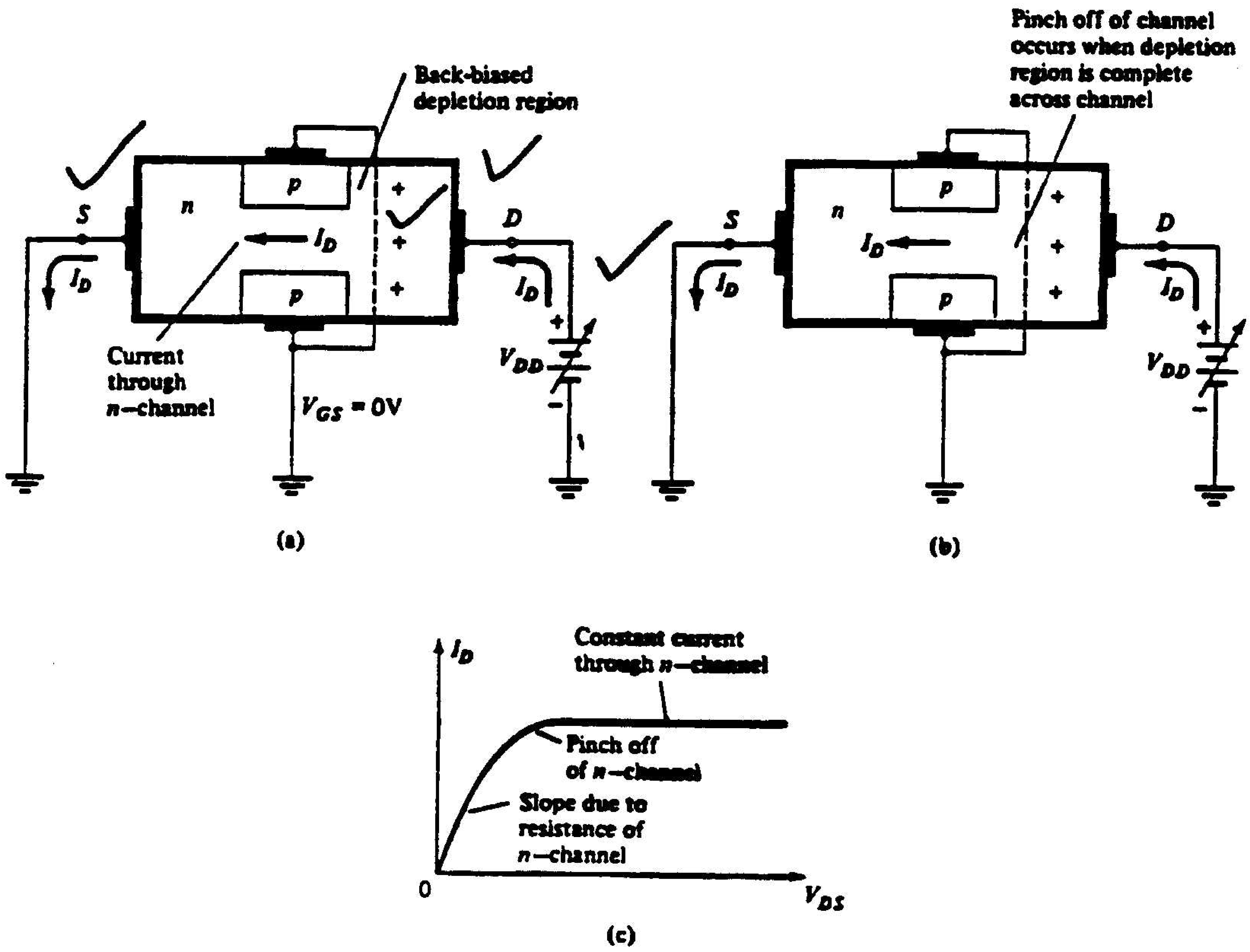
1.3 $\frac{N_p}{N_s} = \sqrt{\frac{Z_p}{Z_s}} = \sqrt{\frac{500}{8}} = 7{,}9 : 1$ = turns ratio

[38]

QUESTION 2 / *VRAAG 2*

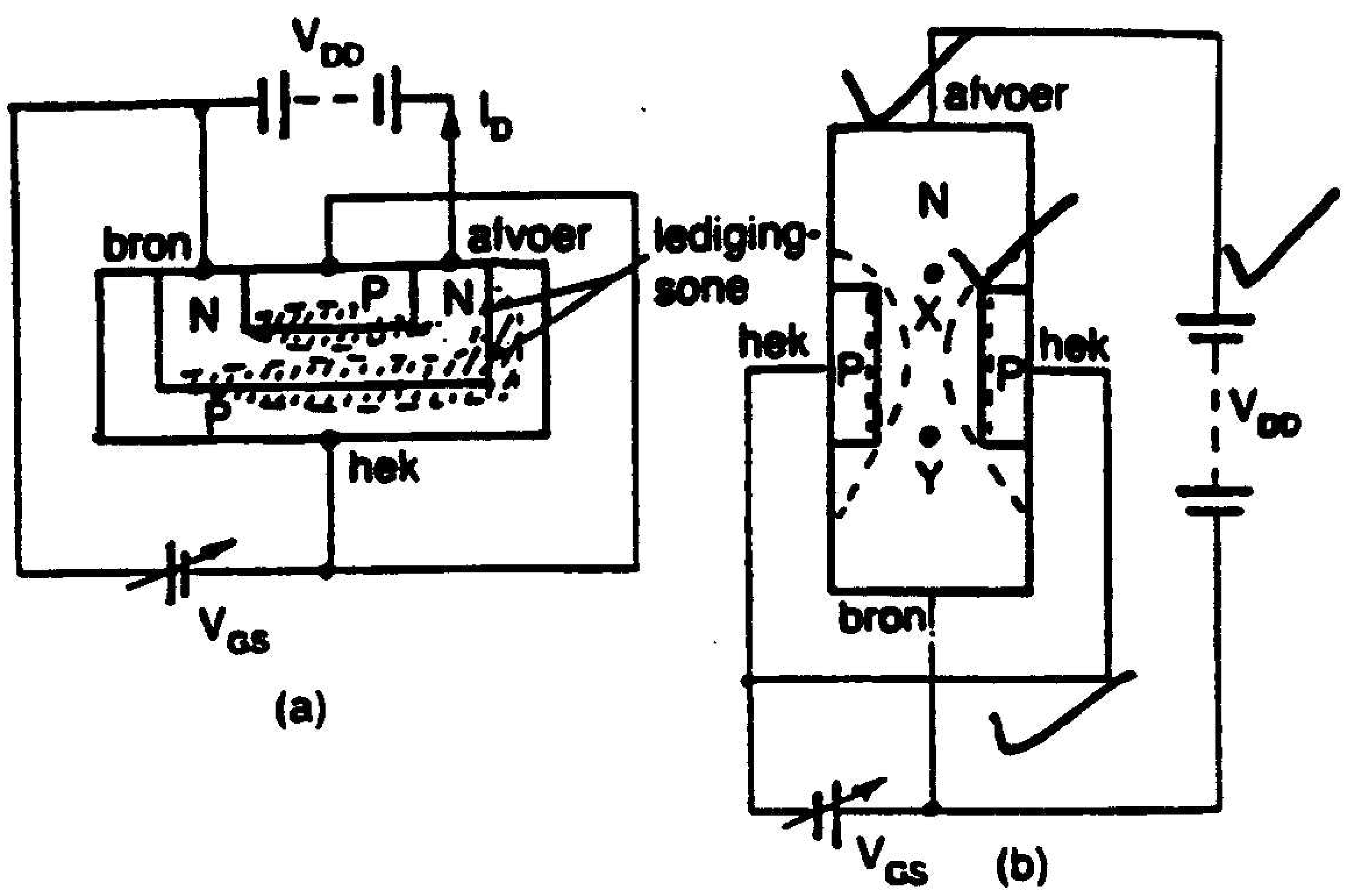
2.1.1	PNP Transistor	(2)
2.1.2	5kr preset resistor / weerstand	(3)
2.1.3	Diode	(1)
2.1.4	10 μH coil / spoel	(2)
2.1.5	In Forad capacitor / kapasitor	(2)

2.2 FET OPERATION / WERKING



To examine how the device is operated, consider the *n*-channel JFET of Fig. 5.2, shown with applied bias voltage to operate the device. The supply voltage, V_{DD}, provides a voltage across drain-source, V_{DS}, which results in a current, I_D, from drain to source (electrons in an *n*-channel actually move from the source, hence name, to drain). This drain current passes through the channel surrounded by the *p*-type gate. A voltage between gate and source, V_{GS}, is shown here to be set by a voltage supply, V_{GG}. Since this gate-source voltage will reverse bias the gate-source junction, no gate current will result. The effect of the gate voltage will be to create a depletion region in the channel and thereby reduce the channel width to increase the drain-source resistance resulting in less drain current.

P.T.O. / *b.o.*



Wanneer die bron-afvoerspanning V_{DD} aan die veldeffektransistor gekoppel word, soos in figuur 5.20 geïllustreer, sal 'n stroom deur die kanaal vloei. Dié stroom word die afvoerstroom I_D genoem.

Die PN-voegvlak tussen die hek en die kanaal word teenvoorgespan. Hierdie teenvoorspanning veroorsaak 'n ledigingsone, dit wil sê 'n sone sonder meerderheidsdraers, in die omgewing van die PN-voegvlak. In die afwesigheid van ladingdraers reageer die ledigingsone soos 'n isolator. Wanneer die kanaal dus vernou word, verhoog die weerstand daarvan met 'n gevolglike verlaging in die afvoerstroom I_D. Dit is dus duidelik dat die effektiewe oppervlakte van die kanaal en dus die stroom I_D, ekstern beheer kan word.

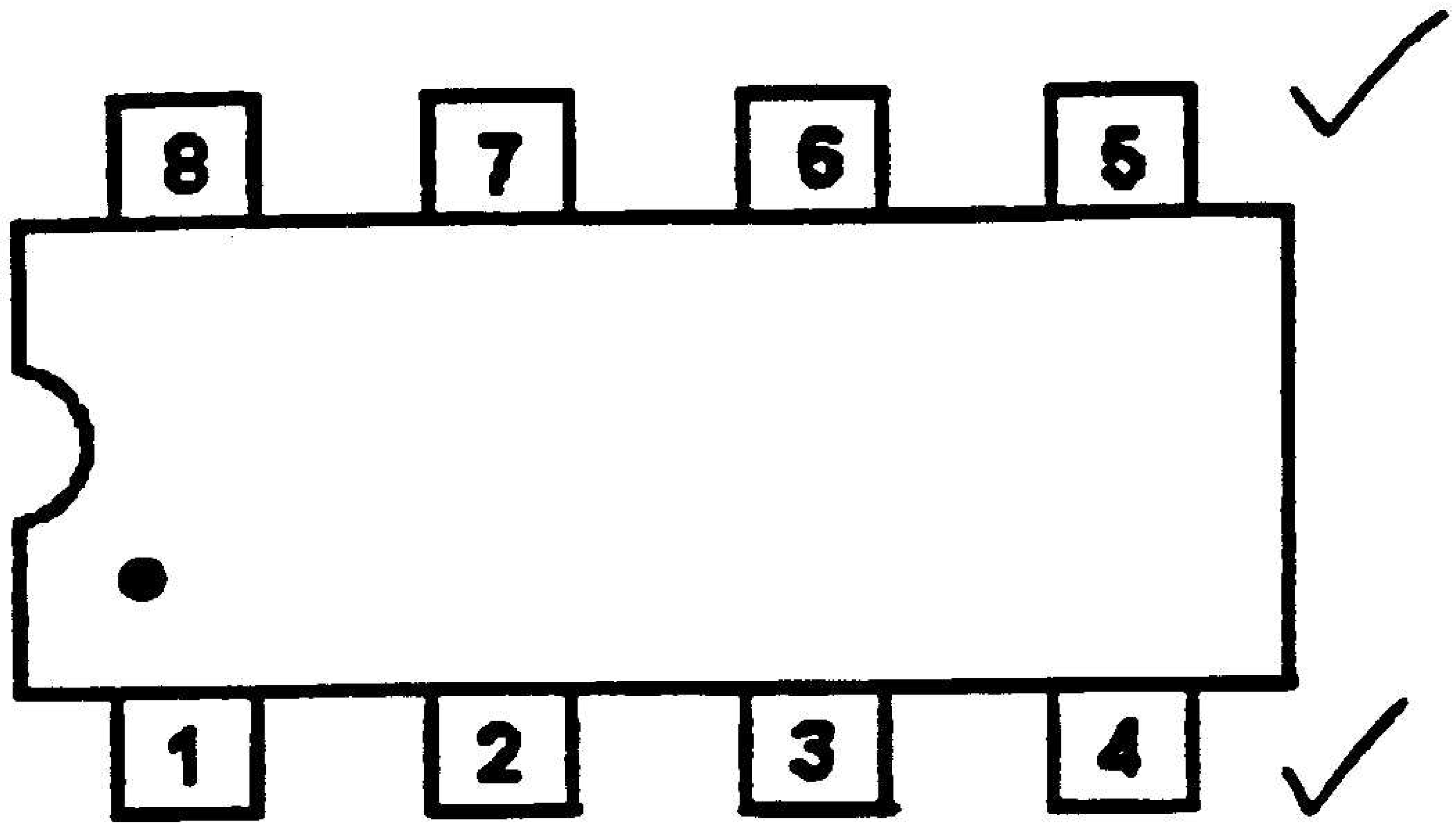
Volgens figuur 5.20(a) en (b) skyn dit asof daar twee ledigingsones gevorm word. Die ledigingsone word om die hele kanaal gevorm aangesien al die kante van die N-tipe kanaal in kontak is met die P-tipe substraat. Die konsentrasie van onsuiwerhede is laer in die kanaal as in die hekdeel. Gevolglik dring die ledigingsone die kanaalarea dieper as die hekarea binne.

Figuur 5.20(b) toon ook dat die ledigingsone in die kanaal effens wyer is aan die afvoerkant as aan die bronkant. Die N-tipe kanaalmateriaal reageer soos 'n gewone resistor, met ander woorde die potensiaalverskil verander lineêr oor die lengte van die kanaal tussen die afvoer- en bronterminale. Punt X in figuur 5.20(b) is derhalwe meer positief, met betrekking tot die bronterminaal, as punt y. Die potensiaalverskil oor die PN-voegvlak tussen punt X en die hek is dus groter as tussen punt Y en die hek, met die gevolg dat die ledigingsone die kanaal dieper binnedring in die omgewing van punt X as by punt Y.

2.3
- Transport in anti-static containers.
- Store unutilized units in conductive sponge.
- Use earthed points soldering irons.
- Use specially earthed wristbands.
- Connect all testing equipment to earth.
- All unutilized inputs must be connected to V_{DD} or V_{SS}. (any 4)

- Vervoer in anti-statiese houers.
- Ongebruiklike eenhede moet in 'n geleide spons gestoor word.
- Soldeerboute moet geaard wees.
- Gebruik geaarde gewrigsbande.
- Aard alle toetstoerusting.
- Ongebruiklike insette moet verbind word na V_{DD} of V_{SS}. (enige 4) (4)

2.4

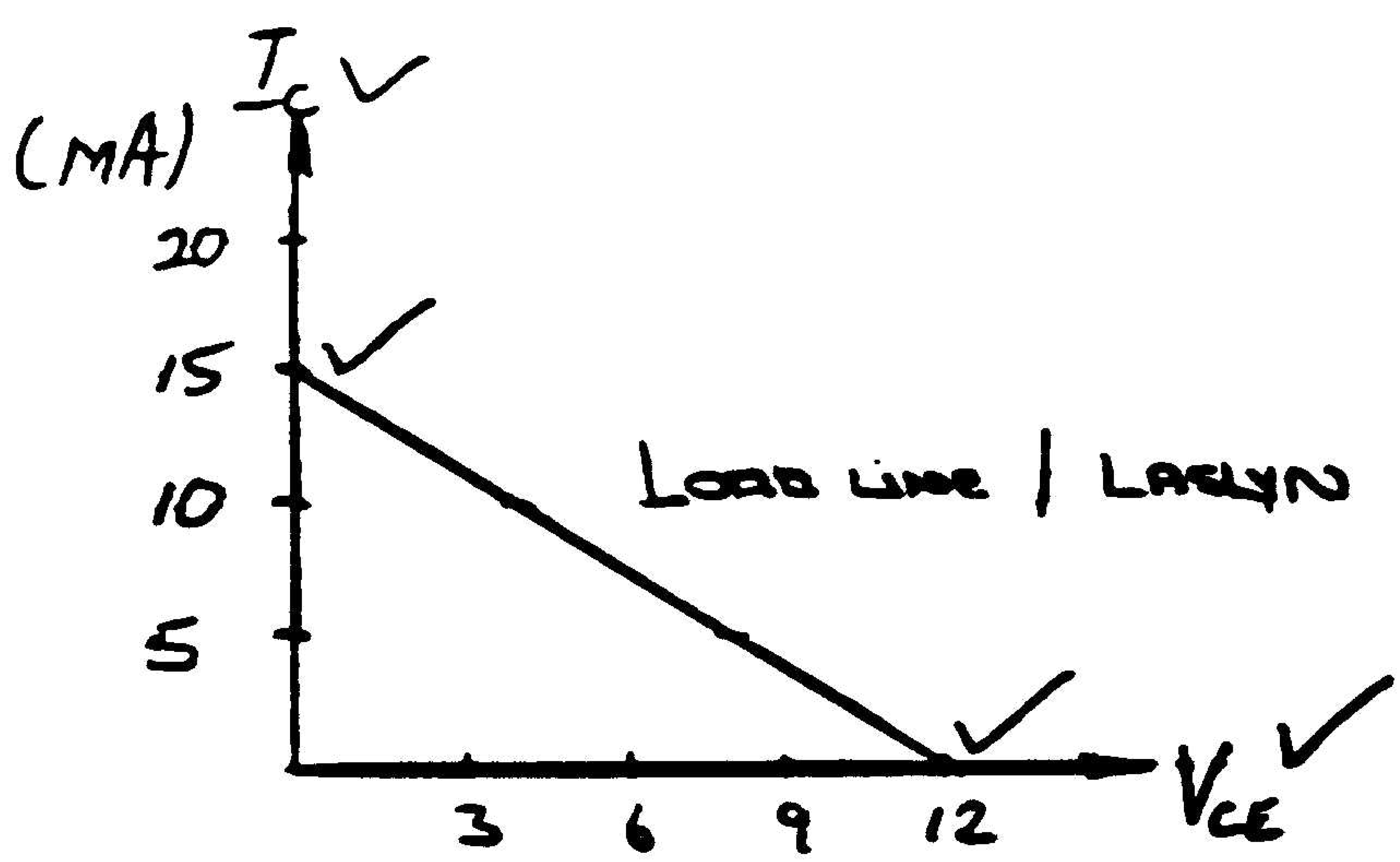


(2)
[28]

QUESTION 3 / *VRAAG 3*

3.1 $V_{CE} = V_{EC} =$ 12 volt

$$I_{CMAC} = \frac{Vcc}{Rc} = \frac{12}{800} = 15 \text{ m Amp}$$



3.1.1 V_{CC} = V_{BE} $= I_B R_B$ **INPUT / INSET**

$\therefore I_B = \dfrac{V_{CC} - V_{BE}}{R_B}$

$= \dfrac{12 - 0,6}{120x10^3}$

$= 95\mu Amps$ (4)

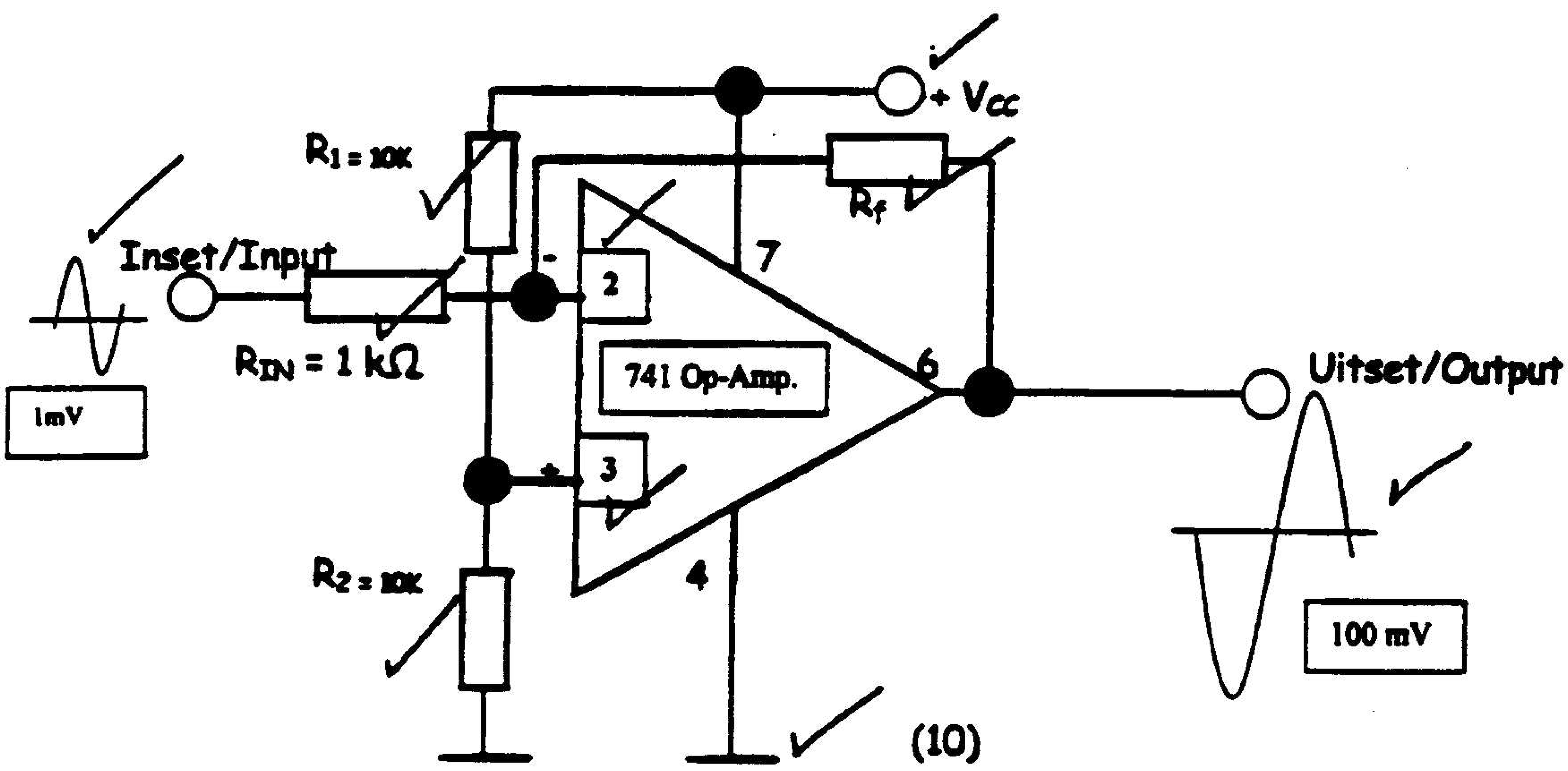
3.1.2 B = I_C / I_B **OUTPUT / UITSET**

$I_C = \beta I_B$

= 120 X

= 11,4 mA (4)

3.2



(10)

$Af = \dfrac{R_f}{R_{in}}$

$R_f = Af \times R_{in}$ (2)

$Wins = \dfrac{100 \text{ mV}}{1 \text{ mV}}$

= 100 (2)

$R_f = Af \times R_{in}$

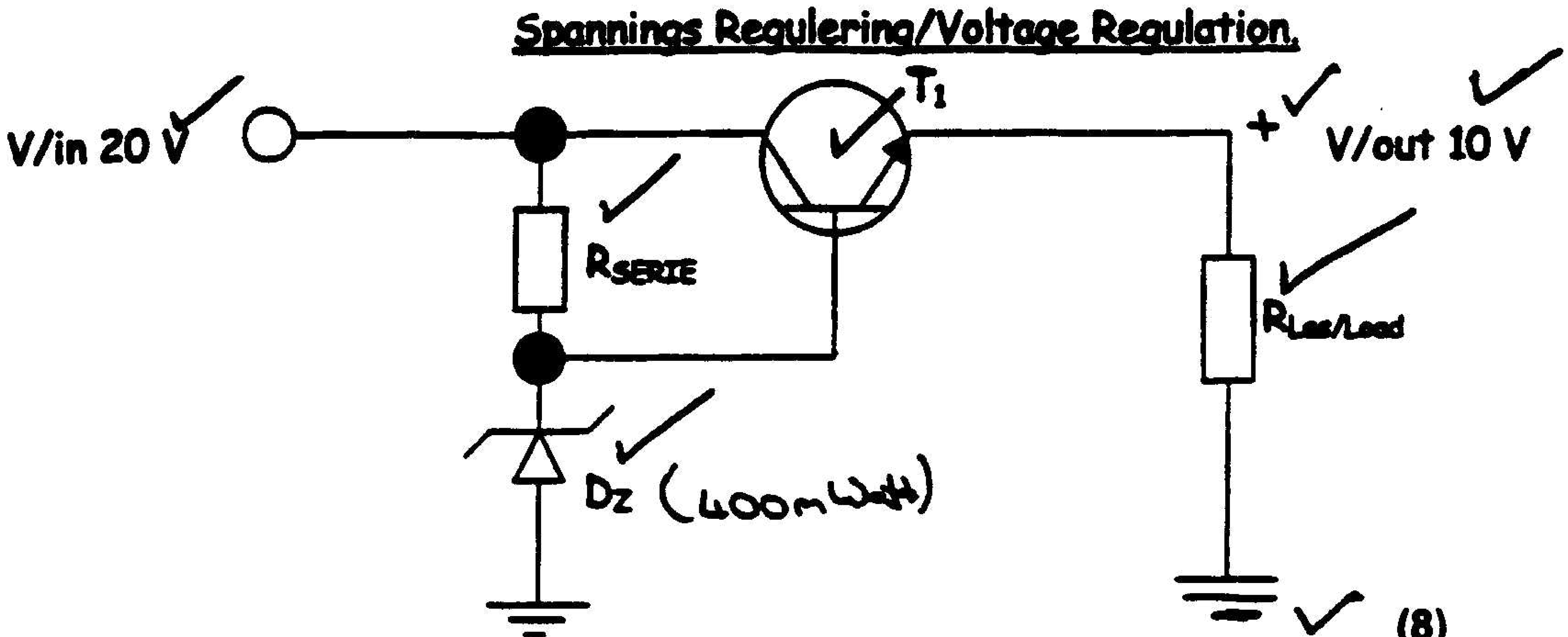
= 100 x 1000

= 100 kΩ (3)

[34]

QUESTION 4 / *VRAAG 4*

4.1



(8)

$$V_Z = V_{uit} + V_{BE}$$
$$= 10\ V + 0.6\ V$$
$$= 10.6\ V$$

(3)

$$P = V \times I$$

$$I_Z = \frac{P_Z}{V_Z}$$
$$= \frac{400\ mW}{10.6\ V}$$
$$= 37.74\ mA \quad (4)$$

(4)

$$V_{Rserie} = V_{in} - V_Z$$
$$= 20\ V - 10.6\ V$$
$$= 9.4\ V$$

(3)

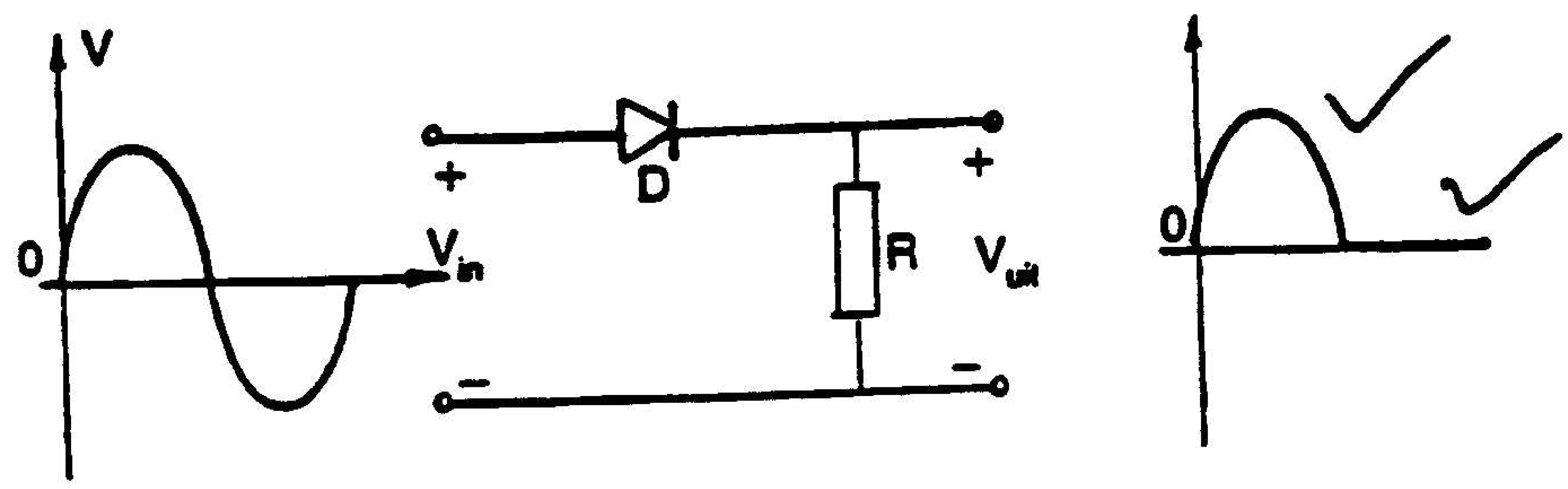
$$R_{serie} = \frac{V_{Rserie}}{I_Z}$$
$$= \frac{9.4\ V}{37.74\ mA}$$
$$= 249.07\ \Omega$$

(3)

4.2 **HOW IT WORKS**

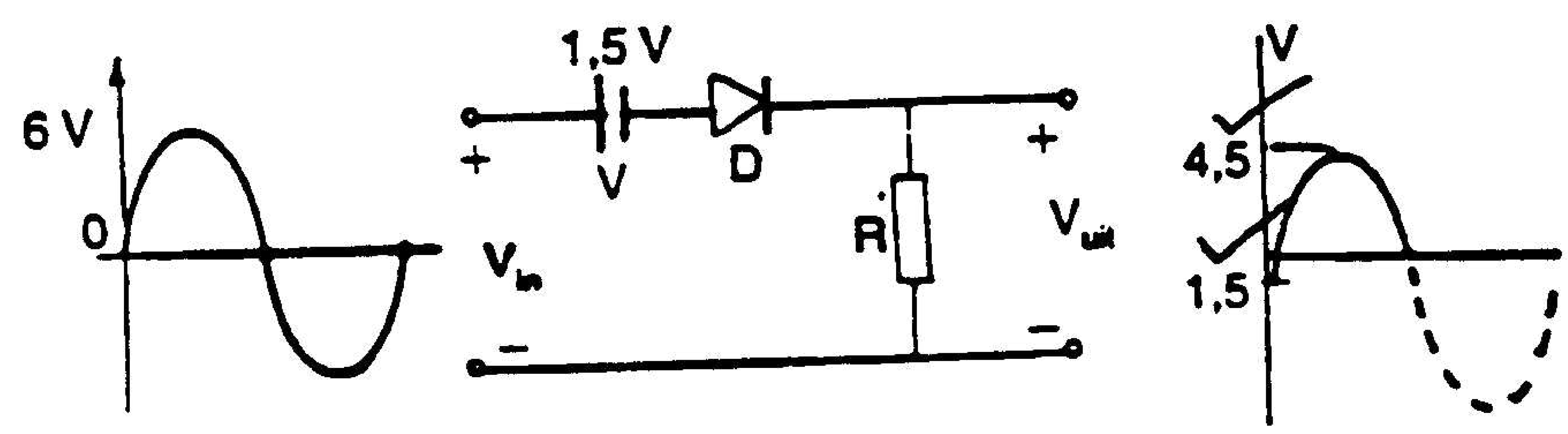
The circuit works as follows. Op.amp IC1a acts as an integrator and IC1b as a comparator with hysteresis set by resistors R4 and R5. Together these two circuit elements form an oscillator with a triangle wave output. Note that the triangle wave from the output of IC1a is applied to the inverting input (pin 2) of IC2, whilst the non-inverting input of IC2 is connected to a control voltage set by VR1, the speed control which provides a range spanning zero to full power. The value of VR1 is shunted by resistor R7 to counteract the wide tolerance typical of these controls. IC2 acts as a comparator and drives output transistor TR1 (a general-purpose *npn* medium power transistor), which in turn powers the brushless motor. Diode D1 counters any back-e.m.f. which may be present. (12)

4.3 (a)



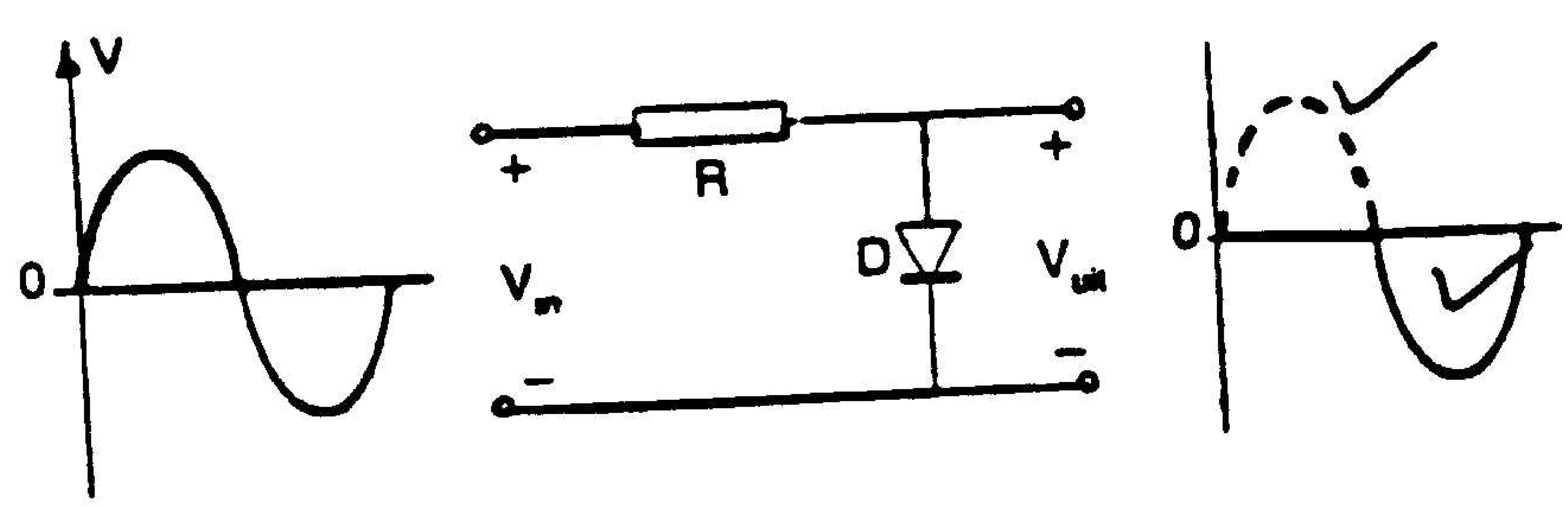
(2)

(b)



(2)

(c)



(2)

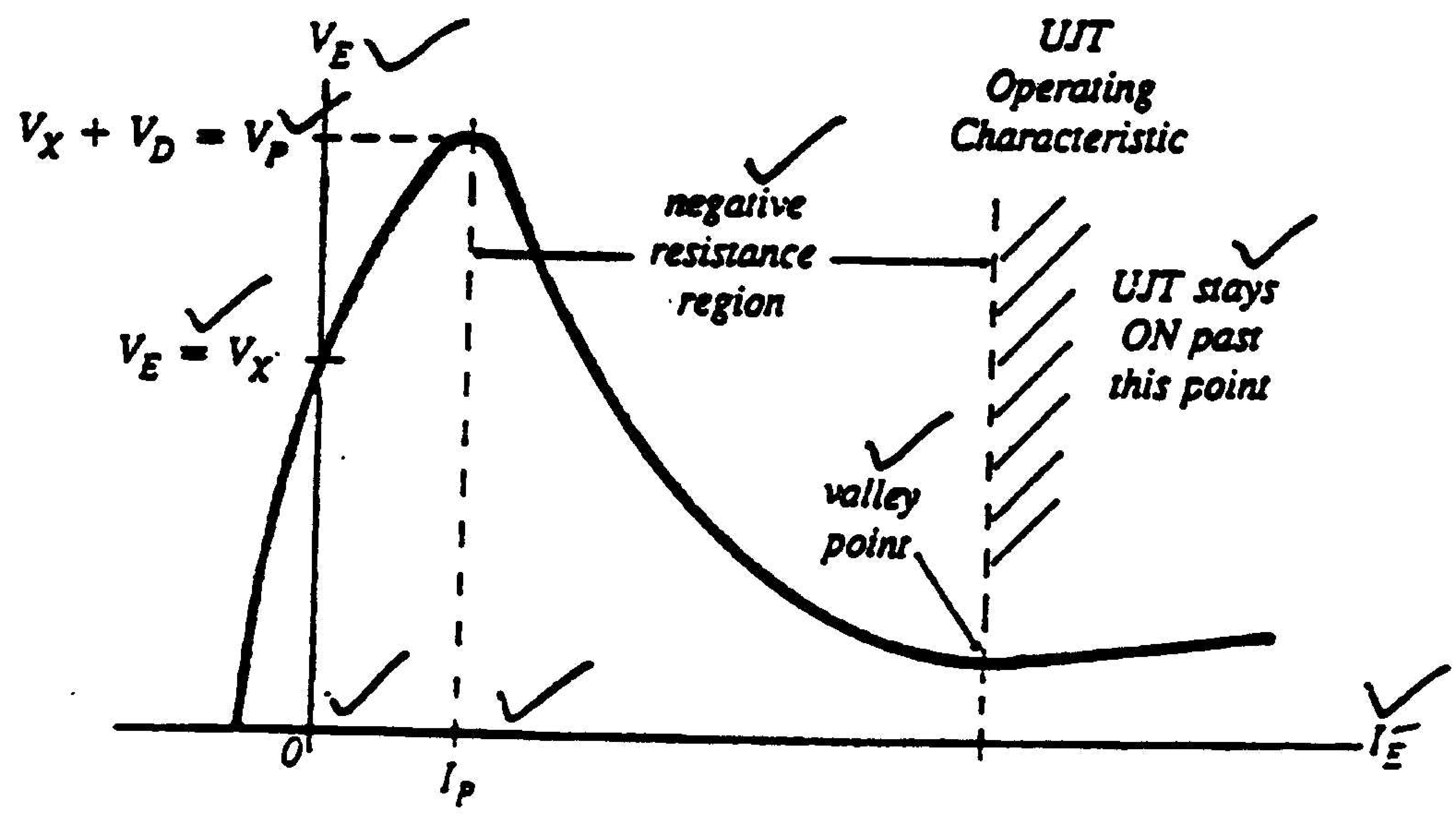
4.4 ANY CORRECT ANSWER
ENIGE KORREKTE ANTWOORD (11)
[50]

QUESTION 5 / *VRAAG 5*

5.1 An oscillator is an electronic circuit that produce an output signal without an external input signal. The output signal can be a sinusoidal or a non-sinusoidal waveform, or a train of pulses.

'n Ossilator is 'n elektroniese stroombaan wat 'n uitset sein genereer, sonder dat dit van 'n eksterne inset sein voorsien word. Die uitet sein kan sinusvormige wees, of nie-sinusvormig of dit mag 'n reeks van pulse wees.

5.2



MAIN OPERATING POINTS:

1. With V_E at O V the diode D is reverse biased because of the high voltage at point V_X in the bar. A small leakage current flows through the diode in the reverse direction. This is shown in the graph as a "negative" current flow.

2. As V_E slowly increases the diode D remains reverse biased but the leakage current falls. This condition holds until V_E reachers a voltage equal to V_X in the bar. At this point the voltages at each end of the diode are equal and no current flows in either direction.

3. As V_E rises above V_X, the diode is still not forward biased, and a small forward current flows.

4. When V_E reaches a point equal to V_X plus the diode voltage (0,6 V) the conditions rapidly change. This point is called the peak voltage point V_P.

(15)
[18]

QUESTION 6 / *VRAAG 6*

COMPUTER PRINCIPLES / *REKENAARBEGINSELS*

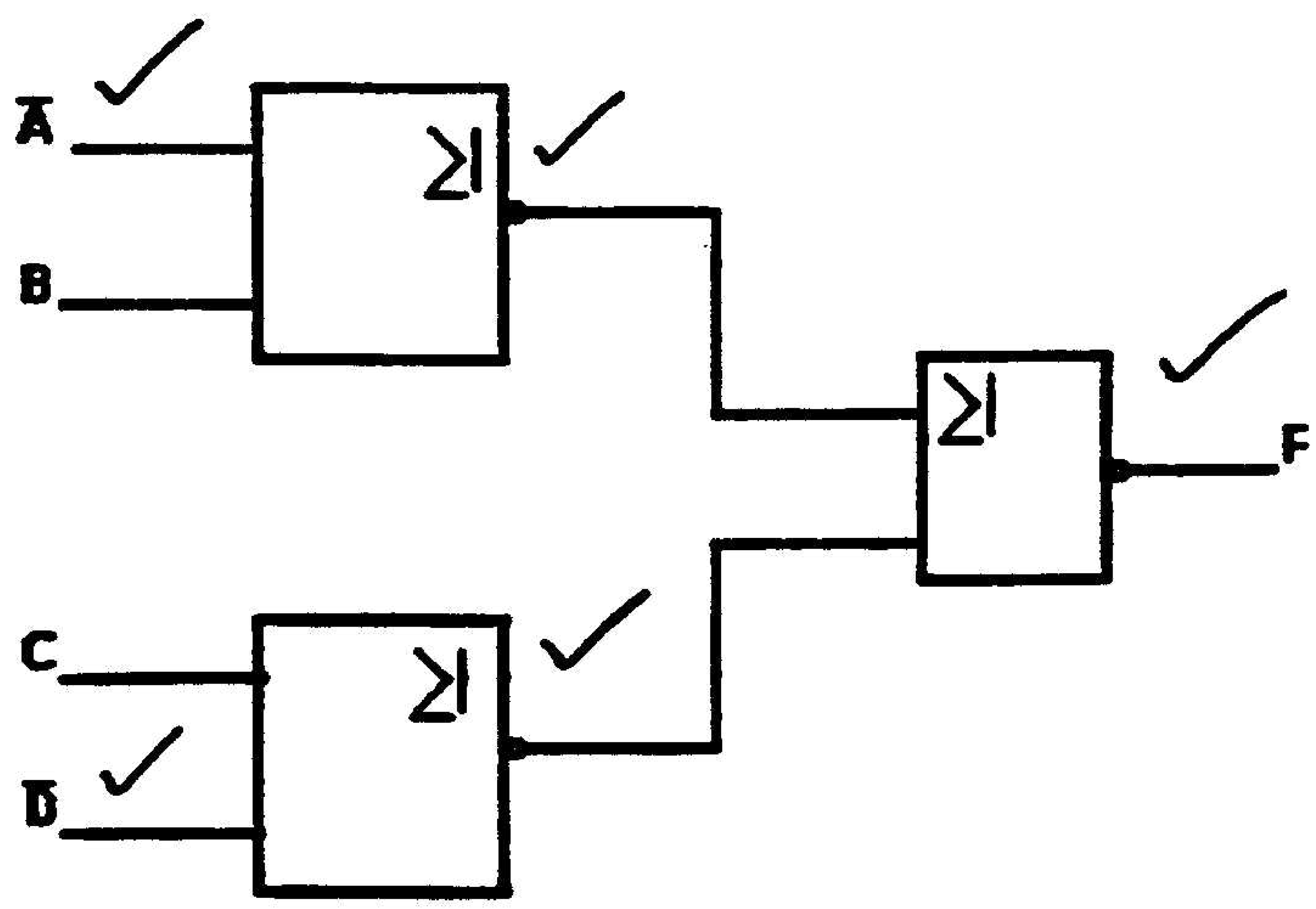
6.1

$$F = (\overline{A} + B)(C + \overline{D}) \checkmark$$

$$= \overline{\overline{(\overline{A} + B)(C + \overline{D})}}$$

$$= \overline{\overline{(\overline{A} + B)} + \overline{(C + \overline{D})}} \checkmark$$

(2)



(5)

$$F = [A\overline{B}(C + BD) + \overline{AB}]C$$

$$= [A\overline{B}C + A\overline{B}BD + \overline{AB}]C \checkmark \checkmark$$

$$= [A\overline{B}C + 0 + \overline{AB}]C \checkmark$$

$$= A\overline{B}C + \overline{ABC} \checkmark \checkmark$$

$$= \overline{B}C(A + \overline{A}) \checkmark$$

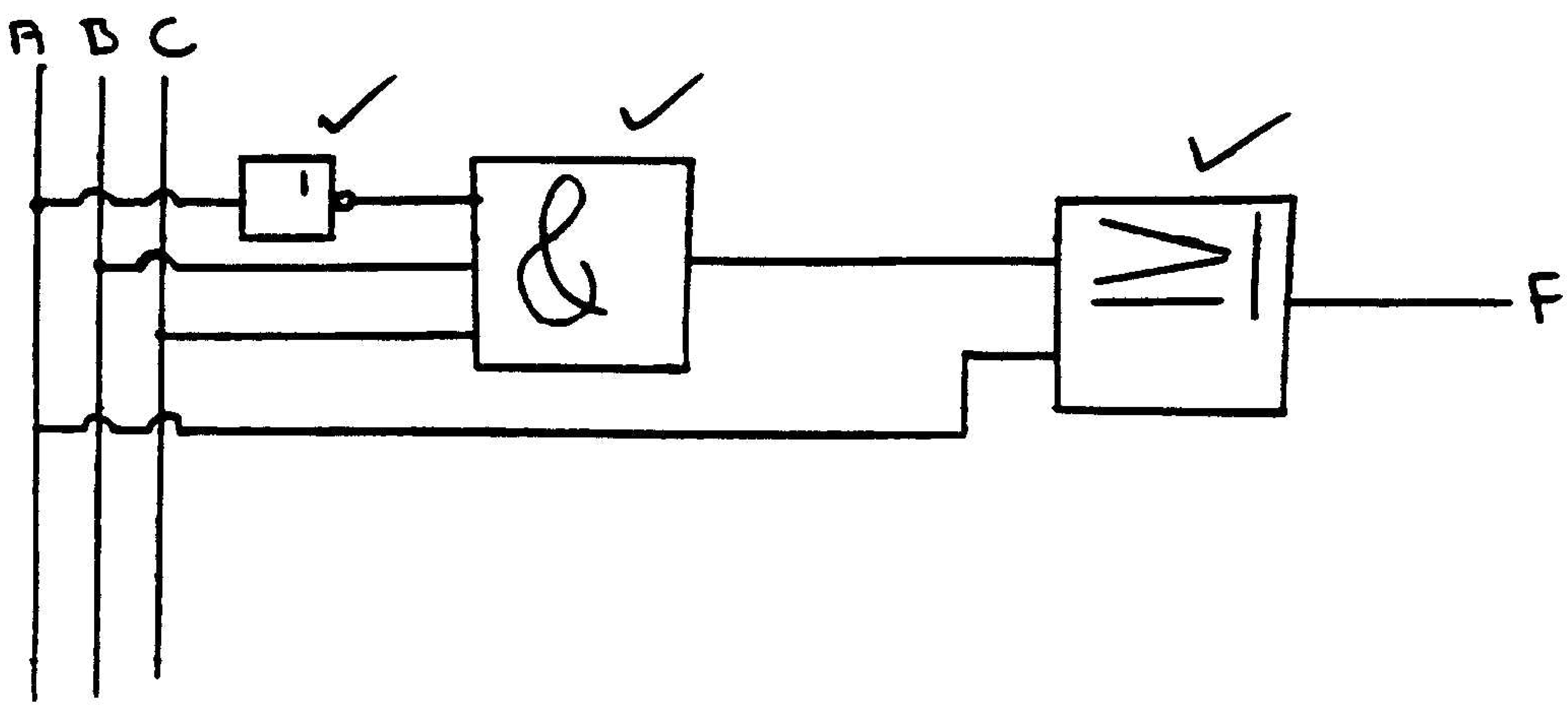
$$= \overline{B}C \checkmark$$

(7)

6.3 A = Blood pressure
B = Temperature
C = Pulse

A	B	C	F
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

$$
\begin{aligned}
F &= \bar{A}BC + A\bar{B}\,\bar{C} + A\bar{B}C + AB\bar{C} + ABC \\
&= \bar{A}BC + A\bar{B}\,\bar{C} + A\bar{B}C + AB\bar{C} + AB(\bar{C}+C) \\
&= \bar{A}BC + A\bar{B}\,\bar{C} + A\bar{B}C + AB\bar{C} + AB \\
&= \bar{A}BC + A\bar{B}(\bar{C}+C) + AB \\
&= \bar{A}BC + A\bar{B} + AB \\
&= \bar{A}BC + A(\bar{B}+B) \\
&= \bar{A}BC + A
\end{aligned}
$$



(15)

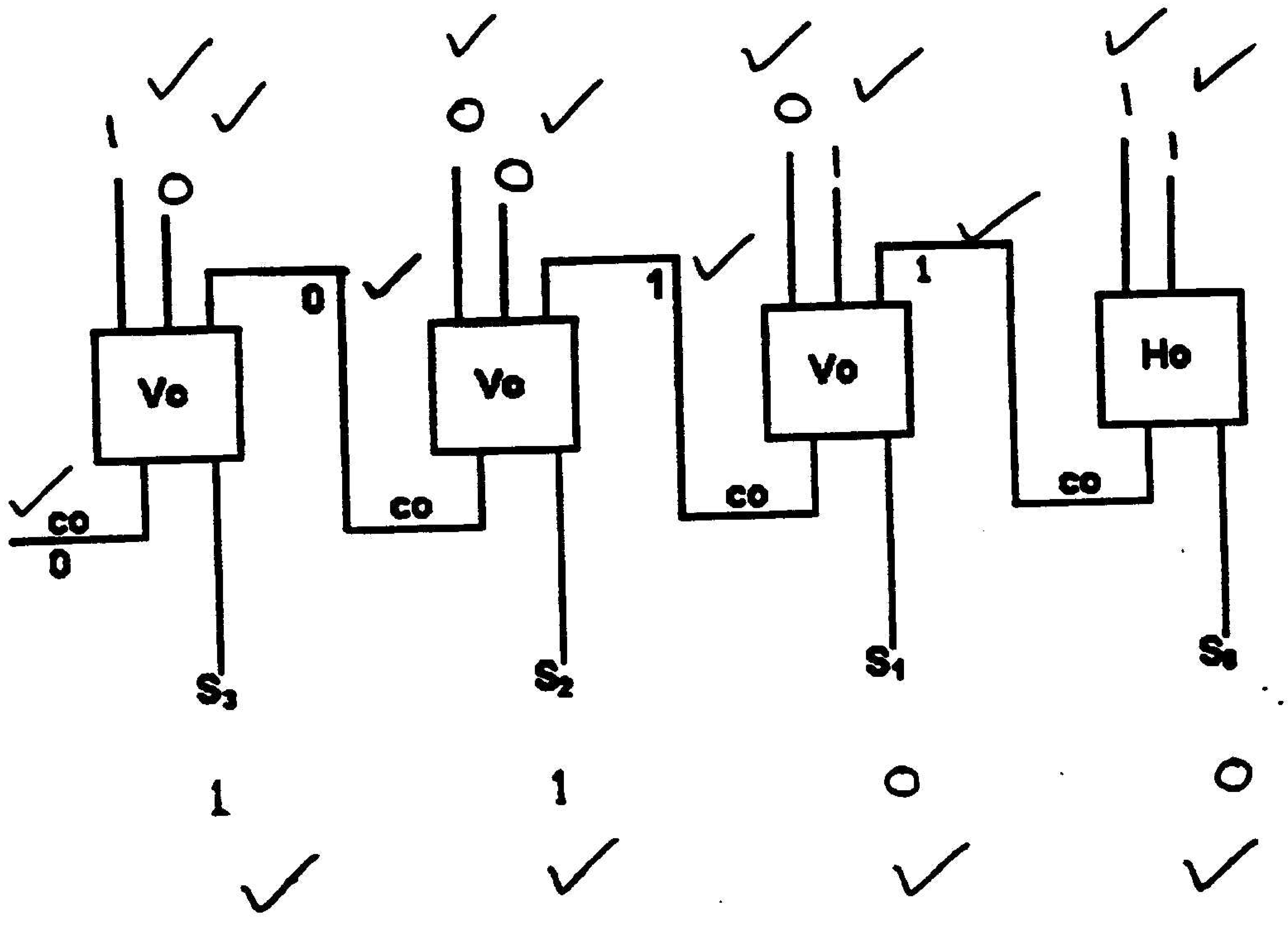
6.4

SET S1	RESET S2		LED1	LED2
0	0		One ON & One OFF	
1	0	SET	ON	OFF
0	1	RESET	OFF	ON
1	1		Disallowed	

(9)

6.4.1 Set-Reset Flip Flop circuit. (1)

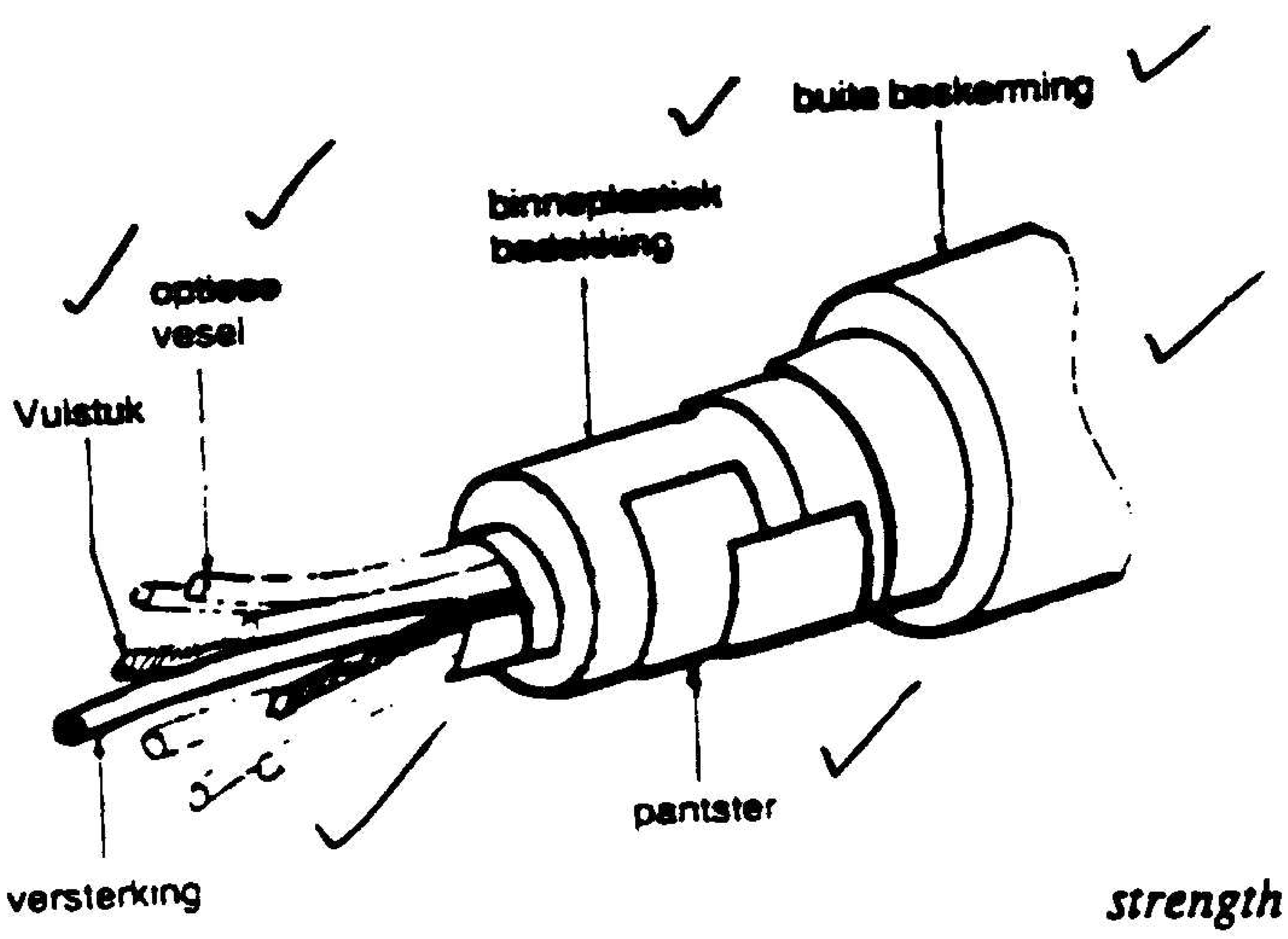
6.5

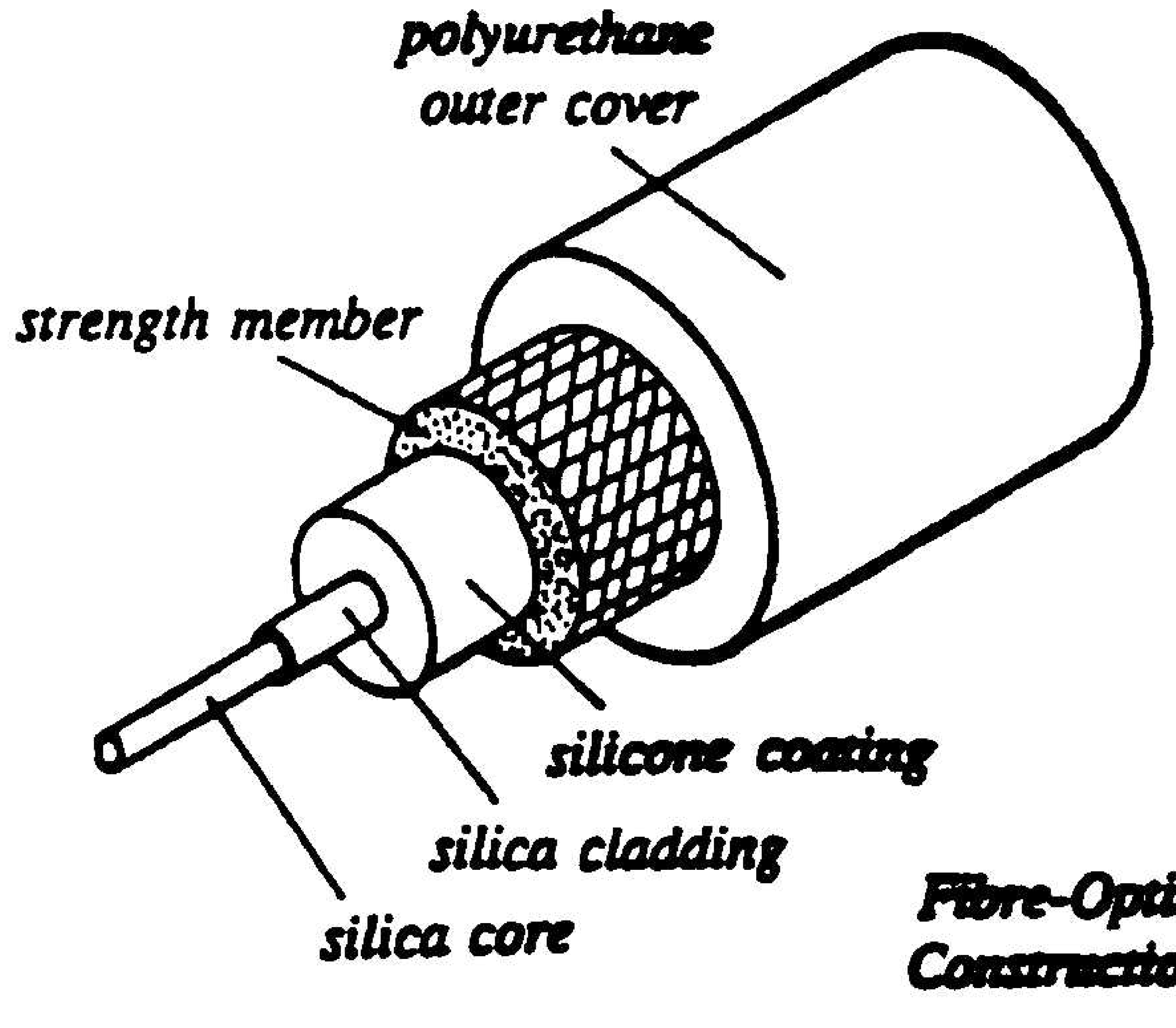


(10)
[55]

QUESTION 7 / *VRAAG 7*

7.1





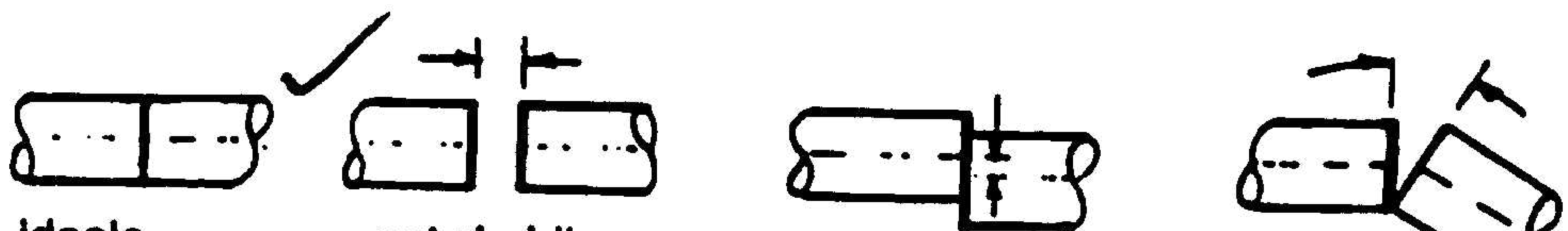
Fibre-Optic Construction

P.T.O. / *b.o.*

7.2 *Laswerk in optiese vesel*

Die las van optiese vesels is uiters kritiek as gevolg van die in-lynversteuring van die binnevlak van die vesel wat mag plaasvind. Enige verskuiwing van hierdie oppervlakte bring energieverliese mee.

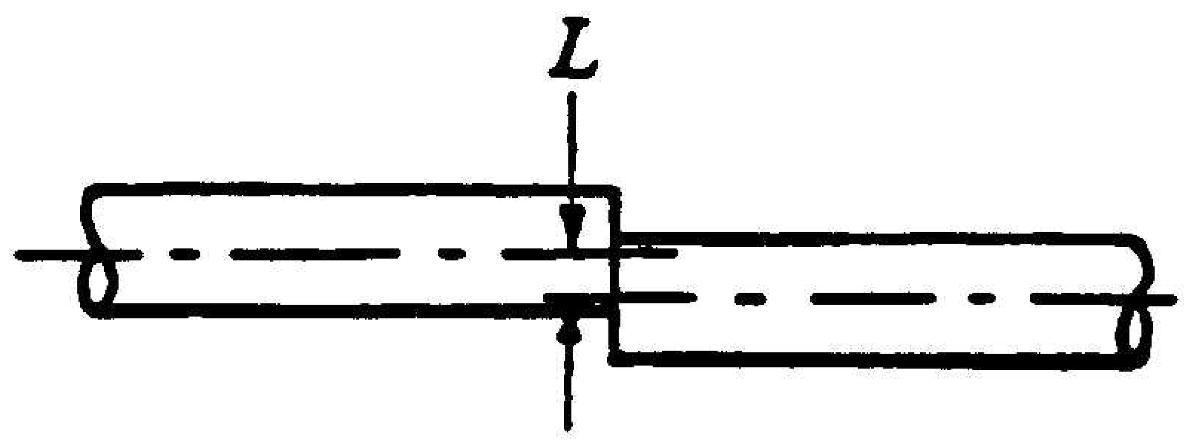
Die grootste oorsaak van ligverlies weens swak laswerk word geïllustreer.



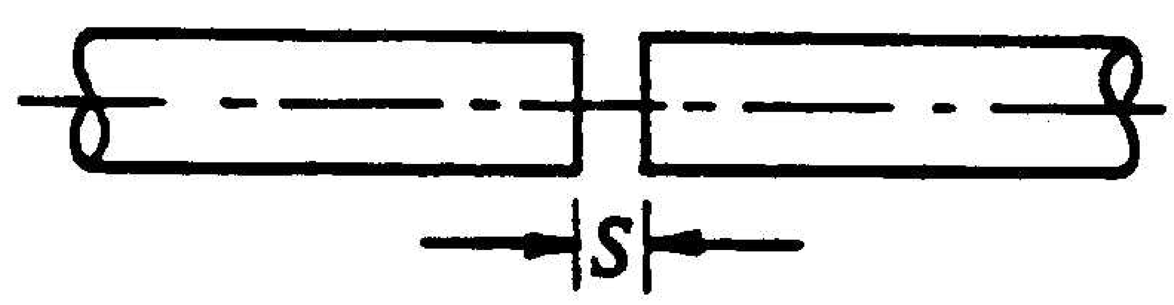
The interfacing between fibre cable ends is also critical as any mis-match between coupling the ends will also contribute to large losses of signal power. When two fibres are not perfectly aligned along their centre axes, losses will result due to loss of light as well as some reflection of light from polished flat end faces.

The major causes of signal power losses are:

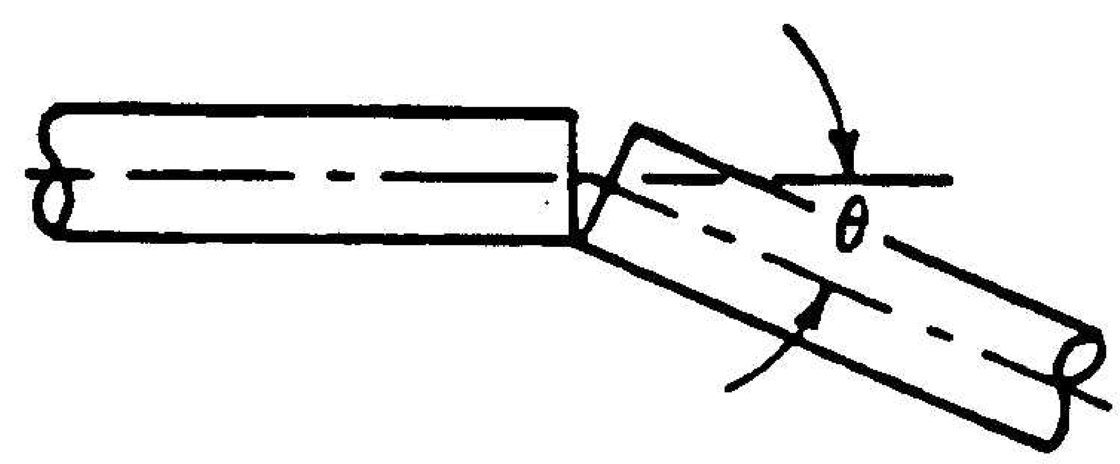
1. **Lateral displacement where the two fibre axes are not aligned.**



2. **End separation where any slight air gap will introduce a change of refractive index leading to some internal reflection loss.**



3. **Angular misalignment** with two ends misaligned, loosing much light signal power.



7.3 ADVANTAGES OF OPTICAL FIBRE COMMUNICATION

The advantages optical fibre communication systems have over radio or direct copper wire system include the handling of a greater number of signal transmissions, reduction of signal loss and reduce resistance to electrical and atmospheric interference.

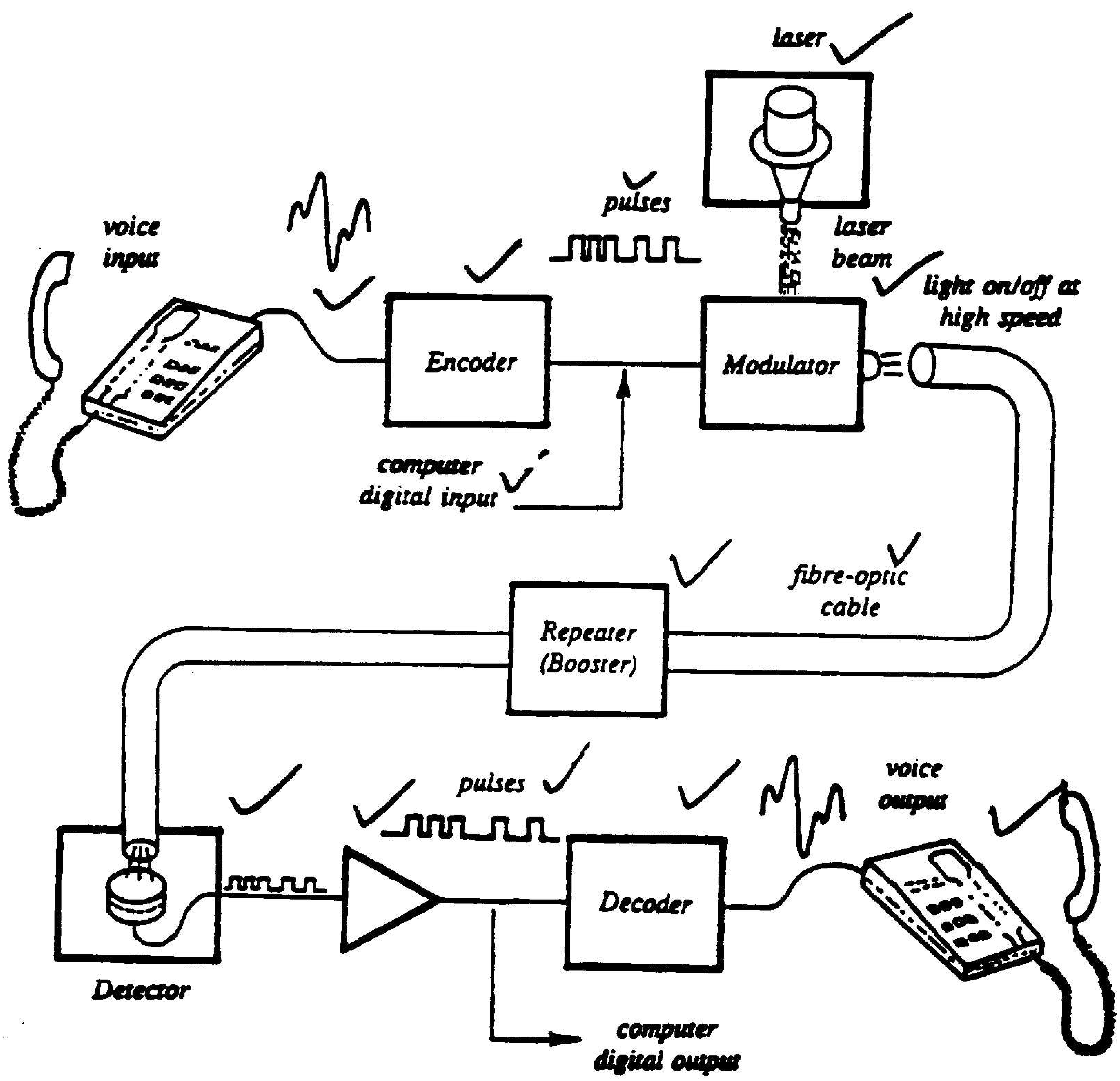
A single cable with 12 optical fibre cores can carry roughly the same number of communication channels as 1 000 pairs of copper wire. This optical fibre cable would be approximately 10 mm diameter with a mass of about 70 kg per kilometre. A similar copper cable would be about 8 cm diameter with a mass of 8 000 kg per kilometre.

Fibre optic communication systems are now widely used for interconnecting computers in business networks as well as for carrying control signals in both ships and aircraft. Their bandwidth also makes optical fibre ideal for TV transmissions.

Extreme caution must be observed when handling a "live" optical fibre cable. One must never to look into the fibre as the light intensity can be so powerful as to burn and permanent damage the retina of the eye. (5)

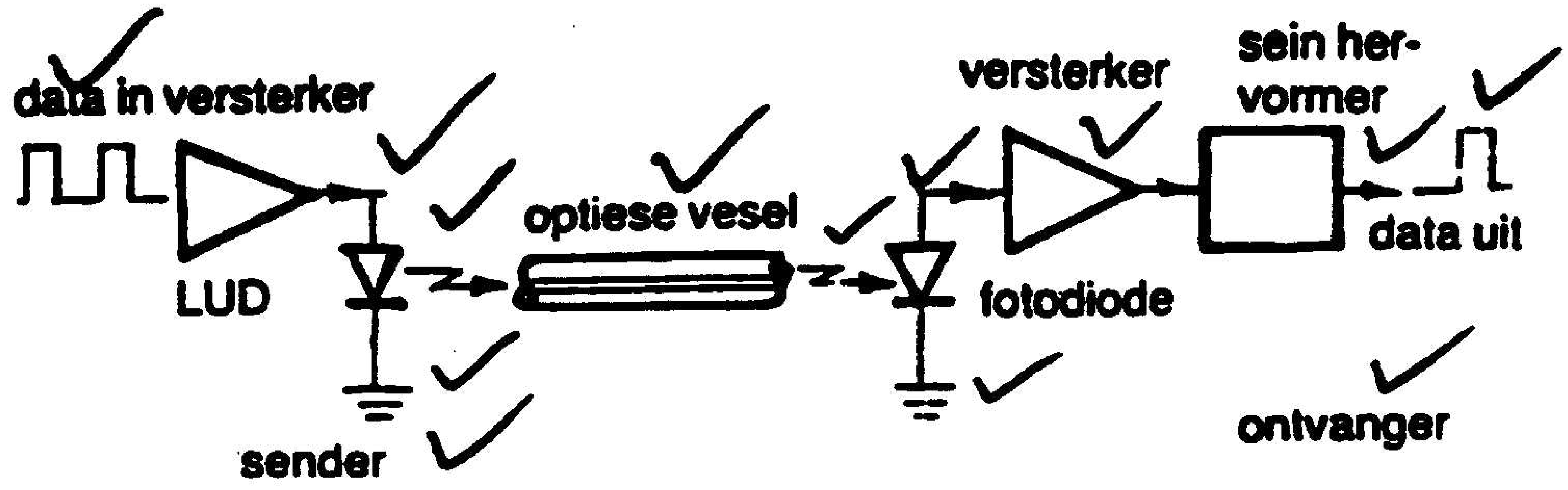
Die ligdraende vesels wissel van 24 mikrometer tot 1 milimeter en word van glas en plastiek vervaardig. Glas beskik oor veel beter liggeleidende eienskappe as plastiek en word daarom vir hoë-tempo-dataversending en lang afstandtransmissie gebruik. Die energieverlies in glasvesel is baie laer as in plastiekvesel. Plastiekvesel is egter meer ekonomies vir die oordra van data oor kort afstande waar energieverlies tot 'n groot mate onbenullig is.

7.4



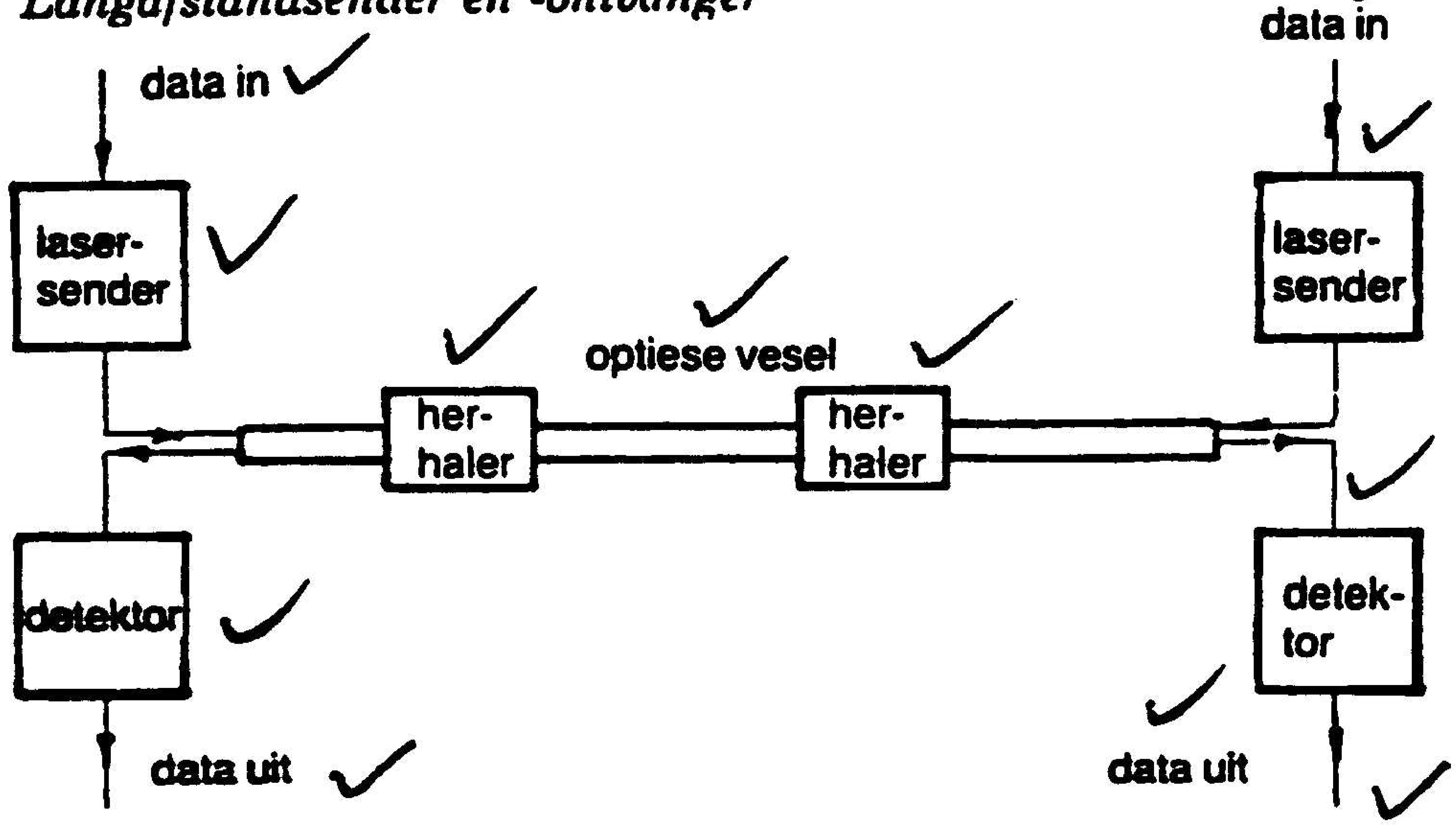
OR

Kortafstand-sender en -ontvanger

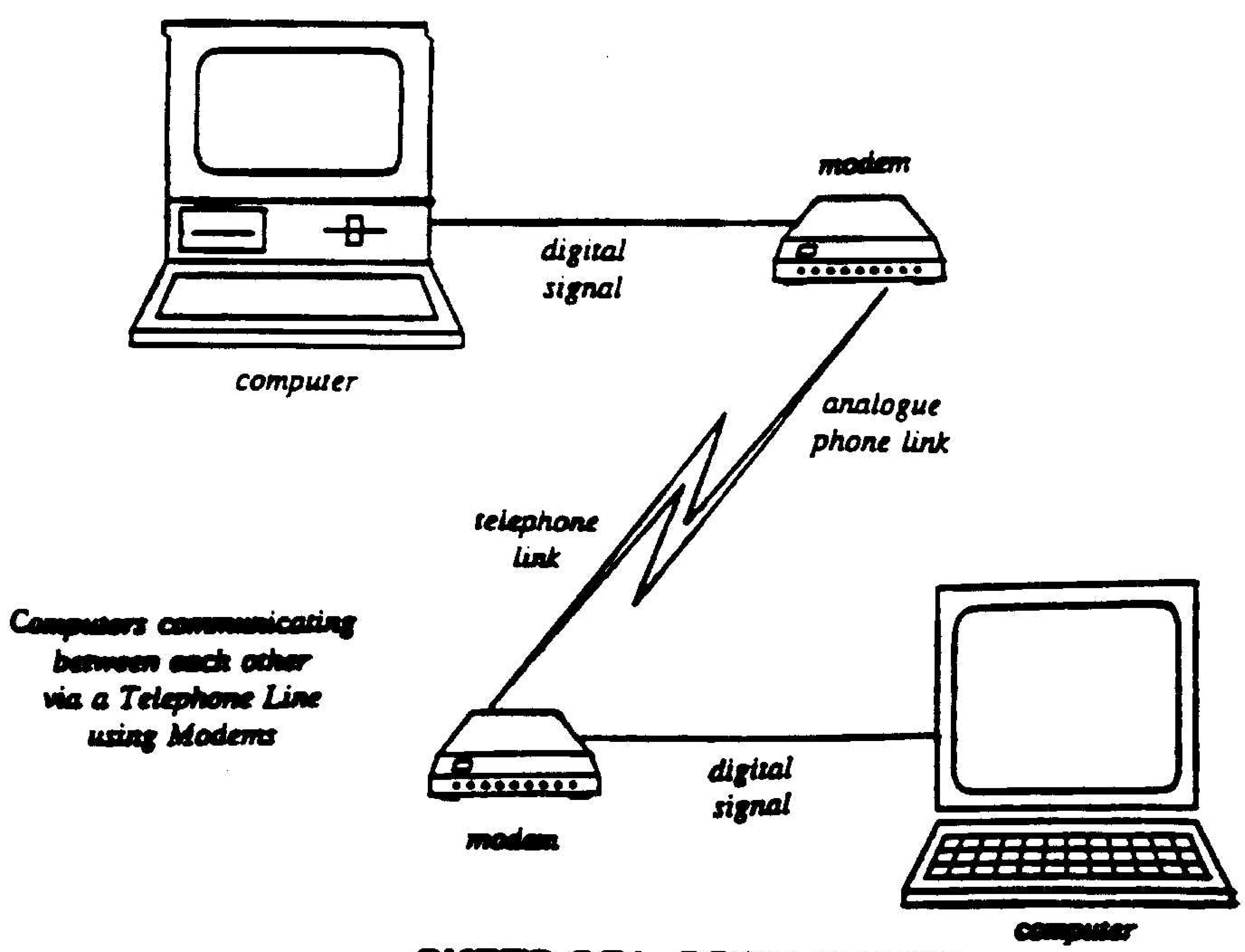


or

Langafstandsender en -ontvanger

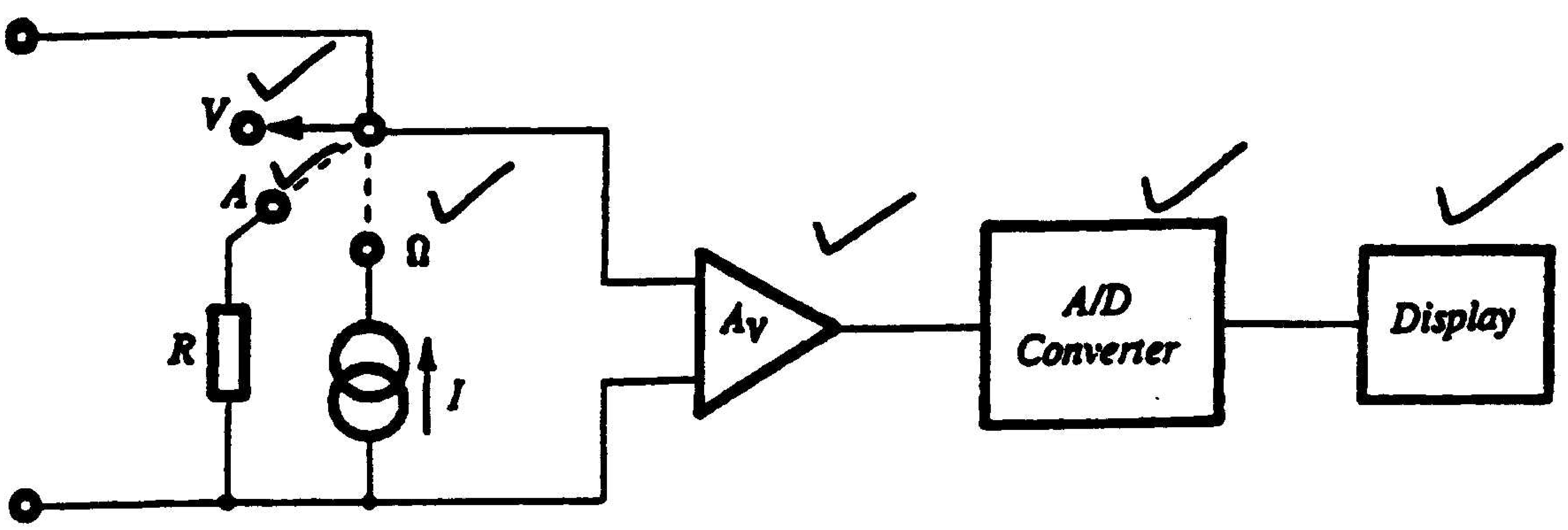


7.5



SKETS OF 'n BESKRYWING

8.1



(6)

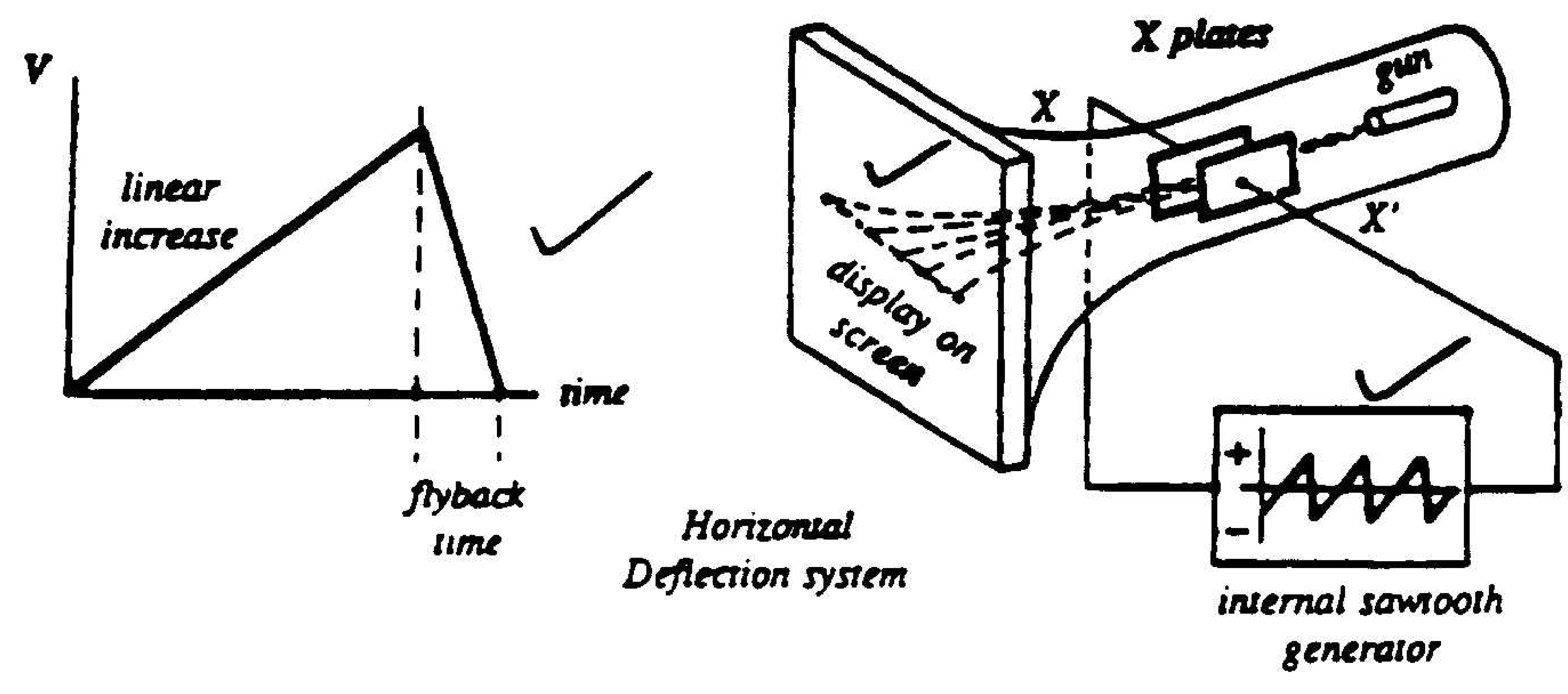
8.2
- Display in a numeric form / Inligting is maklik afleesbaar.
- High level of accuracy (1%) / Baie akkuraat (1%)
- Short response time / Vinnige reageer tyd
- No parallax problems / Geen poralaks foute
- Extremely robust / kan skokke en temp verandering goed hanteer. (5)

8.3 380 volt (2)

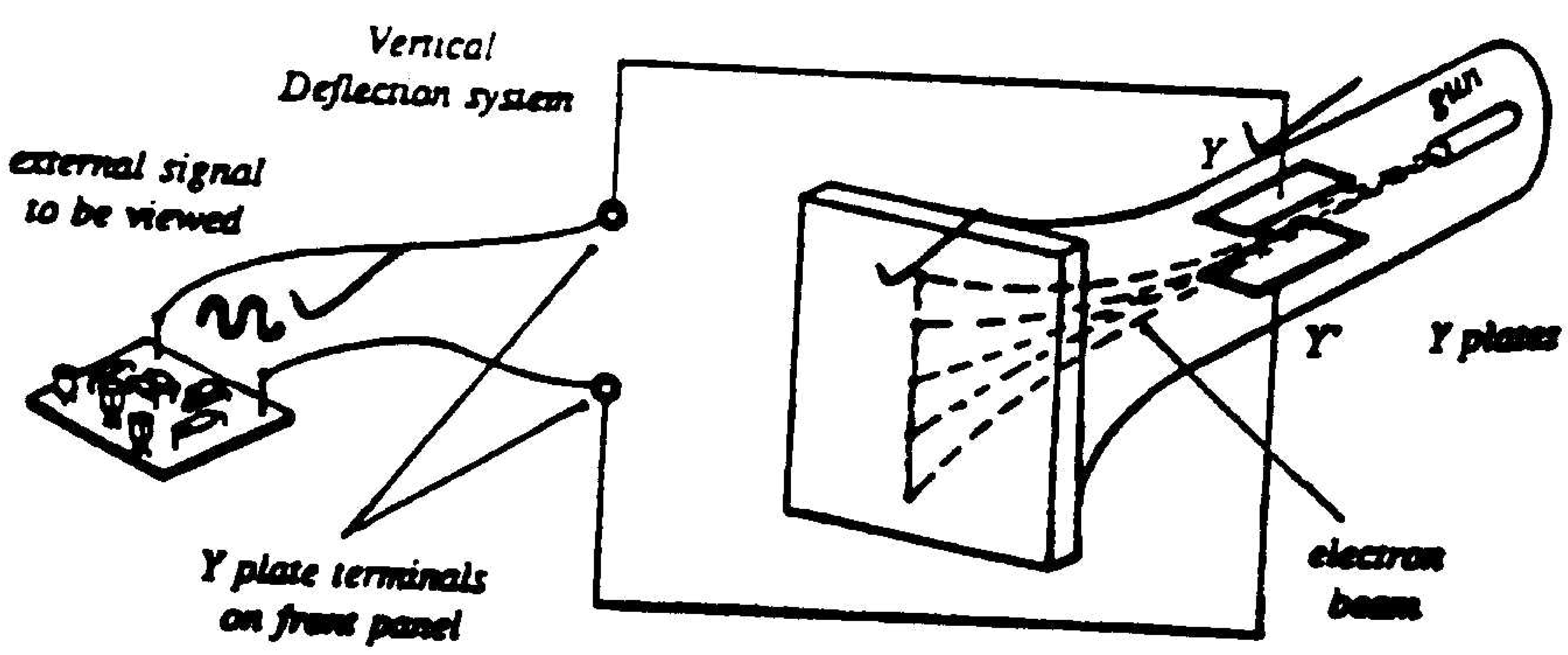
8.4 V_P = V/D_{IV} x No of D_{IV} x Probe settings
= 10 x 3 x 10
= 300 volt

V_{RMS} = V_P x 0,707
= 300 x 0,707
= 212,1 Volt (6)

8.5



(3)



(3)

9.1,
* Verseker dat alle draagbare toerusting buigsame kernbedrading het.
* Alle verbindingspunte moet meganie en elektries korrek wees.
* Isolasie moet in goeie toestand wees en aan regulasies voldoen
* Verseker dat die gronddraad die regte kleur is.
* Verseker dat die gronddraad goeie kontak maak met die metaaldele van die apparaat.
* Koppel die regte kleure op die regte plekke:

(E)	Grond	=	grond en geel
(N)	Neutraal	=	blou
(L)	Lewendig	=	bruin

(5)

9.2
1. The selector switch must always be on the correct scale, e.g. the voltage scale for measuring volts.
2. Set the selector switch to the highest full-scale deflection (FSD) for that range, e.g. 1 000 volts FSD.
3. Check whether you are going to read AC or DC.
4. Plug the leads into the correct positions.
5. Power must be switched off and disconnected before measuring ohms.
6. Check that the voltage or current to be measured does not exceed the capabilities of the meter.
7. Do not drop the meter or cause it any physical shock. It is a delicate instrument.
8. Check the polarity of the leads before connecting the meter into a circuit.

(5)

9.3 Skuim is 'n geleier, die persoon word blootgestel aan skok toestande. (2)

9.4 You can get AIDS from

Having unprotected sec with an infected person.
Sharing a needle for intravenous drug use with an HIV-infected person.
Infected blood entering the body through broken skin.
From an infected mother to an unborn child.

Dra ten alle tye "Latex" handskoene wanneer 'n persoon gehelp word wat enige oop wond aan hom/haar het. (4)

[300]

END / *EINDE*