GAUTENG DEPARTMENT OF EDUCATION
GAUTENGSE DEPARTEMENT VAN ONDERWYS

SENIOR CERTIFICATE EXAMINATION
SENIORSERTIFIKAAT-EKSAMEN

TECHNIKA (ELECTRONICS / *ELEKTRONIES*) HG
Possible Answers / Moontlike Antwoorde
Feb / Mar / Maart 2006

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

Determine circuit impedance / *Bepaal kringimpedansie*

1.1

$$Z = \sqrt{(R_1 + R_2 + R_3)^2 + [(X_{L1} + X_{L2}) - (X_{C1} + X_{C2})]^2}$$

$$Z = \sqrt{(100 + 47 + 68)^2 + [(330 + 270) - (150 + 220)]^2}$$

(4)

Combine terms / *Kombineer terme*

$$Z = \sqrt{215^2 + (600 - 370)^2} = \sqrt{215^2 + 230^2}$$

$$Z = \sqrt{46{,}225 + 52{,}900} = \sqrt{99{,}125} = 314{,}84\,\Omega$$

(2)
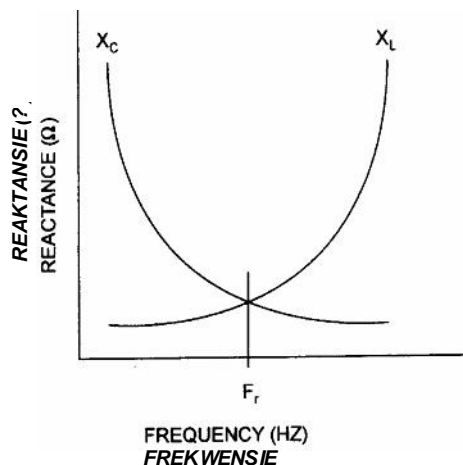
Determine line current / *Bepaal lynstroom*

$$Is = \frac{E_S}{Z} = \frac{120V}{314{,}84\,\Omega} = 0{,}381\,A = 381\,mA$$

(3)

Determine the voltage drop across / *Bepaal die spanningsval oor* X_{L2} :

$$V_{L2} = I_S X_{L2} = 0{,}381 \times 270 = 102{,}91\,V$$

(3)
[12]

1.2

(5)

1.3

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

$$2\pi\sqrt{LC} = \frac{1}{fo}$$

$$\sqrt{LC} = \frac{2\pi}{fo}$$

$$LC = \left(\frac{2\pi}{fo}\right)^2$$

$$C = \left(\frac{2\pi}{fo}\right)^2 \div L$$

$$= \left(\frac{2\pi}{10,7 \times 10^6}\right)^2 \div 23 \times 10^{-6}$$

$$= Forad$$

(5)

1.4

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

$$\left(\frac{Np}{Ns}\right)^2 = \frac{Zp}{Zs}$$

$$Zp = Zs\left(\frac{Np}{Ns}\right)^2$$

$$= 16\left(\frac{25}{1}\right)^2$$

$$= 10\,k\Omega$$

(5)

[27]

QUESTION / *VRAAG 2*
SEMICONDUCTOR DEVICES / *HALFGELEIER-TOESTELLE*

2.1.1 NPN Transistor (2)

2.1.2 Photo diode / *Ligsensitiewe diode* (2)

2.1.3 LED (2)

2.1.4 16 ? Loudspeaker / *Luidspreker* (2)

2.1.5 22 μfarad polarised Capacitor / *gepolariseerde kapasitor* (3)

2.2
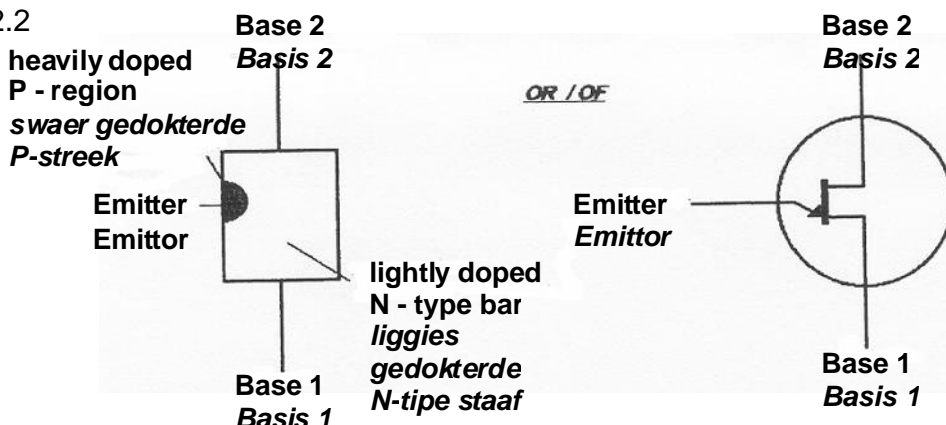
- Three terminal device. / *Drie-terminaal-komponent.*
- Only one junction between / *Een aansluitingsvorm tussen*
- P- and N type material. / *die P- en N-tipe materiaal.*
- Consist of P- and N - type material./ *Bestaan uit N- en P-materiaal.*
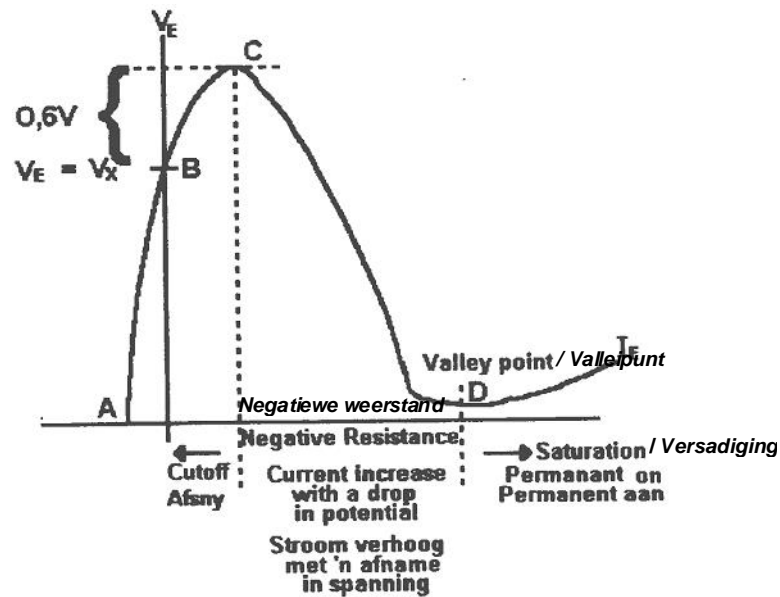
Operation / *Werking*
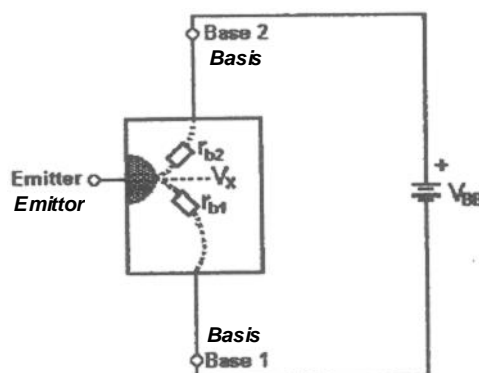
Once a supply voltage is coupled to terminals B_1 and B_2 of the doped bar, this forms a resistance with a voltage drop down the length of the bar. The bar naturally divides into two resistances between its ends and the central heavily doped p-emitter region. These resistances, r_{b1} and r_{b2}, lie from this point down to B_1 and the other up to B_2. When an external voltage is applied these two resistors from a potential divider within the bar which sets up an exact voltage V_x at the emitter pn junction.
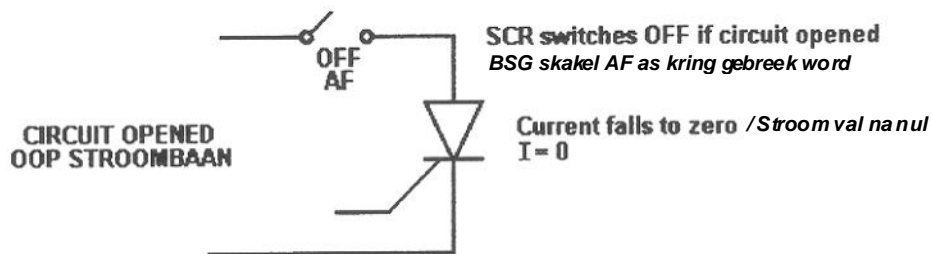
- Emitter - Base 1 = Forward bias / *Emittor - Basis 1 = Voorgespan*
- Emitter - Base 2 = Reverse bias / *Emittor - Basis 2 = Teenvoorgespan*
- Positive pulse on Emitter / *Positiewe puls op Emittor*

Sodra die toevoerspanning aan terminale B_1 en B_2 van die gedokterde staaf gekoppel word, sal dit ? weerstand met ? spanningsval met die lengte van die staaf afstuur. Die staaf verdeel natuurlik in twee weerstande tussen sy ente en die swaargedokterde p-emittor-streek. Hierdie weerstande, r_{b1} en r_{b2} lê met sy een punt af met B_1 en die ander op met B_2. Wanneer ? eksterne las op hierdie twee resistors toegepas word vanaf ? potensiaalverdeler met ? staaf wat ? presiese spanning V_x by die emittor-pn-verbinding opstel.

V_E

0,6V

$V_E = V_X$ — B

C

A

Valley point / Valleipunt

I_E

D

Negatiewe weerstand

Negative Resistance

Saturation / Versadiging

Cutoff
Afsny

Current increase
with a drop
in potential

Stroom verhoog
met 'n afname
in spanning

Permanant on
Permanent aan

(20)

2.3

OFF
AF

CIRCUIT OPENED
OOP STROOMBAAN

SCR switches OFF if circuit opened
BSG skakel AF as kring gebreek word
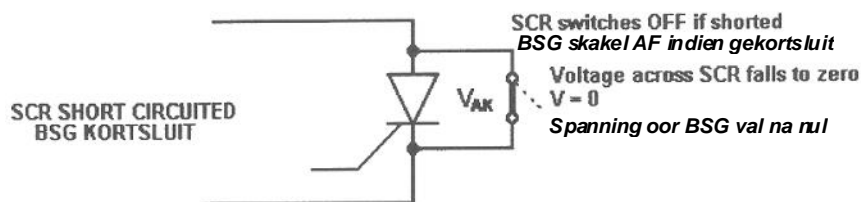
Current falls to zero / Stroom val na nul
I = 0

If the SCR terminal voltage is pulled lower than V_{AK} or even down to zero it in turn will pull the current below the holding current and the SCR will reset and switch off.

Indien die BSG-terminaalspanning laer as V_{AK} of selfs onder hul getrek word, sal dit die stroom onder houstroom en die BSG skakel af. Stroom is laer as die houstroom = BSG skakel af.

(4)

OR / *OF*

SCR SHORT CIRCUITED
BSG KORTSLUIT

V_{AK}

SCR switches OFF if shorted
BSG skakel AF indien gekortsluit

Voltage across SCR falls to zero
V = 0

Spanning oor BSG val na nul

Once the SCR has turned off it goes into the reverse-blocking state and remain in this condition until another triggering pulse appears at the gate to switch it on.

BSG spanning = 0; veroorsaak ? teenvoorspan-effek en bly afgeskakel totdat daar ? hekpuls aanwesig is.

(4)

QUESTION / *VRAAG 3*
AMPLIFIERS / *VERSTERKERS*

3.1

$$Ve \cong \frac{1}{10} x (Vcc)$$

$$\cong \frac{1}{10} x (25)$$

$$\cong 2,5 \, Volt \rightarrow \quad (3)$$

$$Re = \frac{Ve}{Ic}$$

$$= \frac{2,5}{1x10^{-3}}$$

$$= 2,5 \, k\Omega \rightarrow \quad (3)$$

Note / *Let op:* $Ic = Ie$ (1)

$$Rc = \frac{Vcc - Vce - Ve}{Ic}$$

$$= \frac{25 - 6 - 2,5}{1x10^{-3}}$$

$$= 16,5 \, k\Omega \rightarrow \quad (3)$$

$$Vbq = Ve + Vbe$$

$$= 2,5 + 0,7$$

$$= 9,53 \, Volt \quad (3)$$

$$\longrightarrow$$

$$R_{B1} = \frac{1}{10(\beta \, Re)}$$

$$= \frac{200(2,5x10^{3})}{10}$$

$$= 50 \, \Omega \rightarrow \quad (3)$$

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

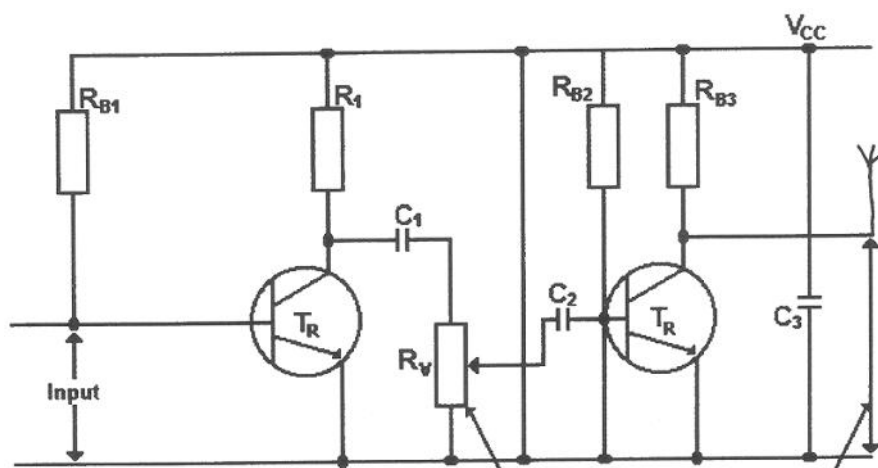$$2,3 = \frac{384\,000}{R_{b1} + 24\,000}$$

$$R_{B1} = \frac{384\,000}{2,3} - 24\,000$$

$$= 143 \, k\Omega \rightarrow \quad (4) \quad\quad (20)$$

3.2

Operation

Gain may be changed continuously.

Variable resistor (volume control) is used to change the gain.
Adjustment does not influence the DC bias.
All of the signal current is developed across R_v.
When the slider of R_v is moved upwards, a bigger AC signal voltage will appear between the earth and the conductor, which is fed to the input of T_2 and amplified.

Werking

Die wins kan voortdurend verander word.
Die verstelbare weerstand (volumebeheer) word gebruik om die wins te verander.
Enige verstelling beïnvloed nie die voorspanning van die transistor nie.
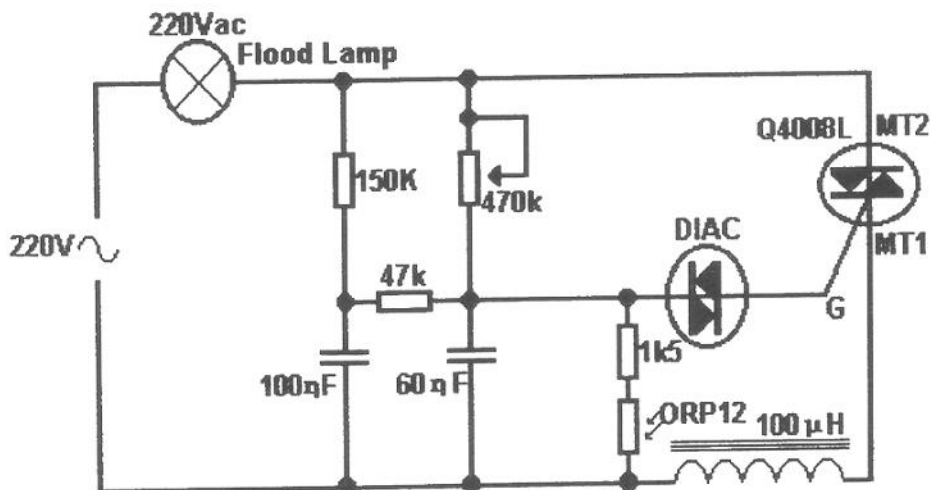*Die totale seinstroom ontwikkel oor R_v.*
Wanneer die glyer R_v van die verstelbare weerstand opwaarts beweeg word, sal dit ? groter seinspanning tot gevolg hê wat deur Transistor T_2 versterk word.

(20)

[40]

QUESTION / VRAAG 4
SWITCHING AND CONTROL CIRCUITS / SKAKEL- EN BEHEERKRINGE

4.1

Any acceptable circuit / *Enige aanvaarbare stroomkring*

4.2 **SCR Alarm with**
   Buffer Circuitry

SCR's are subject to spurious triggering when the gate is connected to long loops. A way to overcome this is to put a buffer circuit between the SCR gate and the loop as shown in the above figure.

Because of the RC constant, a time delay will cause the SCR to be triggered some time after any of the switches are opened. The RC time constant (10k and 2µF) is designed to be long enough so that sporadic noise and pulses will be too short to false-trigger the SCR.

BSG-alarm met
   bufferkringbaan

? BSG kan sporadies gesneller word wanneer die hek gekoppel is aan lang lusse. Een manier om die probleem te oorbrug, is om ? bufferkring te plaas tussen die BSG-hek en die lus soos in bostaande figuur.

As gevolg van die RC-tydkonstante, is daar ? tydvertraging voordat die BSG gesneller sal word nadat enige van die skakelaars oopgemaak is. Sporadiese pulse en ander elektriese "geraas" duur korter as die tydvertraging en sal dus nie die BSG sneller nie.
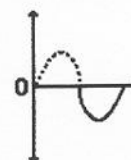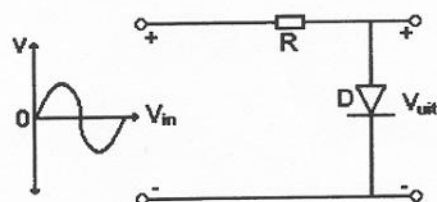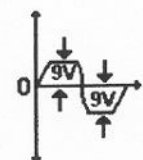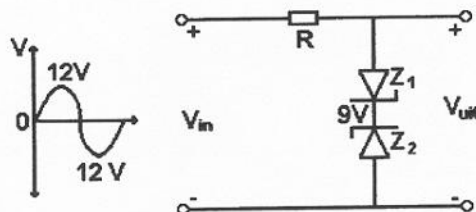
(10)

4.3.1
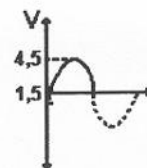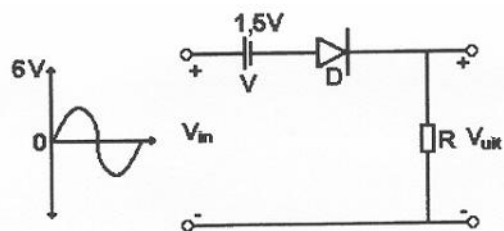
(4)

4.3.2

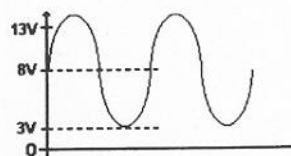

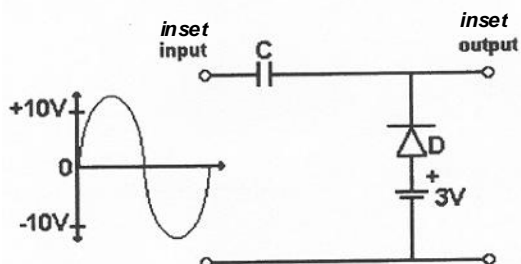(3)

4.3.3

(4)

4.3.4

(4)
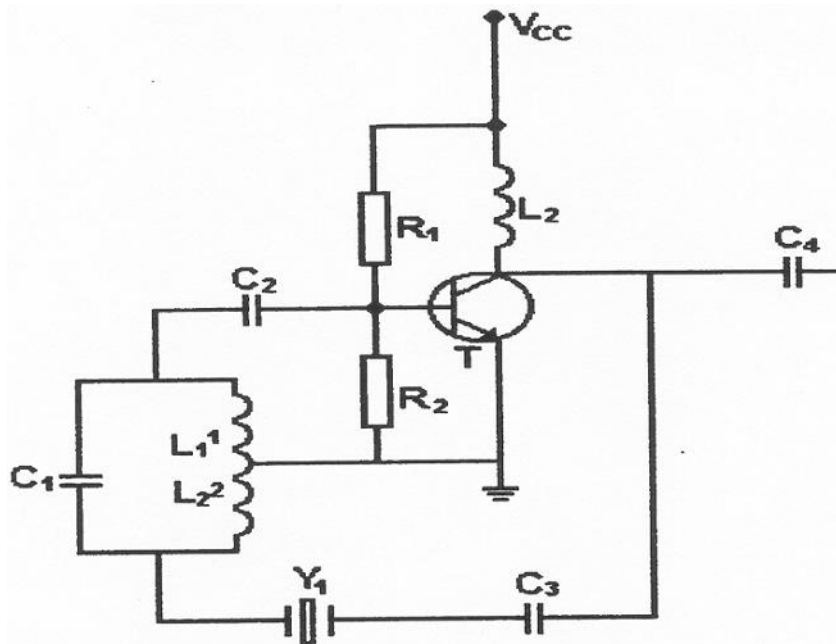
4.4   Any logical explanation / *Enige logiese verduideliking*
              One mark for each fact / *Een punt vir elke feit.*   (15)
                                                                      [50]

QUESTION / *VRAAG* 5
OSCILLATORS / *OSSILLATORS*

5.1

(10)

OPERATION

Makes use of a crystal to control the frequency of the oscillator.

When crystal is used to block low and high frequencies when its impedance is high.

When the frequency of the oscillator is equal to the natural frequency of the crystal, the impedance of the crystal is a minimum resulting in maximum feedback to the amplifier.

WERKING

Maak gebruik van ? kristal om die frekwensie van die ossillator te beheer.

Die kristal word gebruik om lae en hoë frekwensies te blokkeer wanneer die impedansie van die kristal verhoog word.

Wanneer die frekwensie van die ossillator gelyk is aan die natuurlike frekwensie van die ossillator sal die impedansie van die kristal ? minimum wees wat veroorsaak dat maksimum terugvoer na die versterker plaasvind.

(5)

5.2   Improved stabilised voltage gain / *Verbeterde gestabiliseerde spanningwins*

More linear operation / *Verbeterde liniêre werking*

Reduced noise / *Verminderde geraas*

Higher input impedance / *hoër inset-impedansie*

Improved frequency response / *Verbeterde frekwensierepons*

Lower output impedance / *Laer uitset-impedansie*   Any 3 / *Enige 3*   (3)

[18]

QUESTION / *VRAAG 6*
COMPUTER PRINCIPLES / *REKENAARBEGINSELS*

6.1

S1	S2	LED 1
0	0	1
1	0	0
0	1	0
1	1	1

(6)

Exclusive NOR function / *Eksklusiewe NOF-funksie*   (1)

6.2

$\therefore \quad AC(B+B) + ABC + AC(B+B) + ABC$

$= \quad AC + ABC + AC + ABC$

$= \quad C(A+AB) + C(A+AB)$

$= \quad C(A+B) + C(A+B)$

$= \quad (A+B)(C+C)$ (7)

$= \quad A+B$

6.3.1 Legend: A, B, C = Switches / *Skakelaars*

A	B	C	LIGHT
0	0	0	1 ü
0	0	1	1 ü
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1 ü
1	1	1	1 ü

Light A & B are in the same position

(8)

Positive logic is used to solve this problem / *Positiewe logika word gebruik om hierdie probleem op te los.*
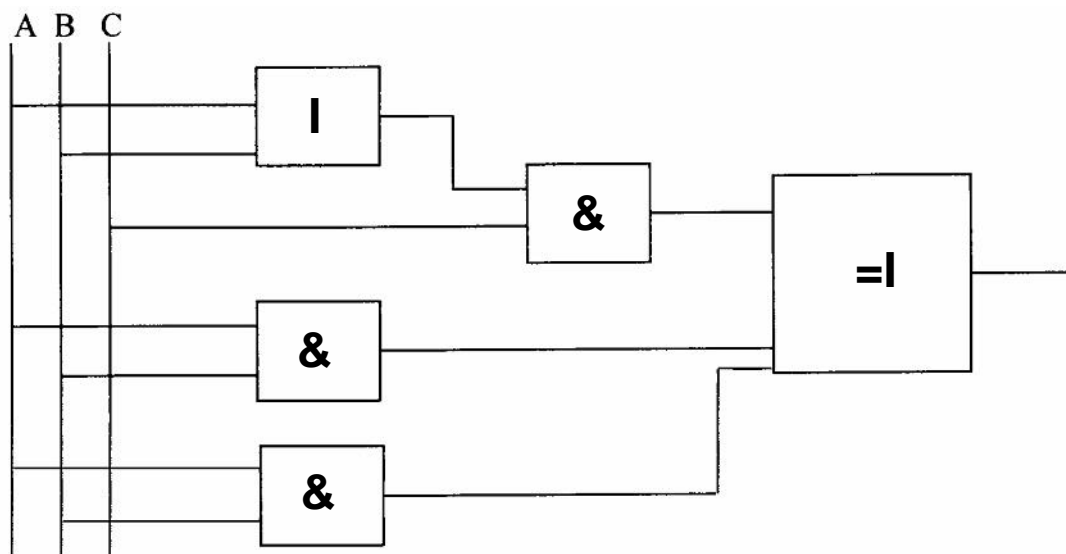Learners are allowed to use any acceptable method to solve the problem) /
(*Leerders mag gebruik maak van enige aanvaarbare tegniek)*

$$F = A.B.C + A.B.C + A.B.C + A.B.C + A.B.C + A.B.C$$

6.3.2
$$= C(AB + AB) + A.B(C + C) + AB(C + C)$$
$$= A\,B + AB + C(A \oplus B)$$

(5)

(4)

6.4

2 | 28   0   MSB

2 | 14   0

2 | 7   1

2 | 3   1

2 | 1   1

   0   LSB
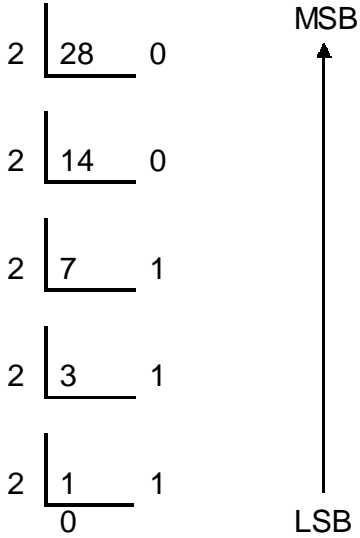
0,375 X 2 = 0,75 carry / *oordrag*   0   LSB

0,75 X 2 = 1,5 carry / *oordrag*   1

0,5 x 2 = 1 carry / *oordrag*   1   MSB

28,375 = 11100,011

2 | 9   1   MSB

2 | 4   0

2 | 2   0

   1   LSB
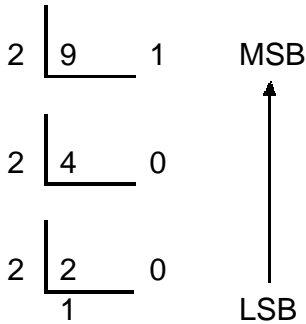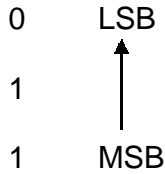
9 = 1001

11100,011

+   1001,000

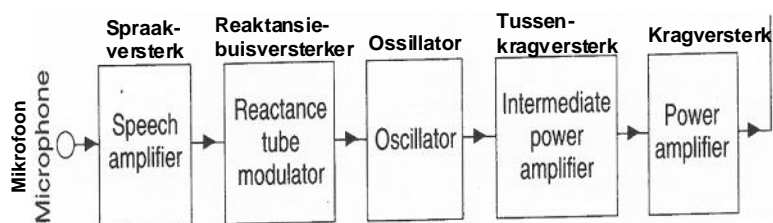 100101,011   (4)

6.5
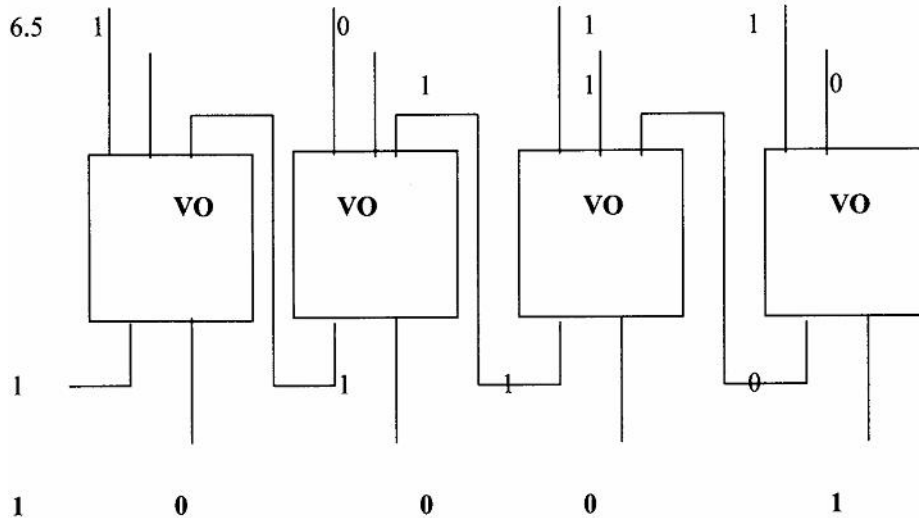
(16)

[51]

QUESTION / *VRAAG 7*
## INFORMATION TRANSFER / *INLIGTINGOORDRAG*

7.1

(8)

7.2 The major causes of signal power losses are:
Die belangrikste oorsake vir verliese aan seinsterkte is:

1. Lateral displacement where the two fibre axes are not aligned.
Laterale verplasing waar die aste van die twee kabels nie in lyn is nie.

2. End separation where any slight air gap will introduce a change of refractive index leading to some internal reflection loss.
Endskeiding waar enige effense luggaping ? verandering van refrakste ? indeks en die refleksieverlies sal veroorsaak.

3. Angular misalignment with two ends misaligned, loosing much light signal power.
Hoekige wanrigting met twee ente wangerig wat veroorsaak dat baie van die krag van die ligsein verlore gaan.
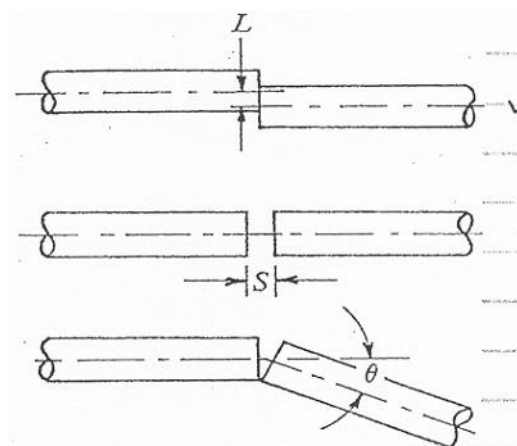
Die las van optiese vesels is uiters kritiek weens die lynversteuring van die binnevlak van die vesel wat kan plaasvind. Enige verskuiwing van hierdie oppervlakke bring energieverliese mee soos bo geïllustreer. (6)
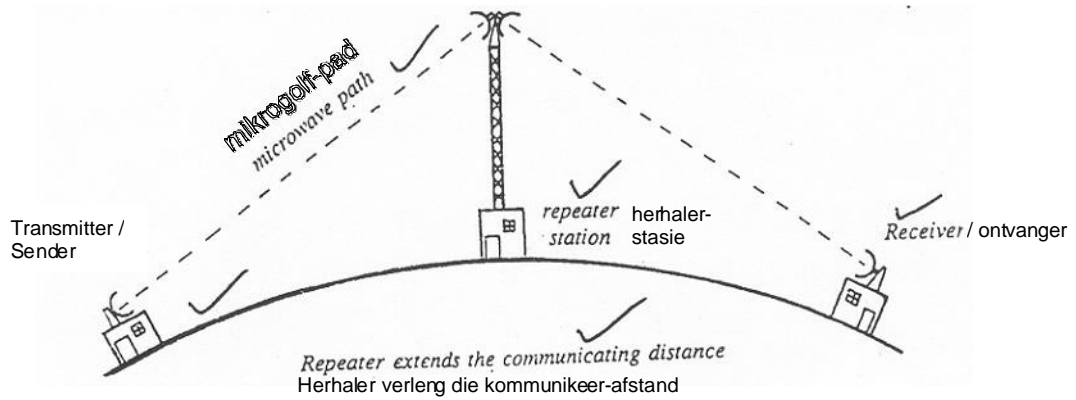
7.3

(12)

7.4

Repeater extends the communicating distance
Herhaler verleng die kommunikeer-afstand
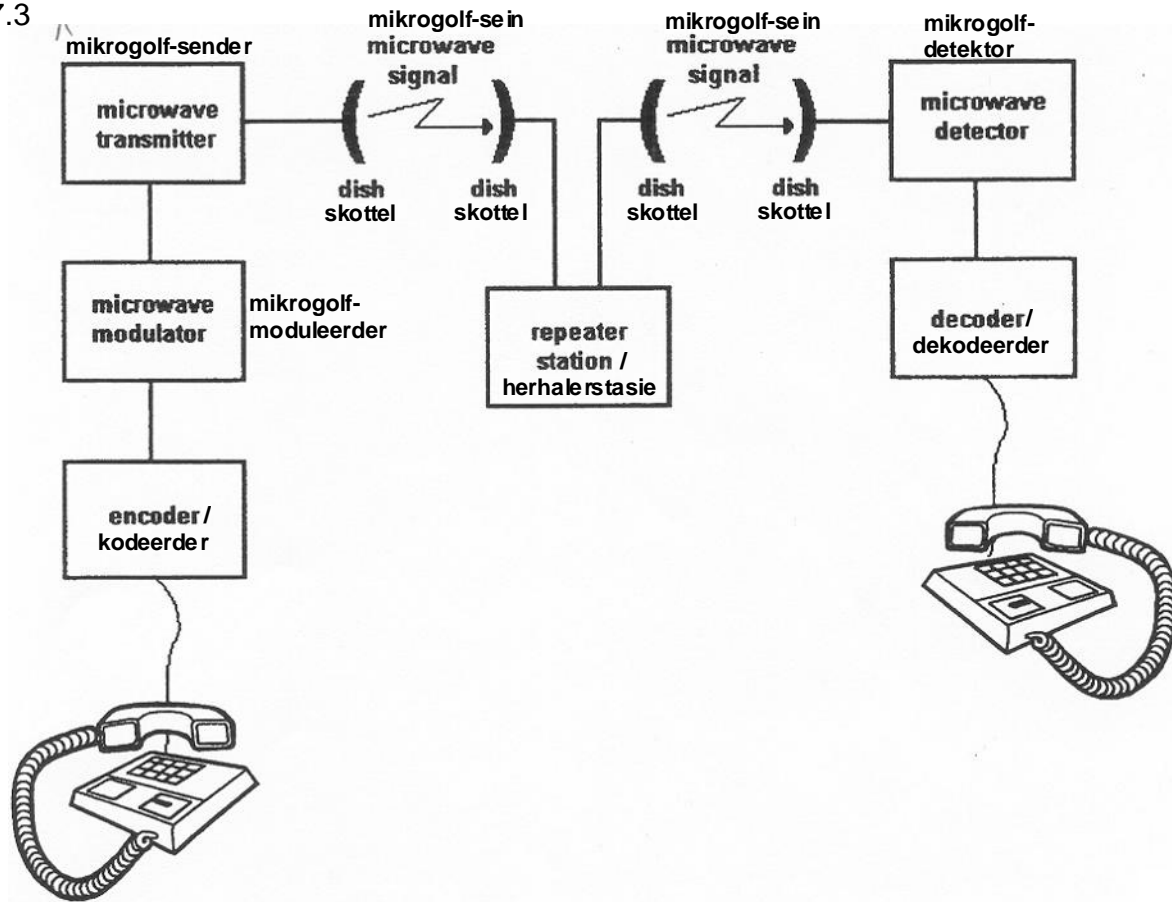
OR / OF

A repeater is a combination of an extremely sensitive receiver and a high-power transmitter, with its antenna located at a convenient high position. It picks up a signal from the transmitter and amplifies it and relays to the receiver station..

? Herhaler is ? kombinasie van ? baie sensitiewe ontvanger en ? hoëkrag-sender, met ? antenne wat hoog op ? geskikte posisie geplaas is. Dit ontvang die sein vanaf die sender en versterk en herlei dit na die ontvanger-stasie. (5)

QUESTION / *VRAAG 8*
MEASURING INSTRUMENTS / *METINSTRUMENTE*

8.1
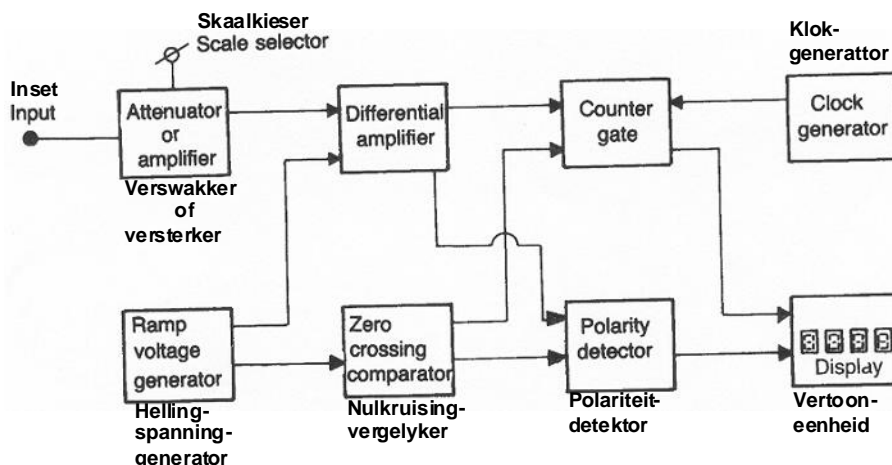
(12)

8.2 Intensity control / *Intensiteitskontrole*

Horizontal gain / *Horisontale wins*

Horizontal position / *Horisontale posisie*

Stability / *Stabiliteit*

Focus / *Fokus*

Vertical gain / *Vertikale wins*

Vertical position / *Vertikale posisie*   Any two / *Enige twee*   (2)

8.3 Generates an internal sawtooth to control the horizontal sweep of the trace.   (2)
Veroorsaak ? interne saagtand om die horisontale veeg van die spoor te beheer.

8.3 V = 0,7 x 30 = 14 Volt

(the 0 – 30 scale should be used since the scale is a sub multiple of 30)   (2)
(die 0 – 3-skaal moes gebruik word omdat die skaal ? onderafdeling van 30 is)

8.4.1 Vp-p =   No. Div. x V/Div. x 2

        =   1.5 x 2 mV x 2

        =   6 mVolt

(3)

15
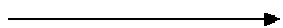
8.4.2 t=   No./Div. x t/Div.

= $3,2 \times 1 \times 10^{-6}$

= $3,2 \, \mu$ sec $\longrightarrow$

(3)

$f = \dfrac{1}{t}$

$f = \dfrac{1}{3,2 \times 10^{-6}}$

$f = 312,5 \, kHz$ $\longrightarrow$

(3)
[27]

QUESTION / *VRAAG 9*
SAFETY PRECAUTIONS / VEILIGHEIDSMAATREËLS

9.1 The selector switch must be on the correct scale.
Die kiesskakelaar moet op die korrekte skaal gestel wees.

Set the selector switch to the highest full-scale deflection for a specific range.
Stel die kiesskakelaar tot die hoogste volskaaldefleksie vir ? spesifieke skaal.

Measuring AC or DC
Meet WS of GS

Plug leads into the correct position
Prop leidings in op die regte posisie

Power must be switch off and disconnected before measuring Ohms
Krag moet afgeskakel en ontkoppel wees voordat Ohm gemeet word.

Check polarity of leads before connecting to a circuit.
Verseker dat die polariteit reg is voor dit aan ? kring verbind word.

Any THREE / *Enige DRIE*   (3)

9.2 National Occupational Safety Association. A company not for gain
*Nasionale Vereniging vir Beroepsveiligheid. ? Nie-winsgewende
maatskappy – Art 21-maatskappy*   (2)

9.3.1 Wood, paper, coal, grass and other organic materials.
Hout, papier, steenkool, gras en ander organiese materiale   (1)

9.3.2 Flammable liquids and greases, e.g. alcohol, benzene, oil, paraffin, petrol.
Vlambare vloeistowwe en olies, bv. alkohol, bensien, olie, paraffien en petrol   (1)

9.3.3 Fires occurring in the presence of live electrical installations
*Brande wat in die teenwoordigheid van lewendige elektriese aanlegte
voorkom.*   (1)

9.4.1 False   *Onwaar*   (1)

9.4.2 False   *Onwaar*   (1)

9.4.3 False   *Onwaar*   (1)

9.4.4 False, be aware of window period? *Onwaar, wat van vensterperiode?*   (1)

9.4.5 False   *Onwaar*   (1)

9.4.6 True   *Waar*   (1)

9.4.7 True   *Waar*   (1)

9.5   080 0012 322   (2)
                                                                          [17]

TOTAAL: 300