TECHNIKA (ELECTRONICS) HG **TECHNIKA (ELEKTRONIES) HG**

714-1 (W)

GAUTENG DEPARTMENT OF EDUCATION
GAUTENGSE DEPARTEMENT VAN ONDERWYS

SENIOR CERTIFICATE EXAMINATION
SENIORSERTIFIKAAT-EKSAMEN

QUESTION / *VRAAG* 1
ELECTRIC CURRENT THEORY / *ELEKTRIESE STROOMTEORIE*

1.1.1 $Xl = 2\Pi fl$

$= 2\Pi \times 50 \times 0{,}1$

$= 31{,}42\Omega \rightarrow$ (3)

1.1.2 $Xc = \dfrac{1}{2\Pi fC}$

$= \dfrac{1}{2\Pi \times 50 \times 100 \times 10^{-6}}$

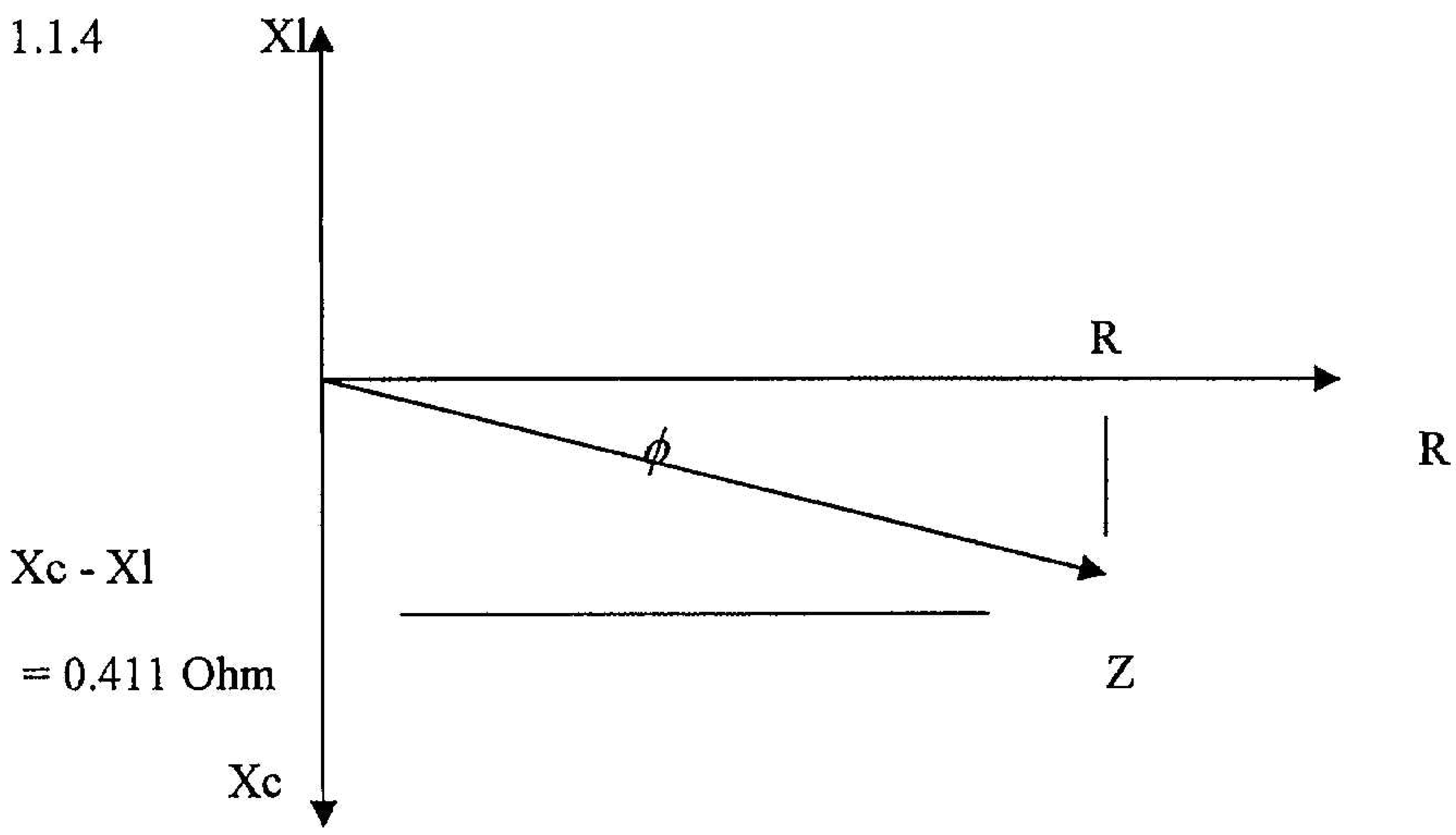
$= 31{,}831\Omega \rightarrow$ (3)

1.1.3 $Z = \sqrt{R^2 - (X_c \cong X_c)^2}$

$= \sqrt{10^2 - (31{,}831 - 31{,}42)^2}$

$= 99{,}83vz$ (3)

1.1.4



(8)

$Cos\phi = \dfrac{R}{Z}$ (4)

$= \dfrac{10}{10.007}$

0.999

$\phi = 2{,}562^0 \rightarrow$

1.2.1 $$Fo = \frac{1}{2\Pi\sqrt{LC}}$$ (3)

$$Fo = \frac{1}{2\Pi\sqrt{400\times10^{-6}\times305{,}7\times10^{-12}}}$$

$$Fo = 455{,}137KHz \rightarrow$$

1.2.2 $$Q = \frac{1}{R}\sqrt{\frac{L}{C}}$$

$$Q = \frac{1}{10}\sqrt{\frac{400\times10^{-6}}{305{,}7\times10^{-12}}}$$

$$Q = 114{,}388 \rightarrow$$ (3)

1.2.3 $$I = \frac{V}{R} \qquad Z = R$$

$$I = \frac{0{,}2}{10}$$

$$I = 0.02A \rightarrow$$ (4)

1.3 $$\frac{Np}{Ns} = \sqrt{\frac{Zp}{Zs}}$$

$$\frac{Np}{Ns} = \sqrt{\frac{500}{8}}$$

$$\frac{Np}{Ns} = 7{,}9:1 \rightarrow$$ (4)

[35]

QUESTION / VRAAG 2

SEMICONDUCTOR DEVICES / HALFGELEIER-TOESTELLE

2.1.1 1N4148 Diode (1)

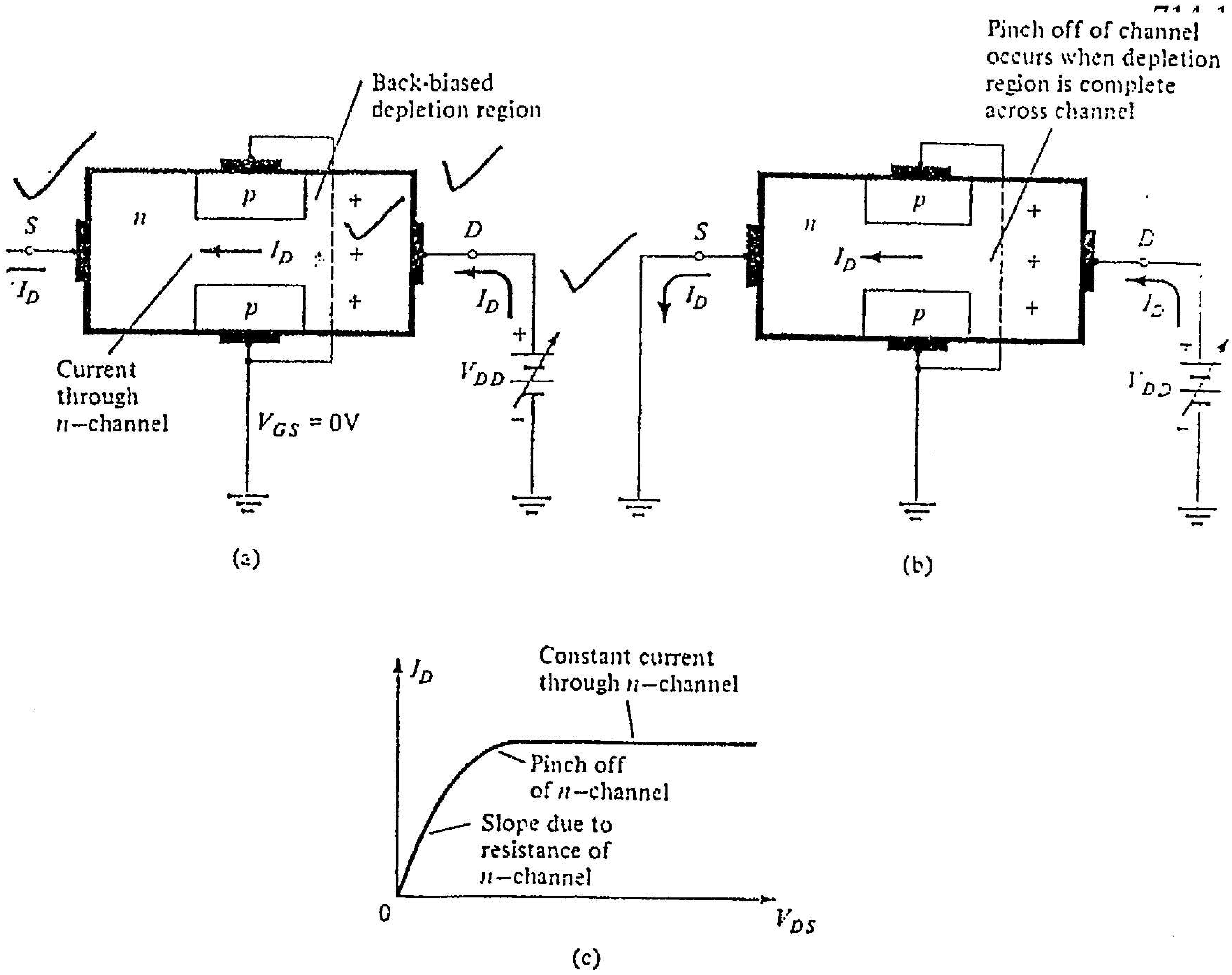
2.1.2 Darlington Pair / Paar (2)

2.1.3 B1 S250 Bridge Rectifier Circuit (fullwave) / Bruggelykrigter (volgolf) (3)

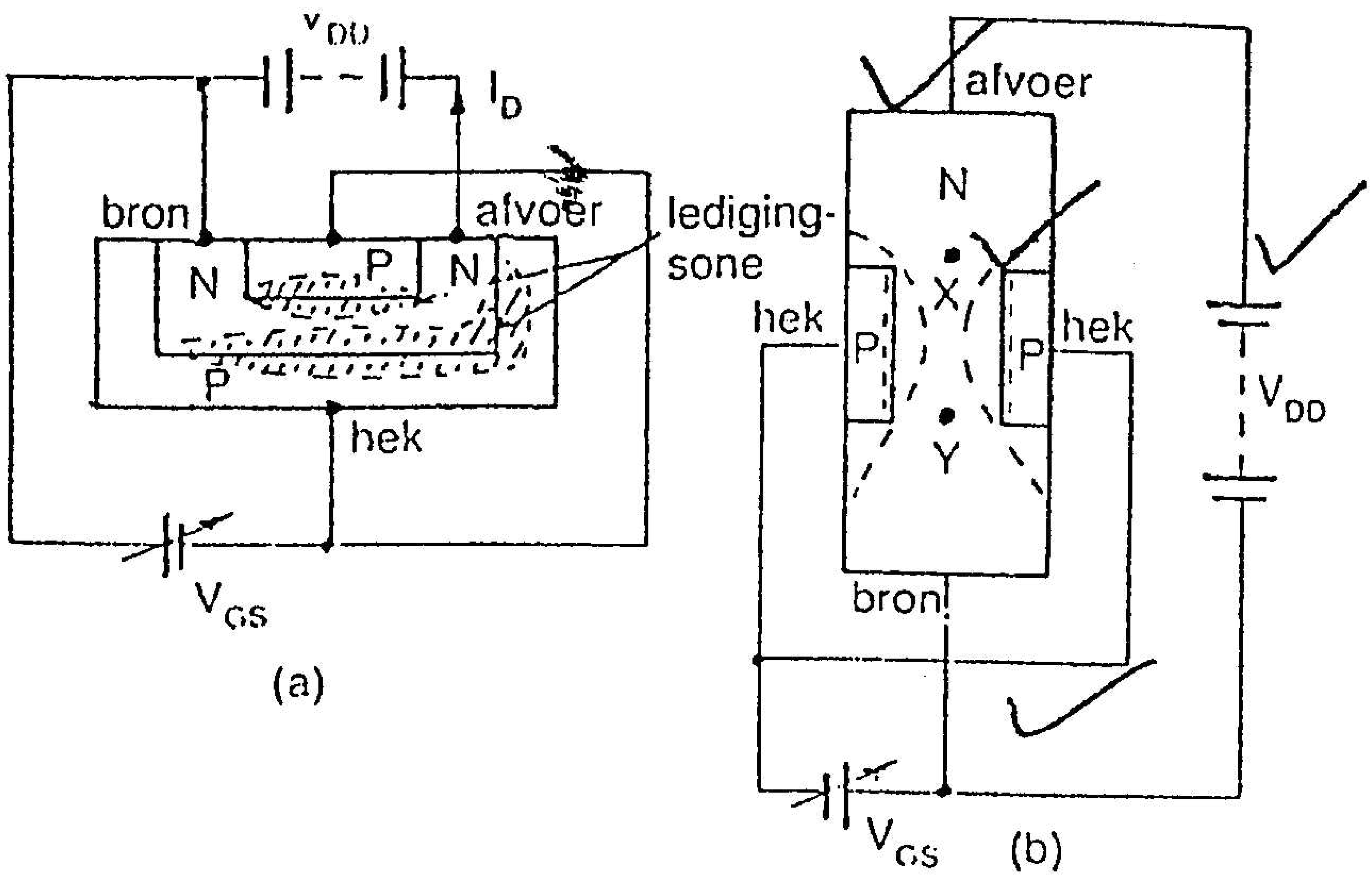
2.1.4 Opt coupler (LED ad photo transistor) / LED en ligsensitiewe transistor (3)

2.1.5 220nF 50V Capacitor / Kapasitor (3)

2.2



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 *chqnnel* 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.



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 / Vervoer in anti-statiese houers.
- Store unutilized units in conductive sponge / Ongebruikte eenhede moet in geleide spons gestoor word.
- Use earthed points soldering irons / Soldeerboute moet geaard wees.
- Use specially earthed wristbands / Gebruik geaarde gewrigsbande.
- Connect all test equipment to earth / Aard alle toetstoerusting.
- All unutilised inputs must be connected to Vdd or Vss / Ongebruikte insette moet verbind word aan Vdd of Vss.

Any Four / Enige Vier (4)

2.4 Improvement of the ripple factor / Verbetering van die ripplefaktor. (2)

[30]

QUESTION / VRAAG 3

AMPLIFIERS / VERSTERKERS

3.1

$$Ve \cong \frac{1}{10}\times(Vcc) \cong \frac{1}{10}\times(16) \cong 1{,}6\,Volt \rightarrow$$

$$Re = \frac{Ve}{Ic} = \frac{1{,}6}{1\times10^{-3}} = 1{,}6\,K\Omega \rightarrow$$

(6)

Vcc = Vc + Vce + Ve

Vc = Vcc – (Vce + Ve)

= 16 – (6 + 1,6)

= 8,4 Volt →

$$Rc = \frac{Vc}{Ic}$$

$$Rc = \frac{8{,}4}{1\times10^{-3}}$$

$$Rc = 8{,}4\,K\Omega \rightarrow$$

(7)

Vb = Ve + Vbe

= 1,6 + 0,7

= 2,3 Volt →

$$R_{B2} \cong \frac{1}{10}(\mathrm{B}\times \mathrm{Re}) = \frac{150\times1600}{10} = 24\,K\Omega \rightarrow$$

(6)

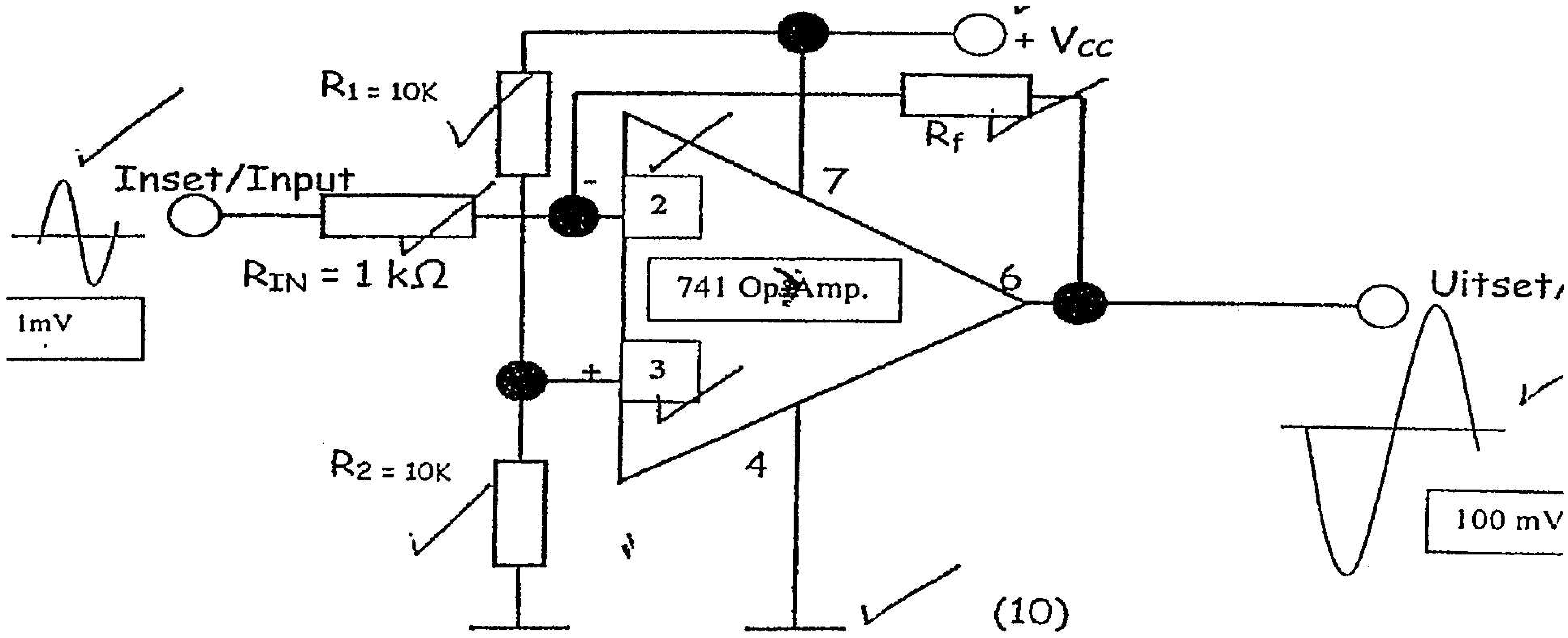
$$\frac{R_{b2}}{R_{b1}+R_{b2}}Vcc = Vb$$

$$R_{b1} = \frac{R_{b2}Vcc}{Vb} - R_{b2}$$

$$R_{b1} = \frac{24\times10^{3}\times16}{2{,}3} - 24\times10^{3}$$

$$R_{b1} \cong 143K\Omega \rightarrow$$ (4)

3.2.1



3.2.2

$$Av = \frac{Vout}{Vin}$$

$$= \frac{1}{5\times10^{-3}}$$

$$= 200 \rightarrow$$

$$A = \frac{Rf}{Rin}$$

$$Rf = A\times Rin$$

$$Rf = 200\times1\times10^{6}$$

$$Rf = 200M\Omega \rightarrow$$

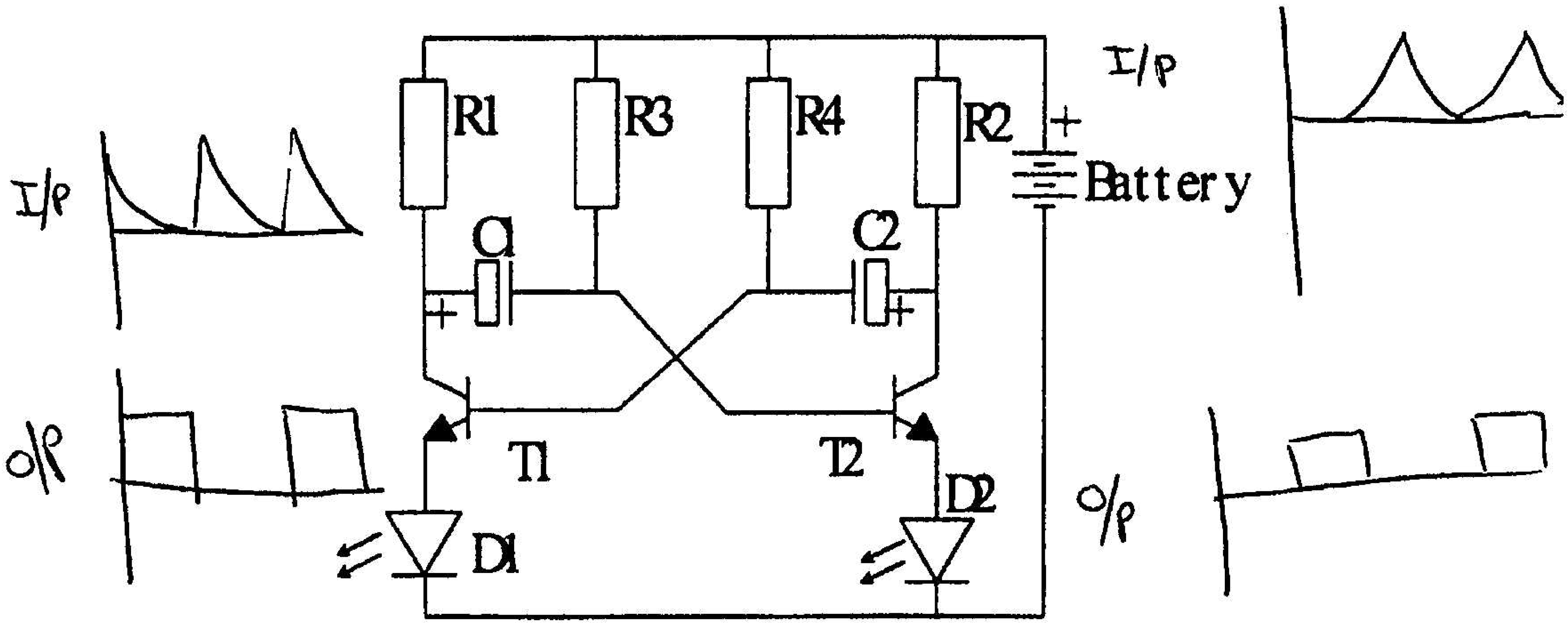
(7)

[40]

QUESTION / VRAAG 4

SWITCHING AND CONTROL CIRCUITS / SKAKEL EN BEHEERKRINGE

4.1



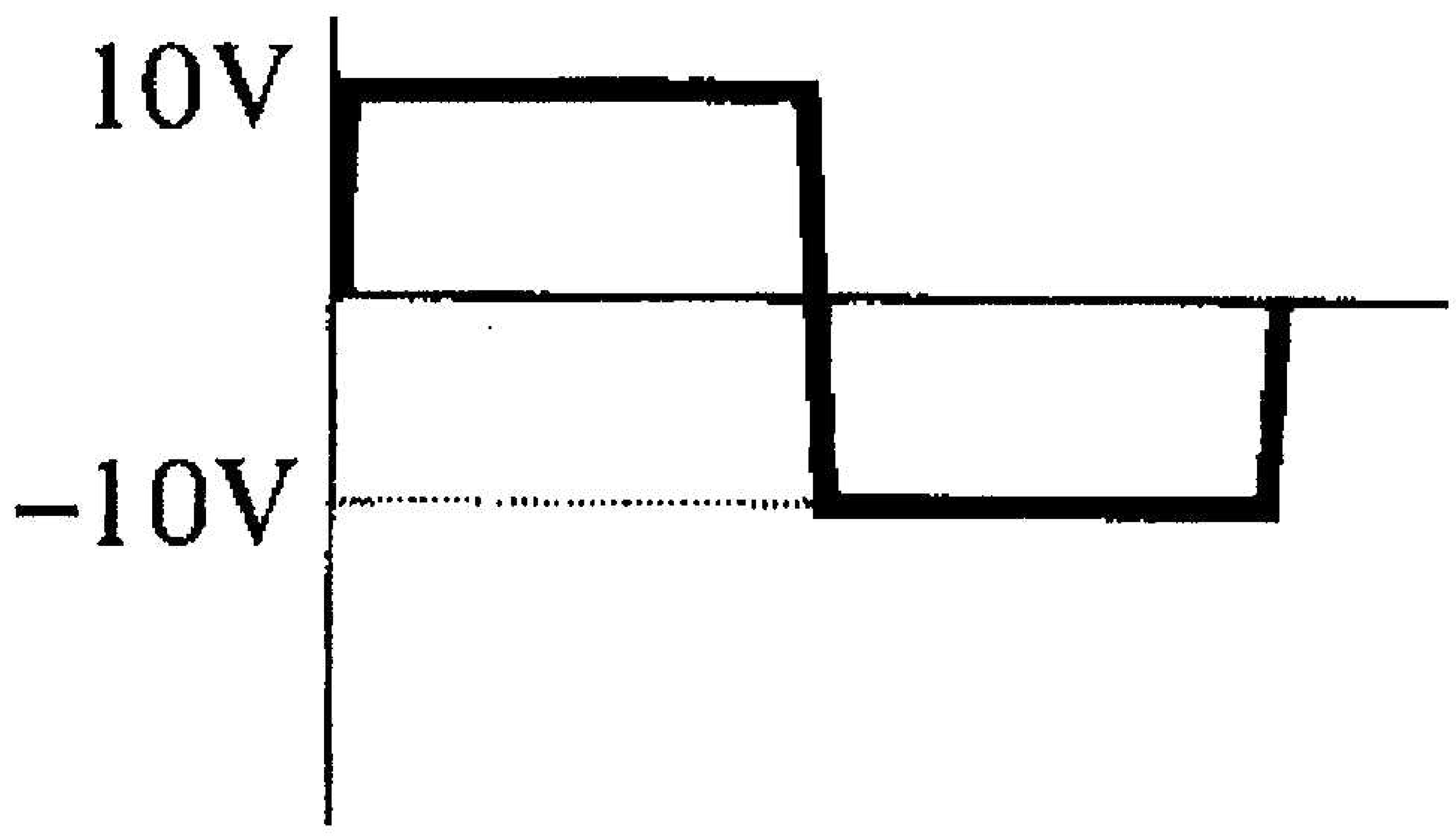
(10)

4.2 The cathode of the thyristor is connected to the load, with the anode connected to the positive terminal of the reserve battery. The gate of the thyristor is also connected to the positive terminal of the reserve battery via a 47-kΩ trimpot (P1). This already clearly suggests how the automatic switchover works.

The voltage across the thyristor is the difference between the two battery voltages. Initially, with both batteries fully charged, the voltages of the two batteries are nearly the same. The thyristor is thus cut off, since there is not any significant voltage across it and no gate current flows via P1. As the main battery becomes increasingly discharged, the voltage across the load decreases, which means that the voltage at the cathode of the thyristor decreases. The anode thus becomes positive with respect to the cathode and the gate. A gate current starts to flow via P1, with its magnitude depending on the voltage and the value of P1. As soon as the gate current exceeds the triggering threshold of the thyristor, the thyristor fires (which means that it suddenly starts to conduct), causing the reserve battery to be connected to the load. Since the voltage of the reserve battery is higher than that of the discharged main battery, diode D1 is cut off, preventing any current from flowing from the reserve battery into the main battery. We thus have a circuit that indeed switches from the main battery to the reserve battery.

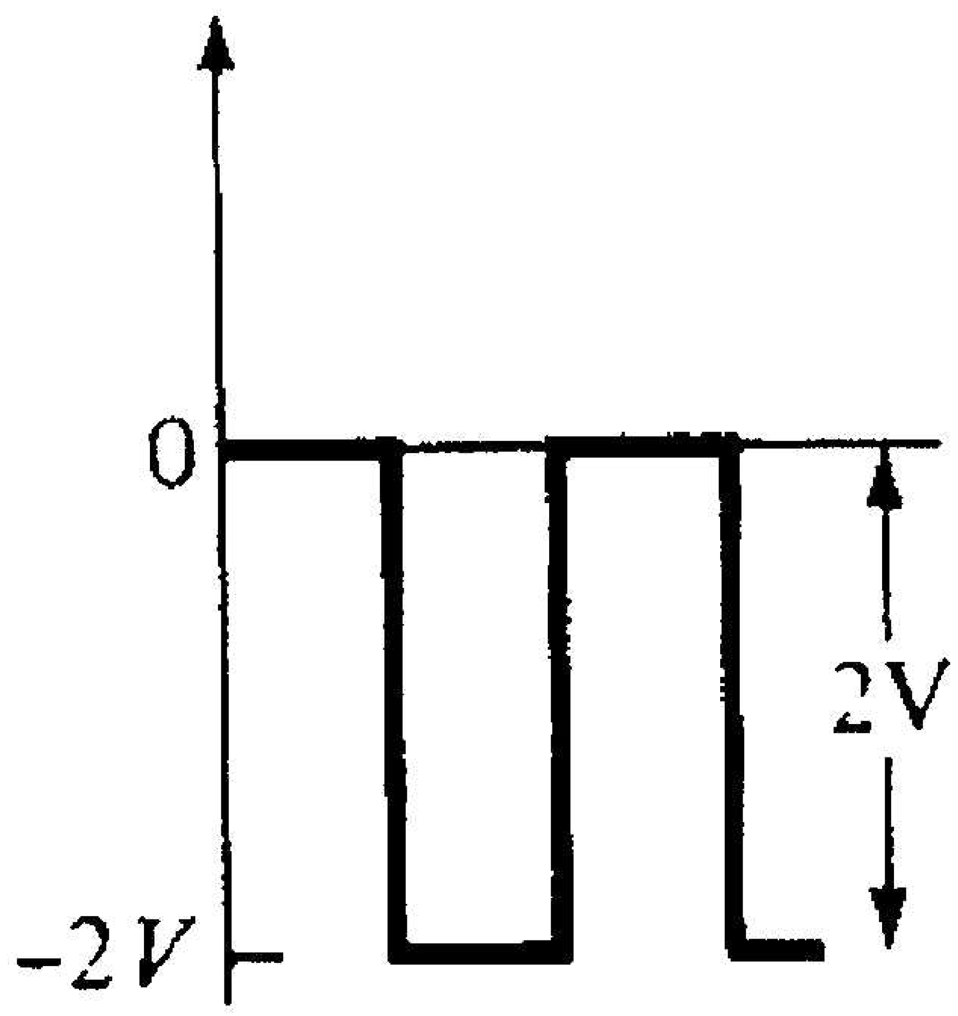
Diode D1 not only prevents a reverse current flow from the reserve battery into the main battery, it also forms part of an indicator circuit, in combination with transistor T1 and LED D2. This circuit works as follows: as long as a current flows from the main battery through D1, a base current also flows through the base-emitter junction of the transistor, which together with the base resistor R1 is connected in parallel with D1. This causes the transistor to conduct, so LED D2 is illuminated to indicate that the main battery is in use. When the circuit switches over to the reserve battery, T1 is also cut off, and the LED is immediately extinguished. (12)

4.3.1



(3)

4.3.2



(3)

4.4.1 Any logical explanation / Enige logiese veduideliking

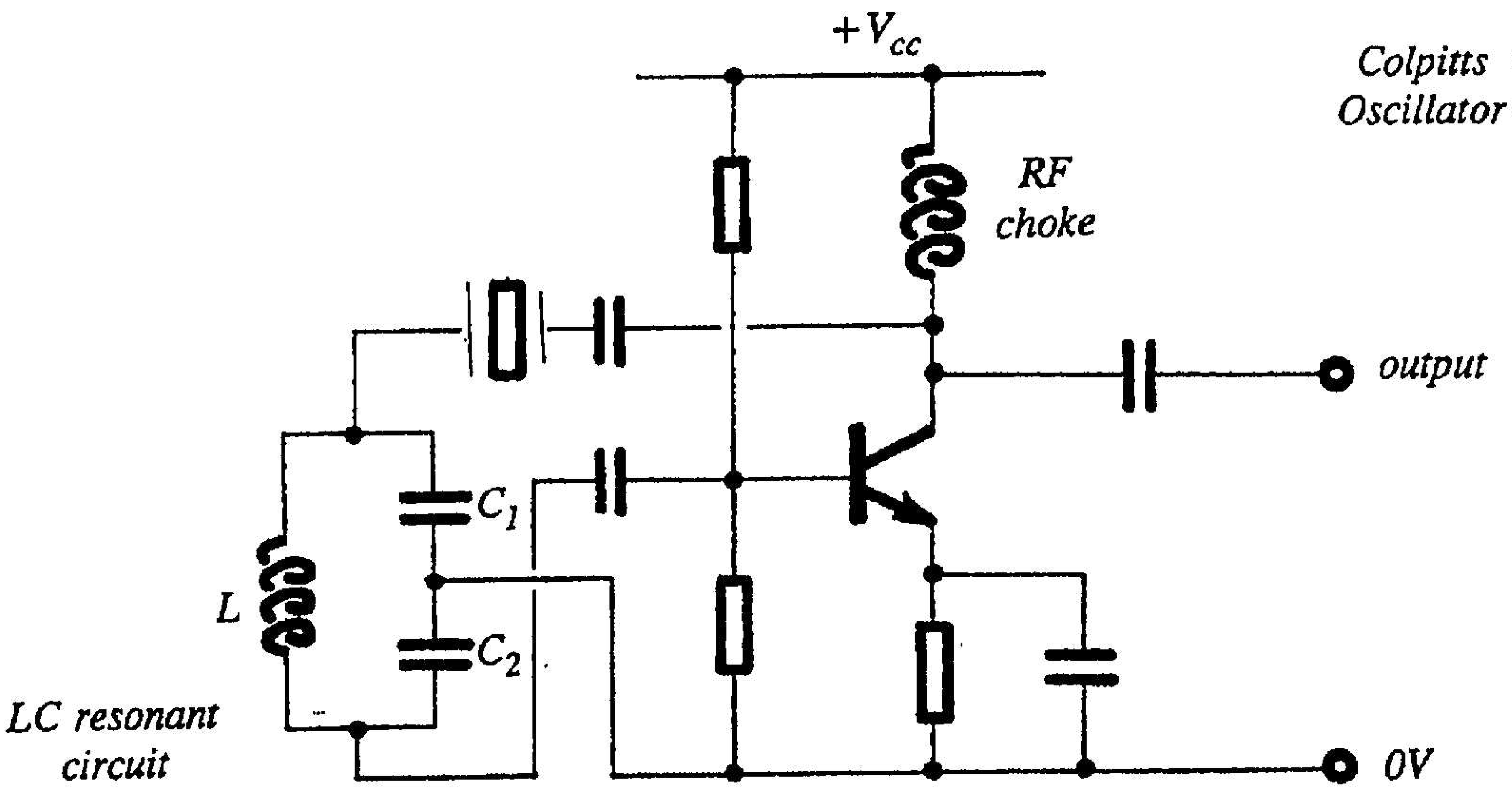
One mark for each correct fact / Een punt vir elke korrekte feit. (15)

[43]

QUESTION / VRAAG 5

OSCILLATORS / OSSILATORS

5.1



Colpitts **Colpitts**
Oscillator **Ossilator**

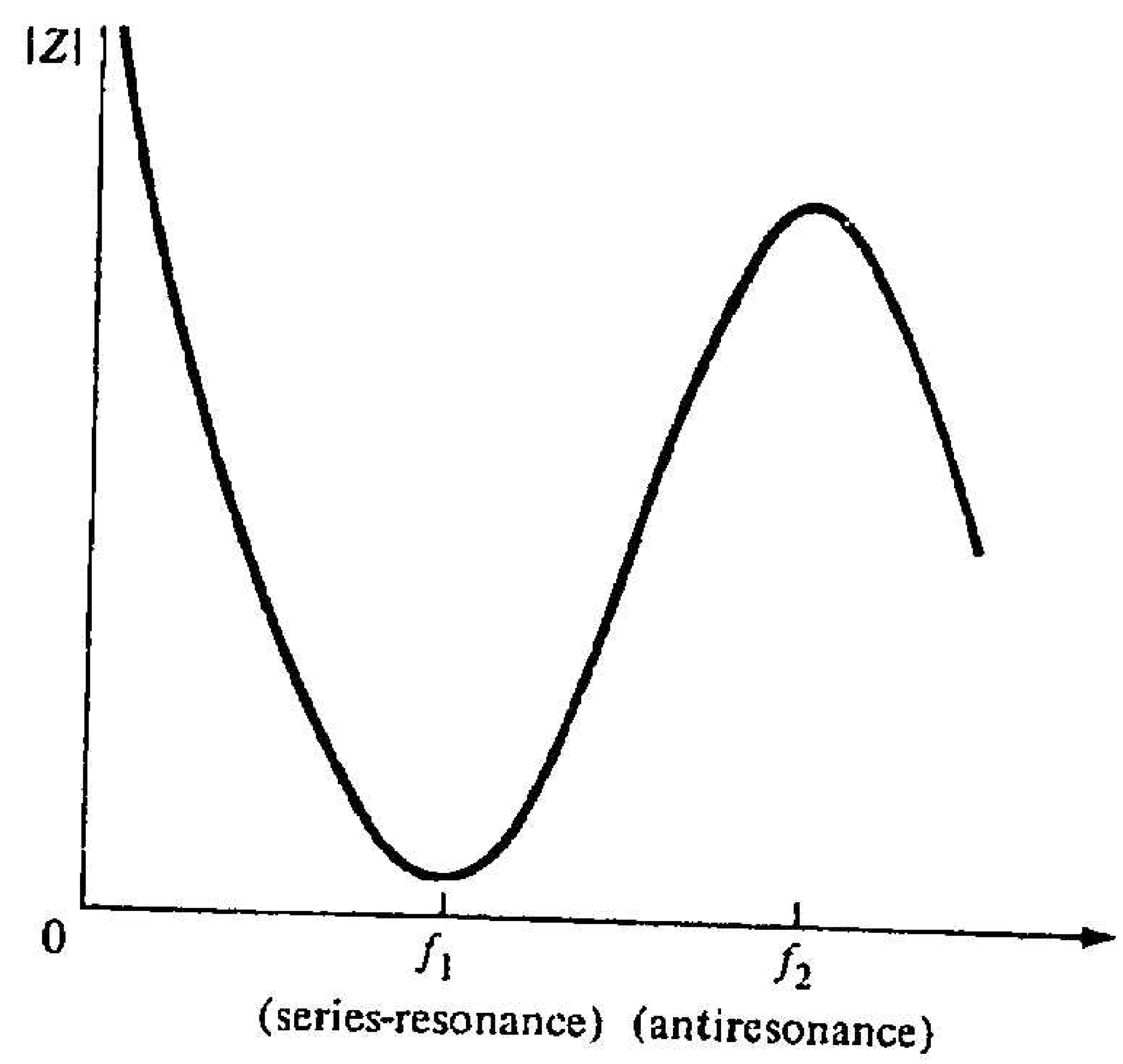
(10)

5.2 When mechanical stress is applied across the faces of a crystal, a potential difference develops opposite the faces of the crystal. Similarly, a voltage applied across the faces of a crystal will result in mechanical vibrations. These vibrations have a natural resonant frequency dependant on the crystal.

Wanneer meganiese druk op die aansigte van 'n kristal toegepas word, veroorsaak dit 'n potensiaalverskil oor die kristal. Soortgelyk wanneer 'n potensiaalverskil op die aansigte van 'n kristal toegepas word, veroorsaak dit dat die kristal sal vibreer (ossileer) teen 'n resonante frekwensie eie aan die tipe kristal.

(4)

5.3



(4)

[18]

QUESTION / VRAAG 6

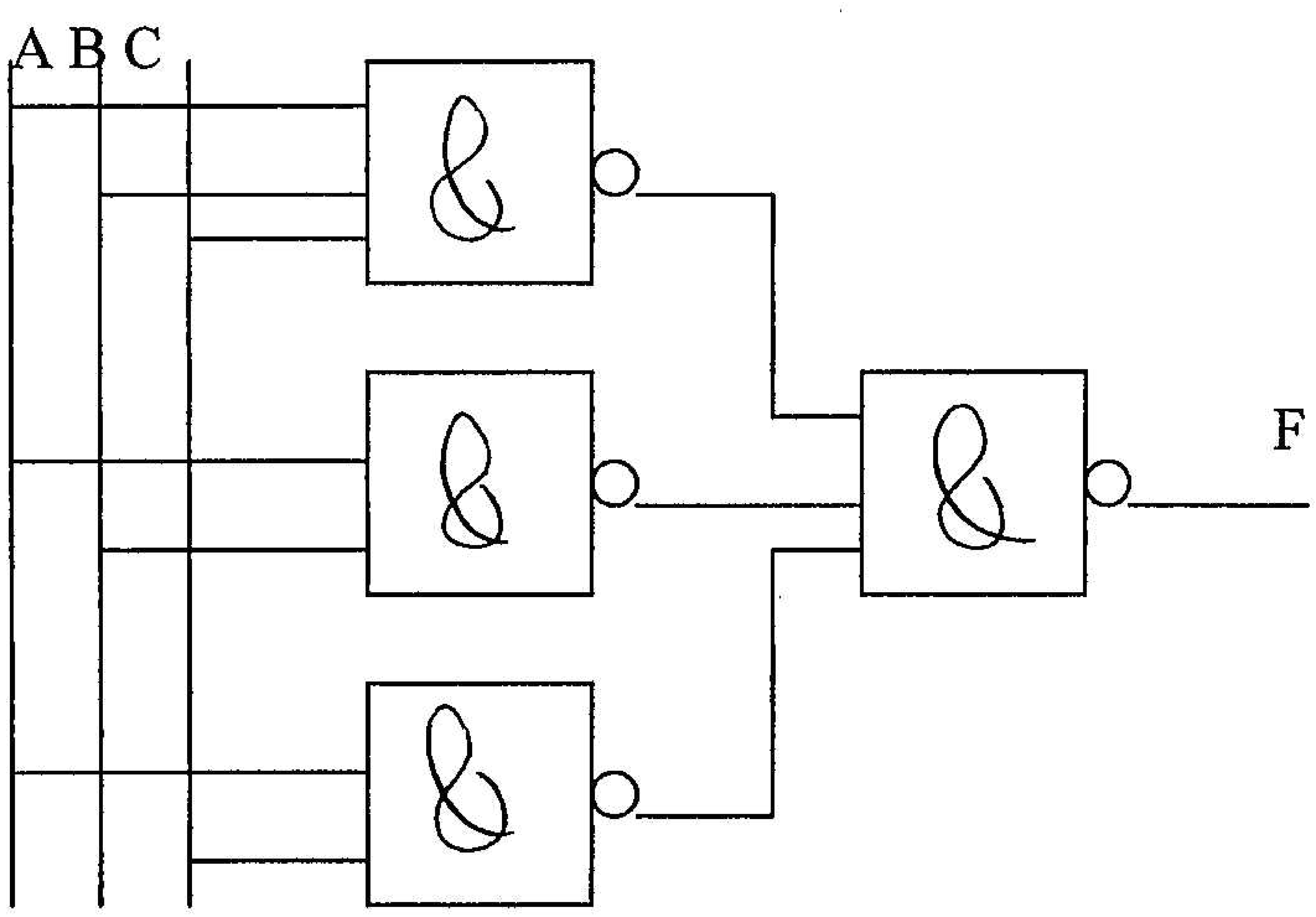
COMPUTER PRINCIPLES / REKENAARBEGINSELS

6.1 $F = ABC + AB + AC$

$F = \overline{\overline{ABC + AB + AC}}$

$F = \overline{\overline{(ABC)}.\,\overline{(AB)}.\,\overline{(AC)}}$ ⟶

(2)



(4)

6.2 $\bar{A}.B + A.\bar{B} = (A + B)\,\overline{AB}$

$\overline{\overline{\bar{A}.B + A.\bar{B}}} = \overline{\overline{\bar{A}B}\,.\,\overline{A\bar{B}}}$

$= \overline{(A + \bar{B})\,.\,(\bar{A} + B)}$

$= \overline{A.\bar{A} + AB + \bar{A}\,.\,\bar{B} + B\bar{B}}$

$= \overline{\bar{A}\,.\,\bar{B} + AB}$

$= (A + B)\,.\,(\bar{A} + \bar{B}) \quad = \quad (A + B)\overline{AB}$ ⟶ (7)

6.3.1

A	B	C	D	F
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	**1**
1	1	0	0	0
1	1	0	1	**1**
1	1	1	0	**1**
1	1	1	1	**1**

Legend: A = Normal working hours / Normale kantoorure (8)

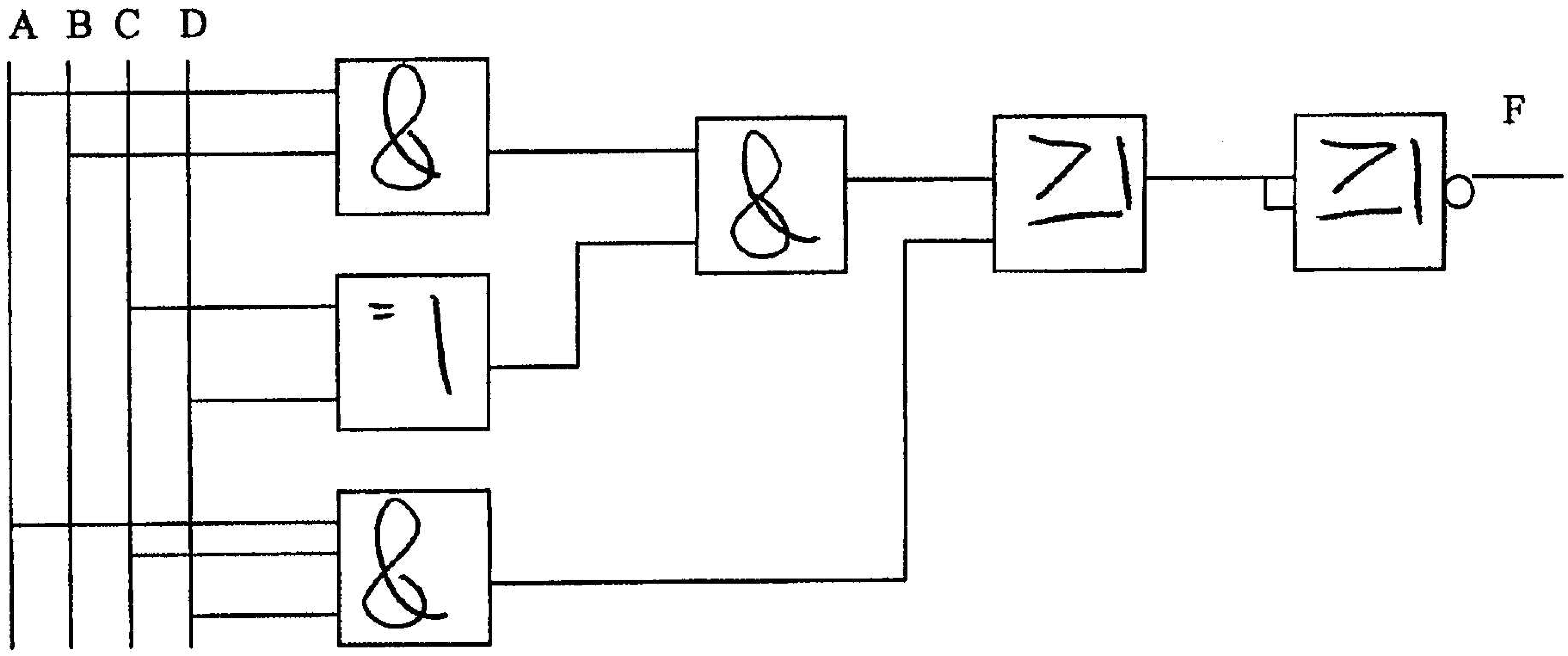
B = Manager / Bestuurder

C = Accountant / Rekenmeester

D = Chief Security Officer / Hoofsekutiteitsbeampte

6.3.2 F $= AB\overline{C}D + A\overline{B}CD + ABC\overline{D} + ABCD$ (4)

6.3.3 $= AB(\overline{C}D + C\overline{D}) + ACD(\overline{B} + B)$



(6)

6.4

2	20	0	MSB ↑
2	10	0	
2	5	1	
2	2	0	
2	1	1	
	0		LSB

0,375 x 2 = 0,75 carry / oordrag	0	LSB
0,75 x 2 = 1,5 carry / oordrag	1	↓
0,5 x 2 = 1 carry / oordrag	1	MSB

20,375 = 10100,011 →

2	10	0	MSB ↑
2	5	1	
2	2	0	
2	1	1	
	0		LSB

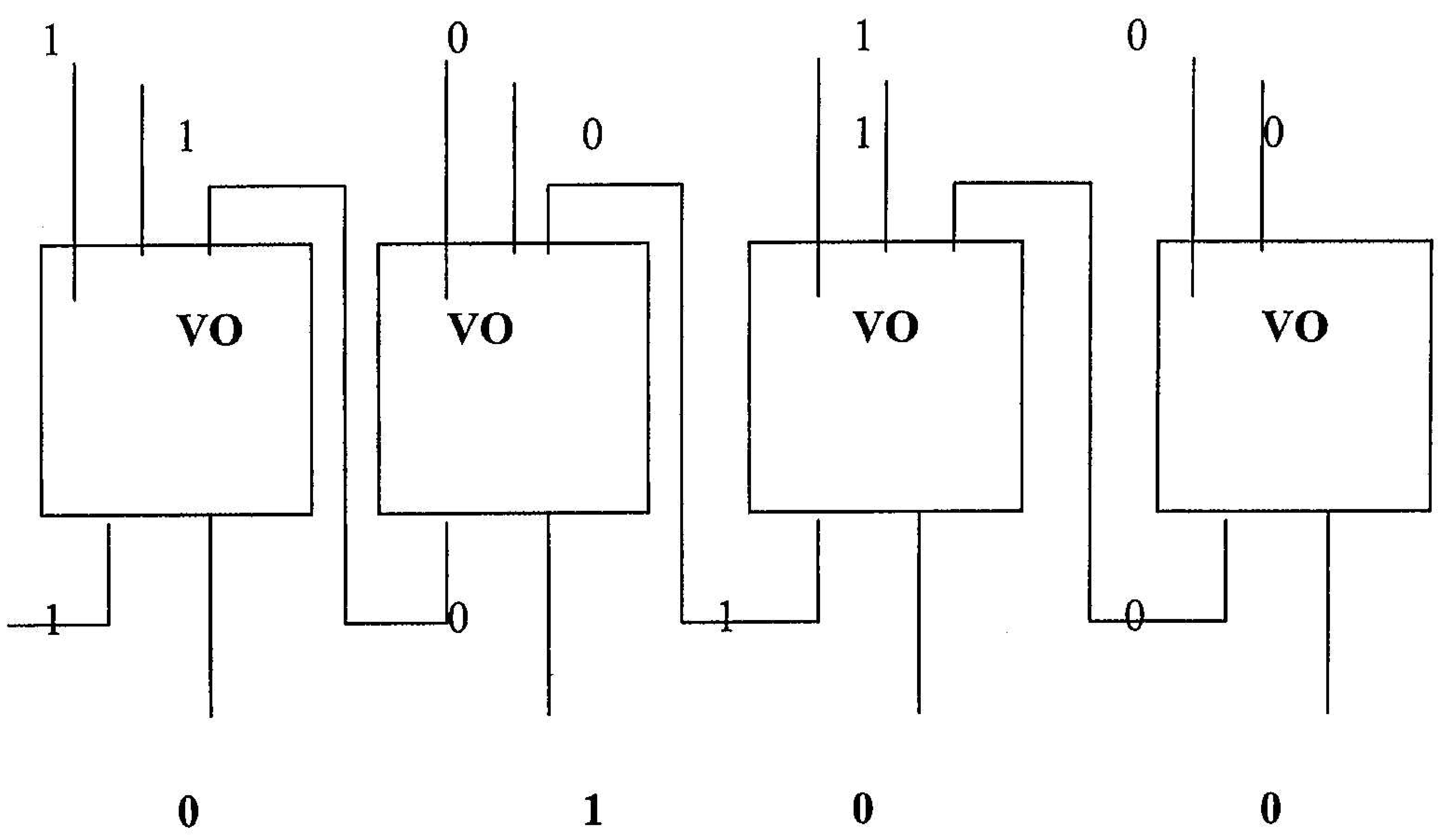
10 = 1010 →

 10100,011
\+ 1010,000

11110,011 →

(4)

6.5

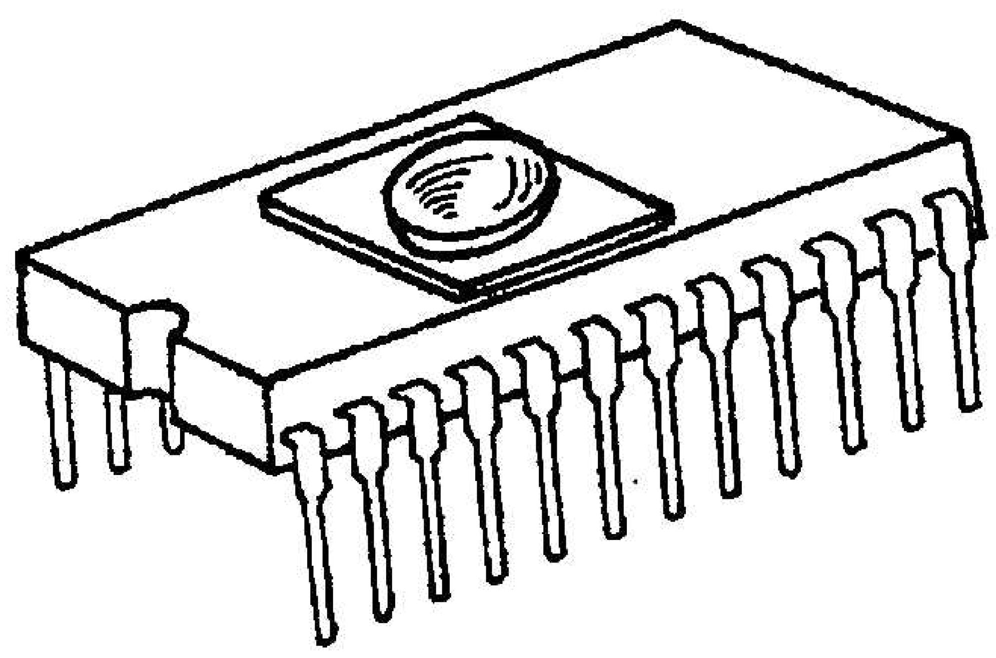


(16)

6.6

3. **EPROM**

A unique type of ROM which allows its programmed (stored) data to be changed under special conditions is known as an **erasable-programmable read-only memory EPROM.** On exposing the device to ultra-violet light all existing data is erased which then allows the memory to be reprogrammed. EPROMs can be recognised by their small quartz "windows" which allow the ultra-violet light through onto the chip.
(Glasspoole)



A Typical EPROM Chip

(4)

[59]

QUESTION / VRAAG 7

7.1

INFORMATION TRANSFER / INFORMASIE OORDRAG

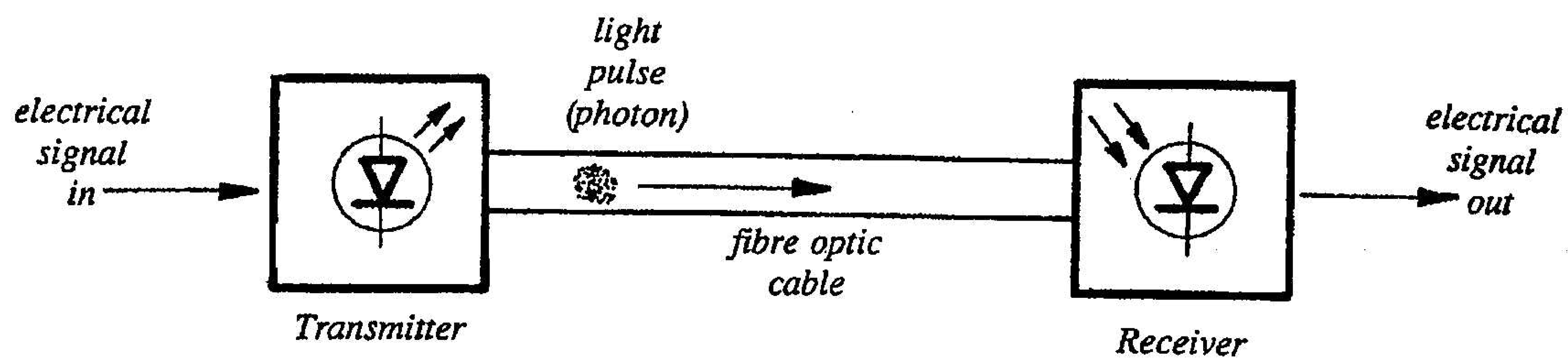
BAND	TERM	USES/GEBRUIKE
30 kHz – 300 kHz	Low Frequency (LF)	Long Distance Communication
300 kHz – 3 MHz	Medium Frequency (MF)	Medium wave broadcasting, radio
3 MHz – 30 MHz	High Frequency (HF)	Short wave, amateur and CB radio
30 MHz – 300 MHz	Very High Frequency (VHF)	FM Radio, Police Comm.,
300 MHz – 3 GHz	Ultra High Frequency (UHF)	E-TV, MNET
Above 3 GHz	Super High Frequency (SHF)	Fibre optic, telephone, Radar, TV links

(6)

7.2 Optic fibre systems have broader bandwidth and can thus carry more traffic due to wider range of modulation that can take place. Not prone to lightning and high measure of security Etc.

Optiese vesel het 'n groter bandwydte en kan sodoende meer "verkeer" hanteer. Dit is weerlig bestand er het geen waarde in die sluikhandel. (4)

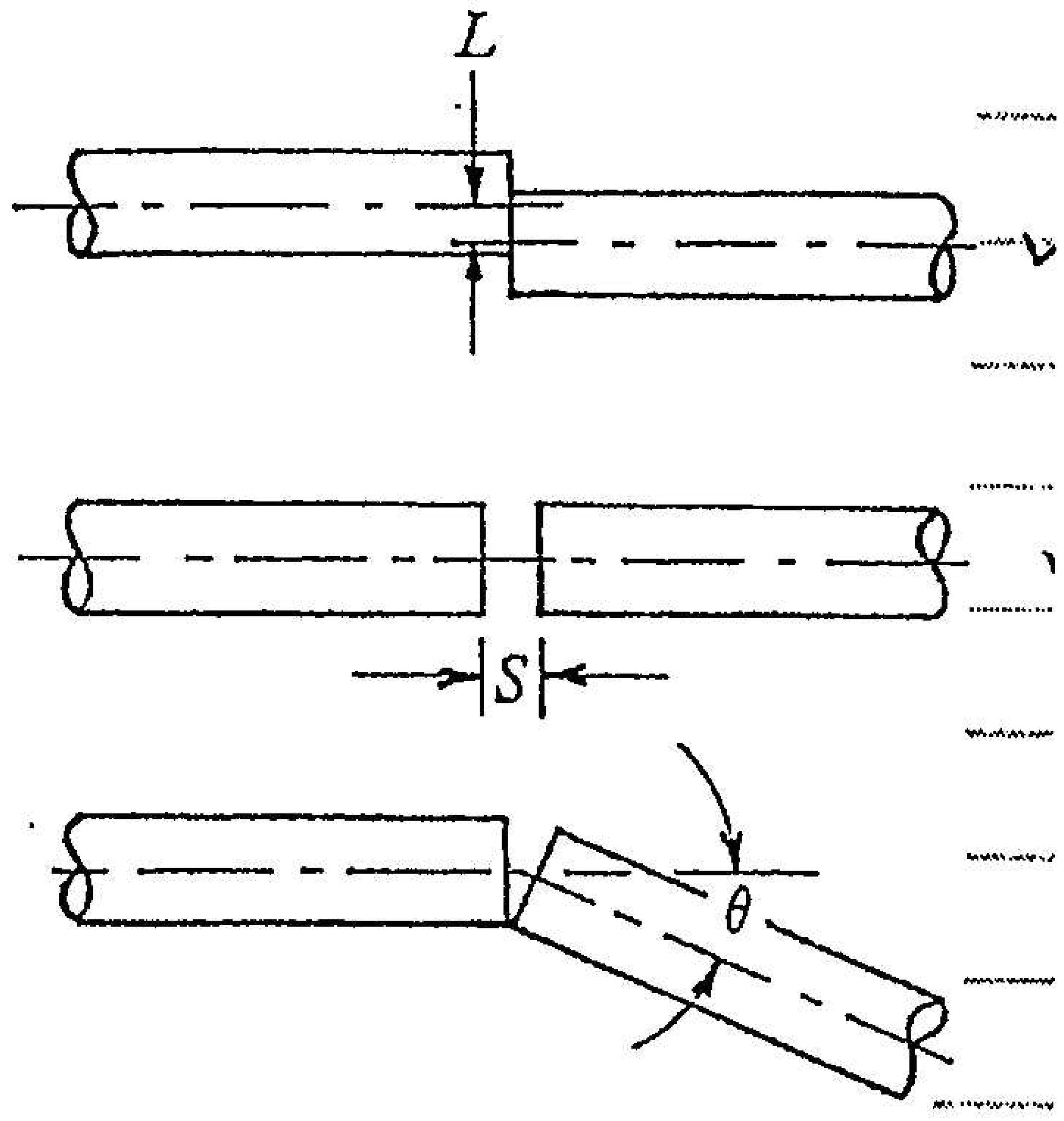
7.3



(6)

7.4 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.

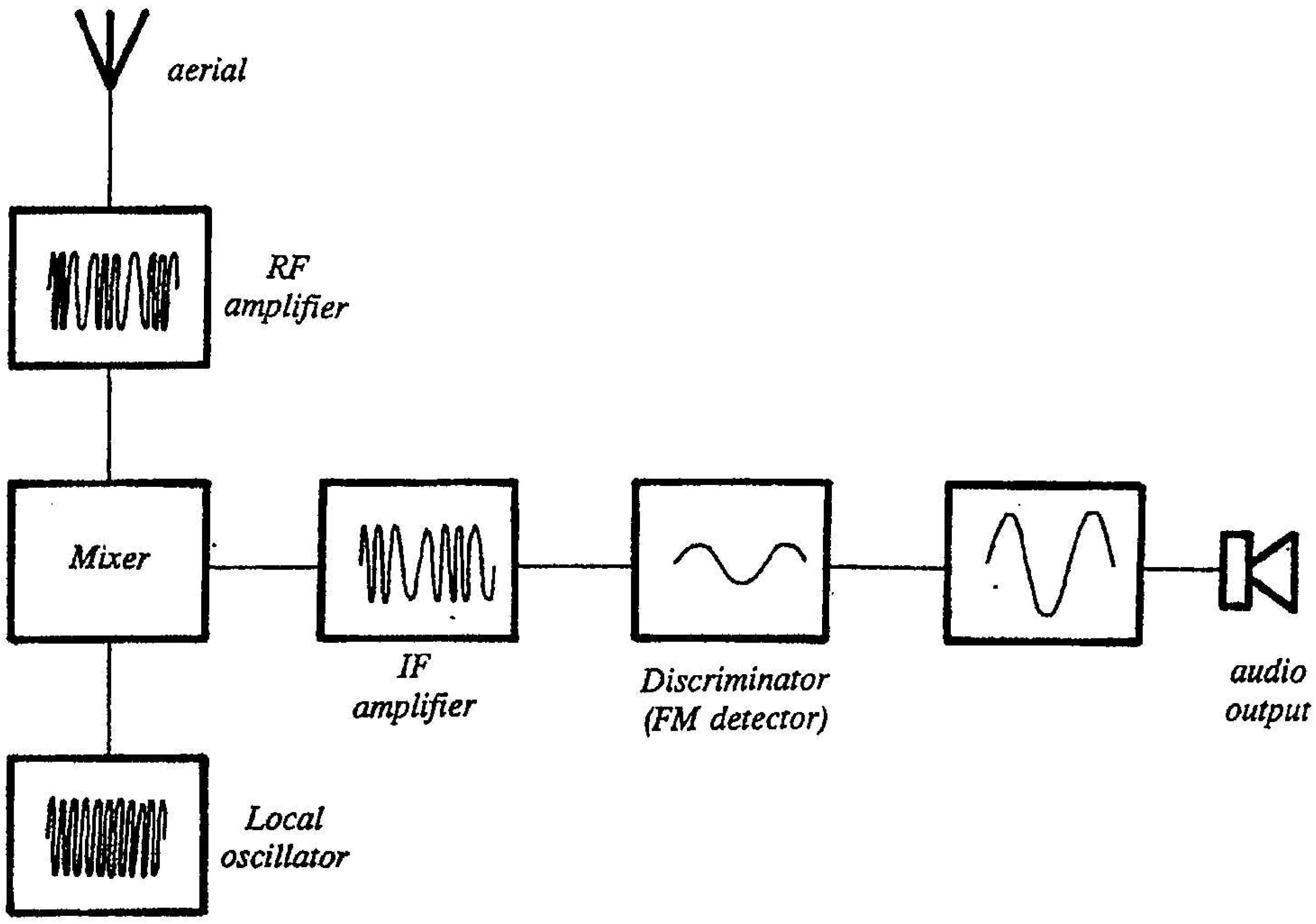
2. End separation where any slight air gap will introduce a change of refractive index leading to some internal reflection loss.

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

Die las van optiese vesels is uiters kritiek a.g.v. die lynversteuring van die binnevlak van die vesel wat mag plaasvind. Enige verskuiwing van hierdie oppervlakte bring energieverliese mee soos bo geïlustreer

(8)

7.5



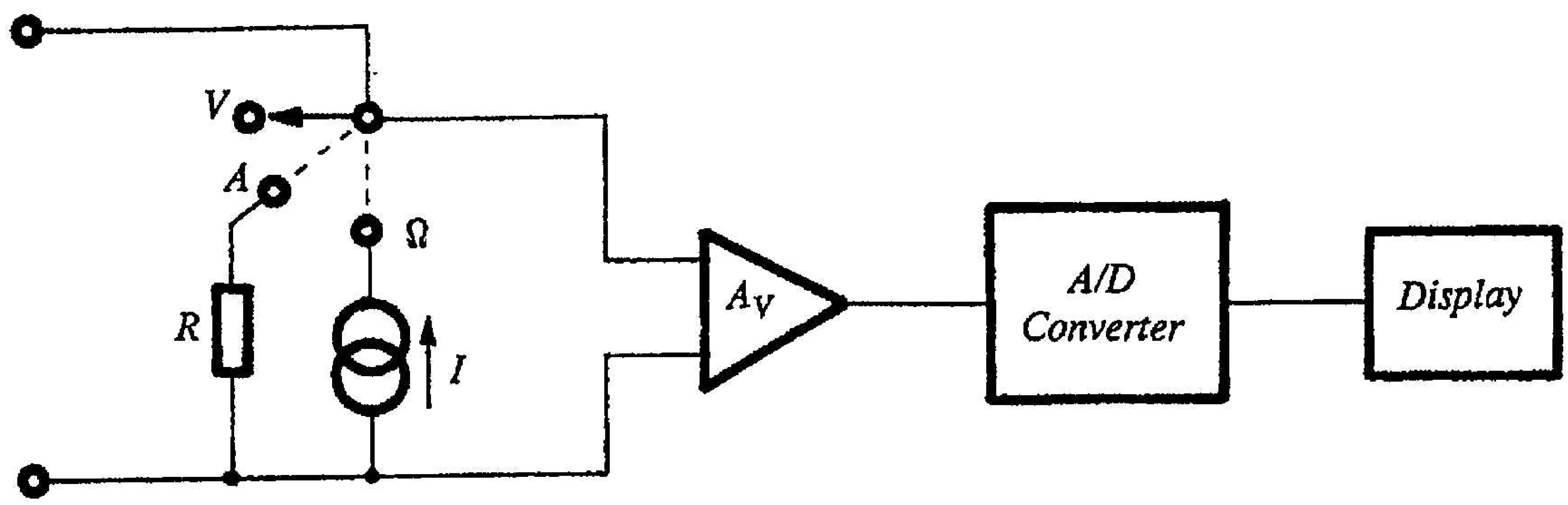
(13)

[37]

QUESTION / VRAAG 8

MEASURING INSTRUMENTS / MEETINSTRUMENTE

8.1



(10)

8.2.1 t = No./ Div. x t/Div.

= $3 \times 2 \times 10 \times 10^{-3}$

= 30 m Sec. (3)

8.2.2 Vp = No./ Div. x V/Div.

= $2 \times 5 \times 10^{-3}$

= 10 mVolt. (3)

8.3 20 KΩ (2)

[18]

QUESTION / VRAAG 9

SAFETY PRECAUTIONS / VEILIGHEID

9.1

- The selector switch must be on the right scale / Die selekteerskakelaar moet op die korrekte skaal gestel word.
- Set the selector switch to the highest FSD / Stel die selekteerskakelaar op die hoogste VSD.
- Check the AC/DC setting / Kontroleer die AC/DC verstelling.
- Plug the leads into the correct positions / Maak seker dat die toets-geleiers in die korrekte sokke geplaas word.
- Power must be off when measuring Ohms / Skakel die krag af wanneer Ohm gemeet word.
- Do not drop the meter / Moenie die meter nie laat val nie. (Any five / Enige vyf) (5)

9.2 * Do not use a foam fire extinguisher (2)

* Make use of a chemical fire extinguisher

9.3.1 False / Onwaar (1)

9.3.2 False / Onwaar (1)

9.3.3 False / Onwaar (1)

9.3.4 False, be aware of window period? / Onwaar (1)

9.3.5 False / Onwaar (1)

9.3.6 Yes / Ja (1)

9.3.7 False / Onwaar (1)

9.4 080 0012 322 (1)

9.5 Loose clothing / Los klere

Working without safety glasses when expected / Deur nie 'n veiligheidsbril te gebruik wanneer dit vereis word nie.

Play in workshop / Speel in werkwinkel

Work without permission / Werk sonder toestemming

Working with the wrong tools / Werk met die verkeerde gereedskap.

Any acceptable answer / Enige aanvaarbare antwoord (5)

[20]

[300]