GAUTENG DEPARTMENT OF EDUCATION

GAUTENGSE DEPARTEMENT VAN ONDERWYS

SENIOR CERTIFICATE EXAMINATION
SENIORSERTIFIKAAT-EKSAMEN

ELECTRONICS / *ELEKTRONIKA* SG

POSSIBLE ANSWERS / MOONTLIKE ANTWOORDE SUPP 2007

PLEASE NOTE THIS MEMO SERVES ONLY AS A GUIDE TO MARKERS. ALTERNATIVE CALCULATION METHODS AND EXPLANATIONS MUST BE CONSIDERED.

NEEM ASSEBLIEF KENNIS DAT HIERDIE MEMO SLEGS AS 'N RIGLYN VIR NASIENERS DIEN. ALTERNATIEWE BEREKENINGSMETODES EN VERDUIDELIKINGS MOET IN AG GENEEM WORD.

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

1.1.1

$$X_L = \frac{V_{SS}}{I_L}\ \Omega$$

$$X_L = \frac{220\ V}{2{,}122\ A}$$

$$X_L = 94{,}25\ \Omega \qquad \text{and / en } X_L = 2 \times \Pi \times f \times L$$

$$\therefore L = \frac{X_L}{2 \times \Pi \times F}$$

$$L = \frac{94{,}25}{2 \times \Pi \times 50}$$

$$L = 0{,}3\ 000\ H$$

$$L = 300\ mH$$

(7)

1.1.2

$$X_C = \frac{V_{SS}}{I_C}$$

$$X_C = \frac{220\ V}{3{,}142\ A}\ s$$

$$X_C = 63{,}653\ \Omega$$

$$\therefore C = \frac{1}{2 \times \Pi \times f \times X_C}\ (F)$$

$$C = \frac{1}{2 \times \Pi \times 50 \times 63{,}653}\ (F)$$

$$C = \frac{1}{19\,997{,}179}\ F$$

$$C = 0{,}0000500(7\ F$$

$$C = 50\ \mu F \qquad (7)$$

1.1.3 $I_X = I_C - I_L$ (A)

$I_X = 3{,}142\ A - 2{,}122\ A$

$I_X = 1{,}02\ A$ (3)

1.1.4

$$I_T = \sqrt{I_R{}^2 + I_X^2} \qquad or\ /\ of\ \ I_T = \sqrt{I_R{}^2 + (I_C - I_L)^2}$$

$$I_T = \sqrt{(2)^2 + (1{,}02)^2} \qquad or\ /\ of\ \ I_T = \sqrt{(2)^2 + (3{,}142 - 2{,}122)^2}$$

$$I_T = \sqrt{5{,}0404} \quad or\ /\ of\ \ I_T = \sqrt{5{,}0404}$$

$$I_T = 2{,}245\ A \quad or\ /\ of\ \ I_T = 2{,}245\ A \qquad (4)$$

1.1.5

$$\phi = \cos^{-1}\frac{I_R}{I_T}$$

$$\phi = \cos^{-1}\frac{2}{2{,}245}$$

$$\phi = \cos^{-1}\ 0{,}89$$

$$\phi = 27° \qquad (3)$$

1.2.1

$$Fr = \frac{1}{2 \times \Pi \sqrt{LC}} \text{ Hz)}$$

$$Fr = \frac{1}{2 \times \Pi \sqrt{200 \times 10^{-3} \times 50 \times 10^{-6}}} \text{ (Hz)}$$

$$Fr = \frac{1}{6{,}283 \times \sqrt{10\,000 \times 10^{-9}}} \text{ (Hz)}$$

$$Fr = \frac{1}{6{,}283 \times 0{,}003162}$$

$$Fr = \frac{1}{0{,}01986859}$$

$$Fr = 50{,}33 \text{ Hz} \qquad (6)$$

1.2.2

$$I_L = \frac{V_{SS}}{X_L} \text{ (A)} \quad \text{and / } en \; XL = 2\Pi fL$$

$$I_L = \frac{200}{2\Pi \; 50 \times 200 \times 10^{-3}}$$

$$I_L = \frac{200}{62{,}83}$$

$$I_L = 3{,}183 \text{ A} \qquad (3)$$

1.2.3

$$Z_D = \frac{L}{CR}$$

$$Z_D = \frac{200 \times 10^{-3}}{50 \times 10^{-6} \times 4}$$

$$Z_D = \frac{0{,}2}{0{,}0002}$$

$$Z_D = 1\,000 \; \Omega$$

$$Z_D = 1 \text{ k}\Omega \qquad (3)$$

1.2.4

$$Q - \text{factor / } faktor = \frac{X}{R} L \qquad \text{and / } en \; X_L = 2\Pi fL$$

$$Q \text{ - factor / } faktor = \frac{2 \times \Pi \times 50{,}33 \times 200 \times 10^{-3}}{4}$$

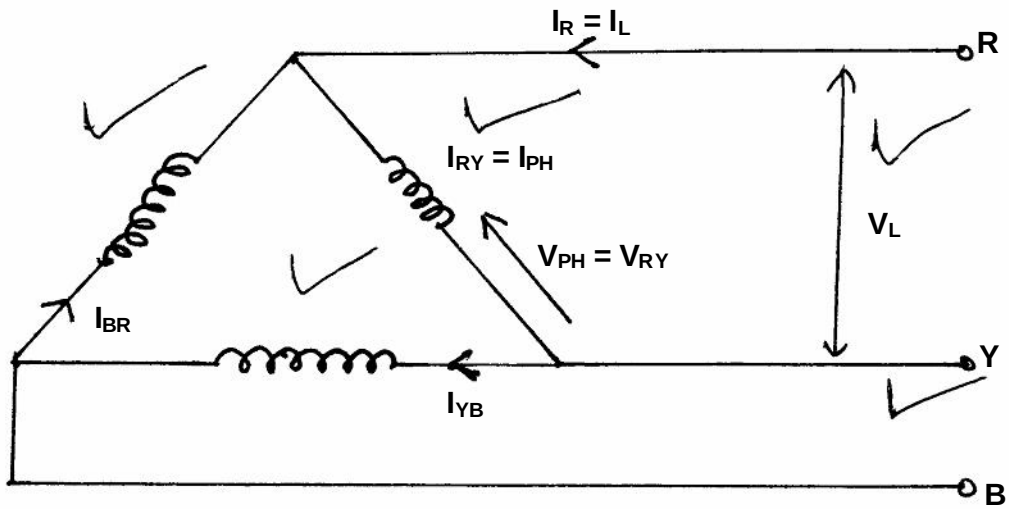
$$Q - \text{factor / } faktor = 15{,}7 \qquad (4)$$

[40]

QUESTION 2 / *VRAAG 2*
THREE-PHASE ALTERNATING-CURRENT SYSTEMS / *DRIEFASIGE WISSELSTROOMSTELSELS*

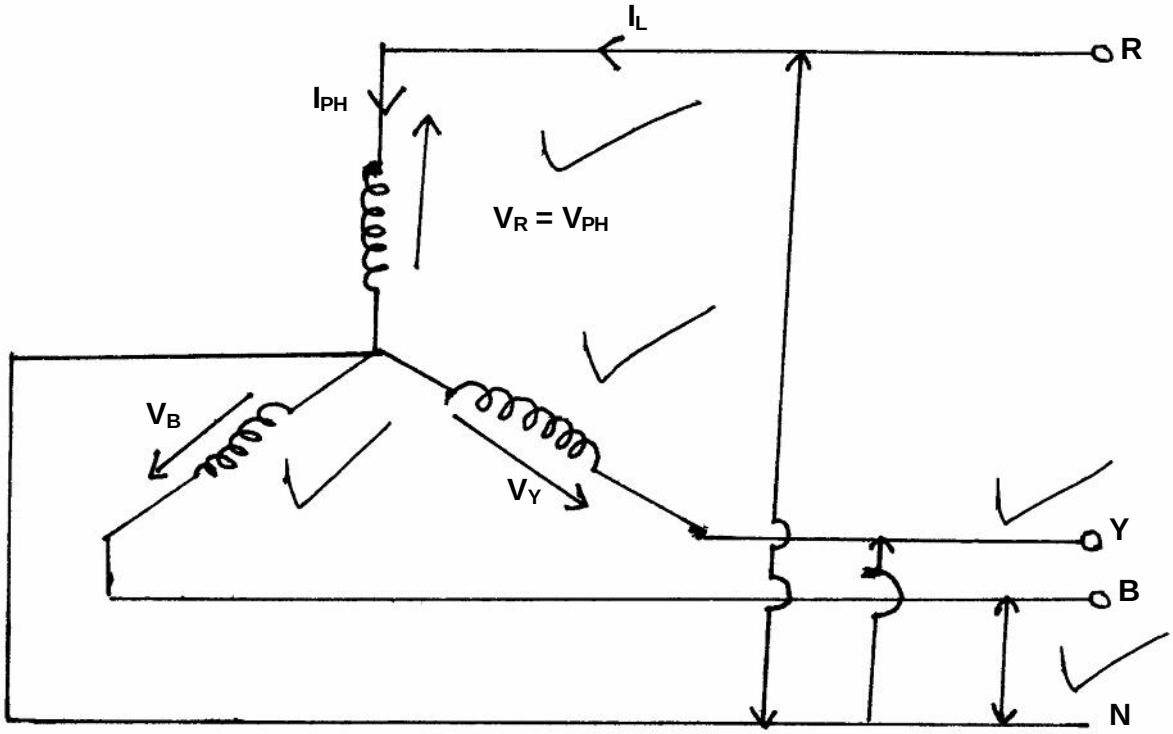
2.1 $V_L = \sqrt{3} \times Vph$ (2)

2.2.1 A delta-connected three-phase system / *? delt averbinde driefasestelsel*



(5)

2.2.2 A star-connected three-phase system / *? sterverbinde driefasestelsel*

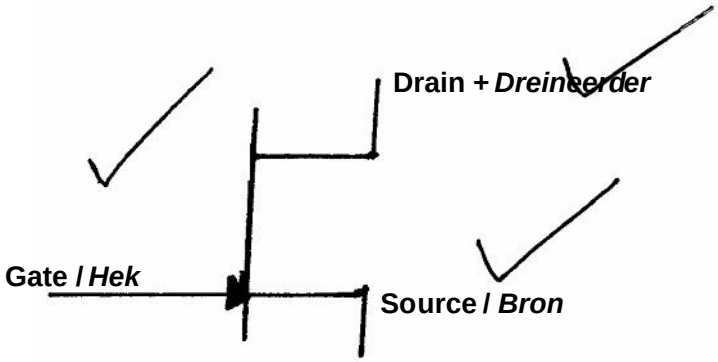


(5)
[12]

QUESTION 3 / *VRAAG 3*
SEMICONDUCTORS / *HALFGELEIERS*

3.1 Diffusion process / *Diffusieproses* (2)

3.2.1



N-channel FET
? N-kanaal-VET

(3)

3.2.2

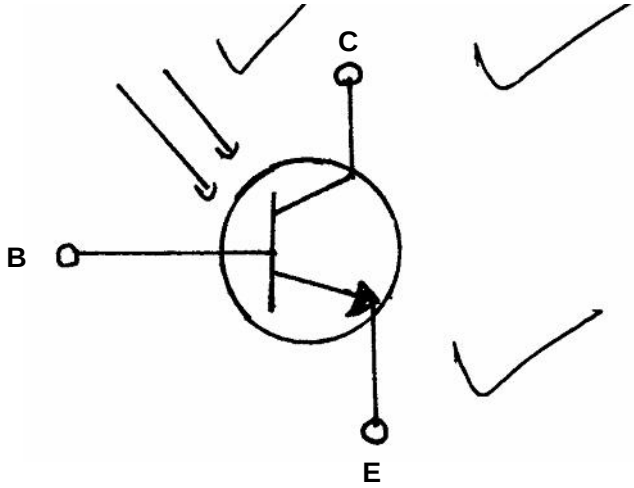
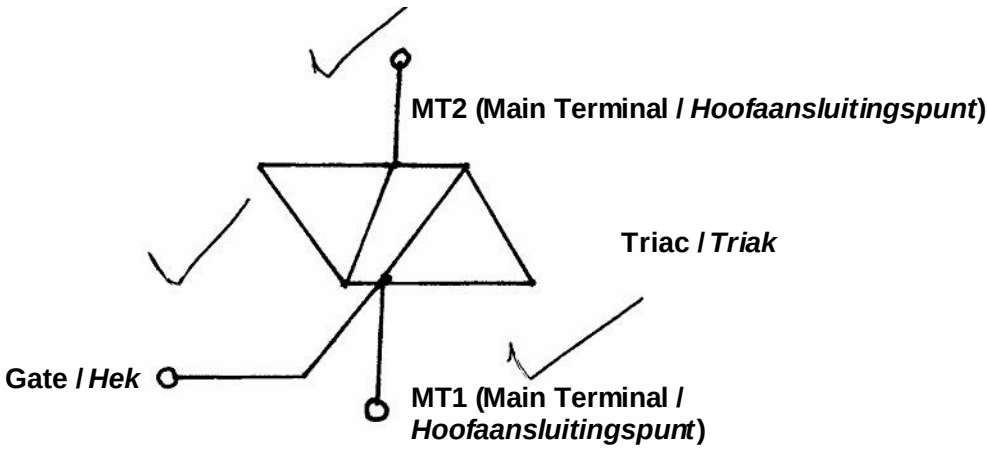


Photo transistor
Fototransistor

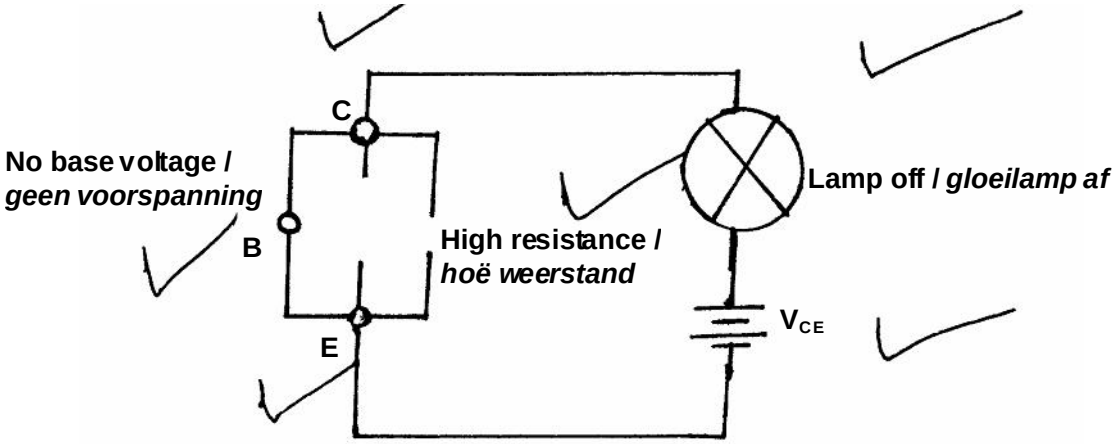
(3)

3.2.3



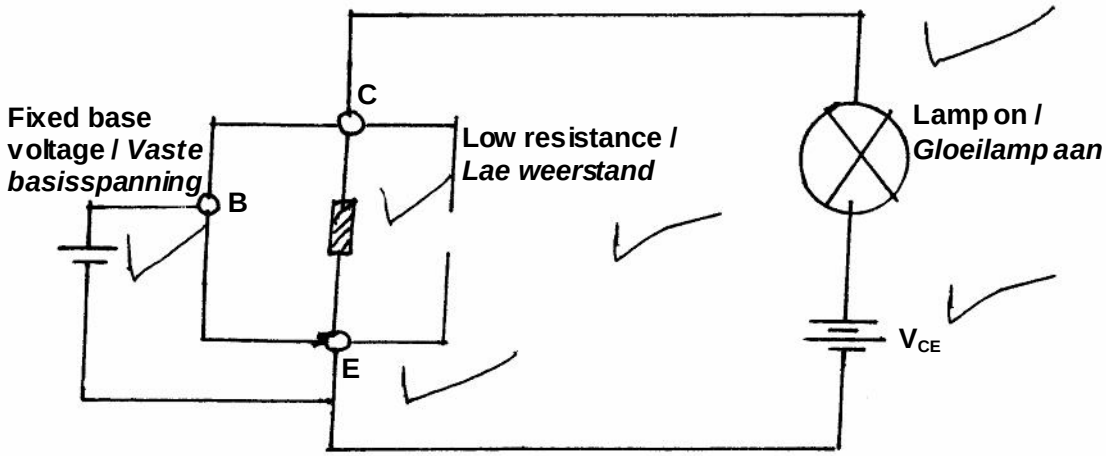
(3)

3.3



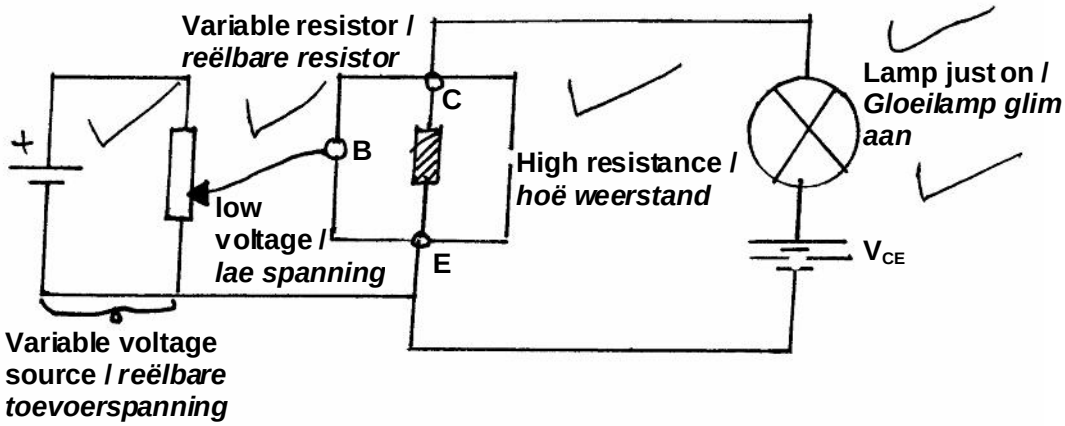
(6)

OR / *OF*



(6)

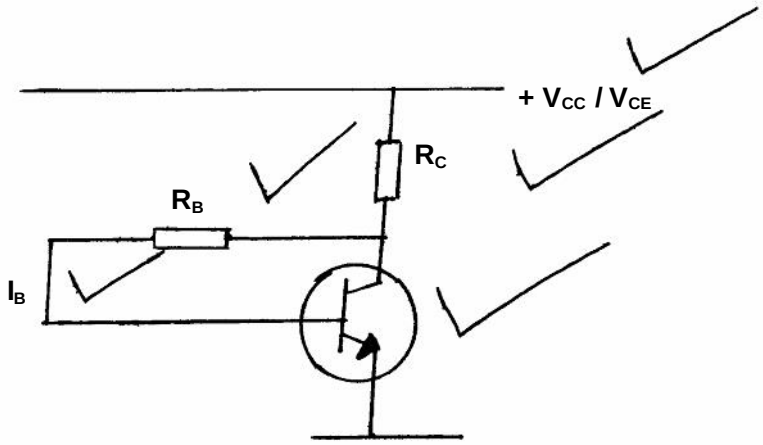
OR / *OF*



(6)
[17]

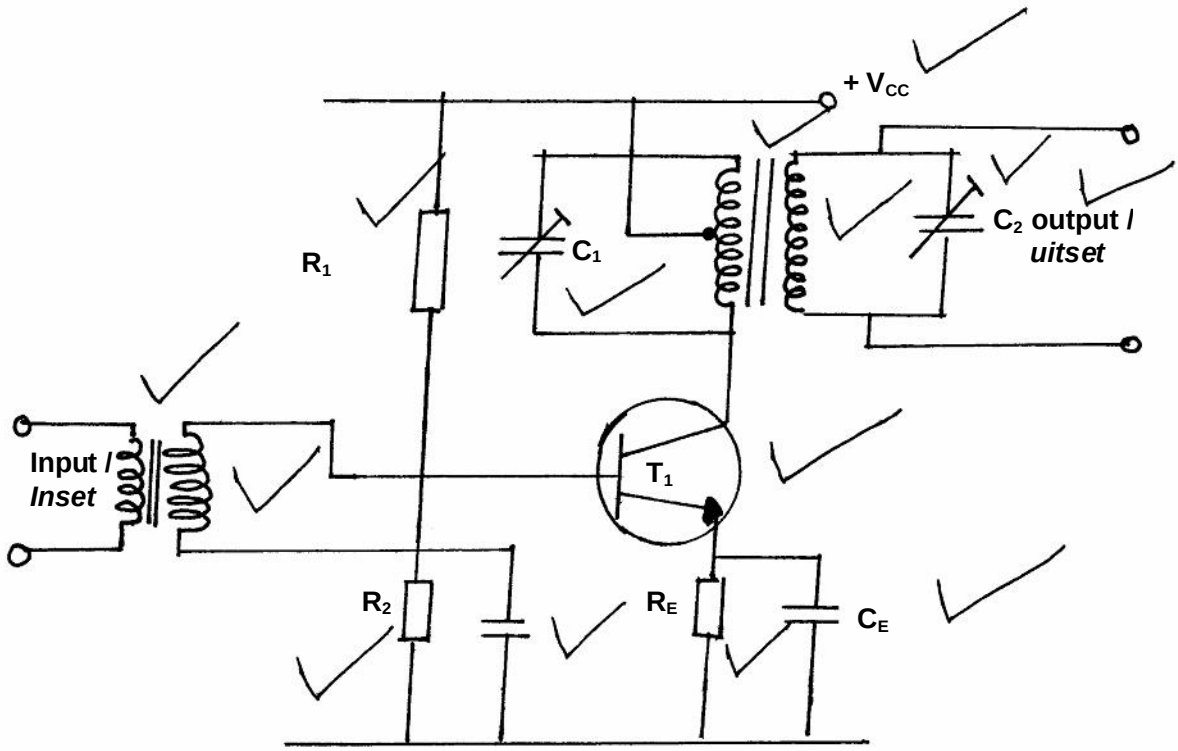
QUESTION 4 / *VRAAG 4*
AMPLIFIERS / *VERSTERKERS*

4.1



(5)

4.2 Radio-frequency amplifier / *Radiofrekwensie-versterker*



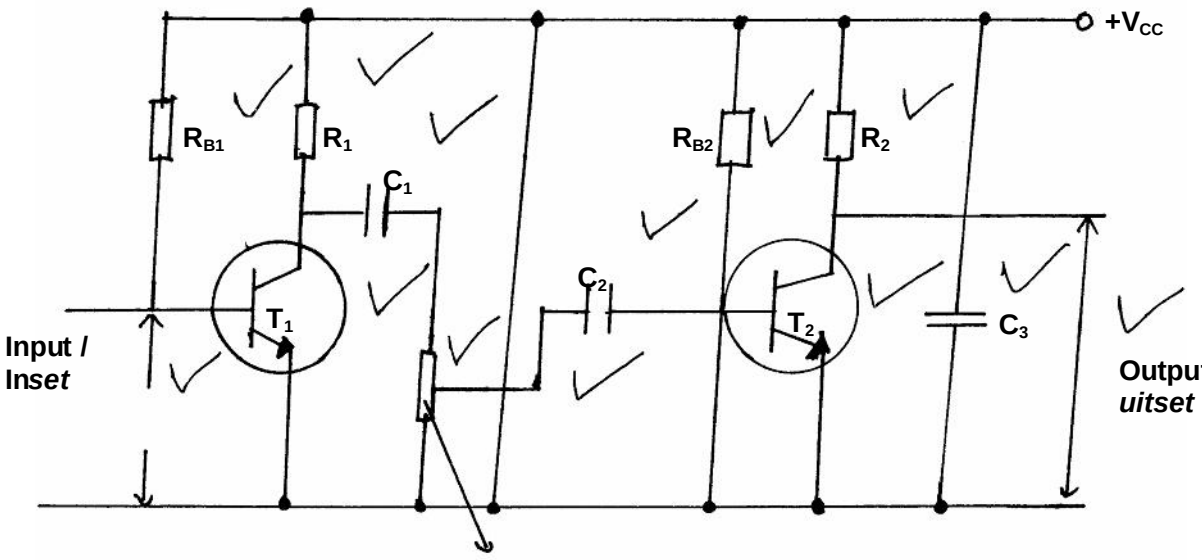
(14)

- Amplify a single high frequency and suppress all others.
- LC-tuned circuit is tuned to resonate at the required frequency and is selective.
- To make the circuit more frequency selective and to be tuned to a range of frequencies, the variable capacitors are added to the transformer secondary winding. (4)
- *Versterk ? enkele hoë frekwensie en onderdruk al die ander.*
- *? LC-geskakelde kring is ingestel om op die verlangde frekwensie te resoneer en is selektief.*
- *Om die kring meer frekwensie-selektief te maak en om op ? reeks frekwensies te kan inskakel, word veranderbare kapasitors by die transformator se sekondêre wikkeling gevoeg.*

OR / *OF*

* Gain may be changed continuously.
* Variable resistor (volume control) is used to change the gain.
* Adjustment does not influence the DC bias of the transistor.
* All of the signal current is developed across RV.
* When the slider of RV 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.

* *Die wins mag voortdurend verander word.*
* *Die verstelbare weerstand (volumebeheer) word gebruik om wins te verander.*
* *Enige verstelling beïnvloed nie die gs-voorspanning van die transistor nie.*
* *Die totale seinstroom ontwikkel oor RV.*
* *Wanneer die glyer van die verstelbare weerstand opwaarts beweeg word, sal dit ? groter gs-seinspanning tussen die aarde en die geleier tot gevolg hê wat na die inset van T_2 gevoer word en versterk word.*



(14)

4.3 * Changes in either temperature or power supply voltage can cause the transistor's currents to change. This will have the effect of shifting the operating point.

* If a circuit is not correctly biased and stable it could allow increases in currents leading to a thermal runaway situation, which could destroy the transistor. (4)

4.3 * *? Verandering in of die temperatuur of toevoerspanning kan tot die verandering in die transistor se stroom lei. Dit sal veroorsaak dat die transistor se werkspunt skuif.*

* *Indien die kring nie korrek voorgespan en stabiel is nie, kan die strome verhoog wat tot termiese weghol kan lei, wat die transistor kan vernietig.* (4)

4.4 The collector resistor performs two functions:

* It will set a limit to the maximum current flowing in the collector circuit and so protect the transistor from damage.

* It will set up a voltage drop across itself relative to the amount of current flowing in the collector circuit, according to Ohm's law. As the current through the transistor rises and falls, the voltage across the resistor rises and falls. (2)

4.4 Die kollektor-resistor verrig twee funksies:

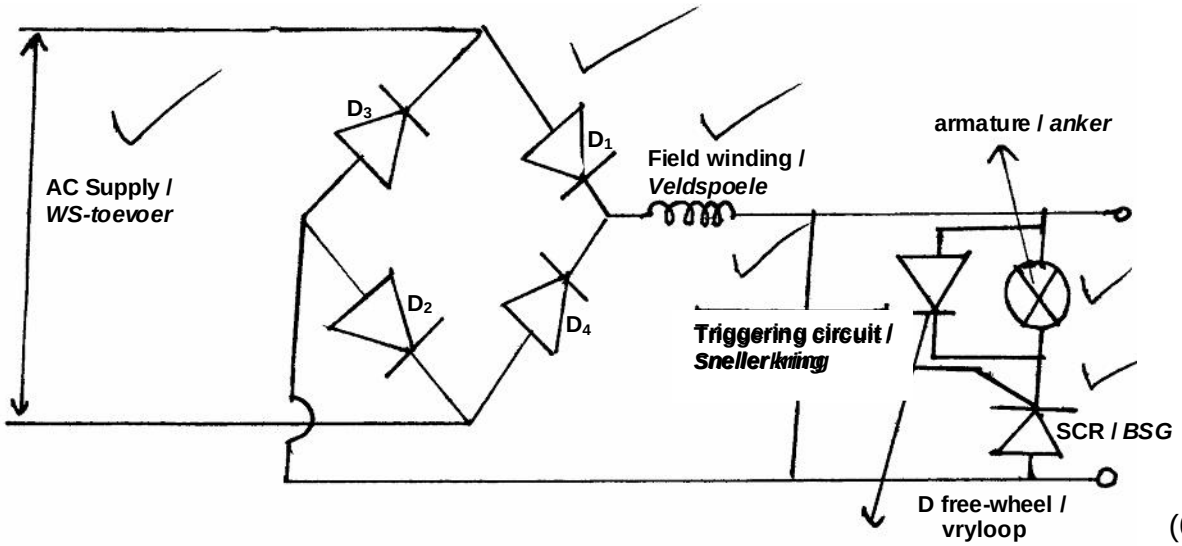
* *Dit stel ? limiet vir die maksimum stroomvloei deur die kollektorkring om sodoende die transistor te beskerm teen beskadiging.*

* *Dit stel ? spanningsval oor homself op wat direk eweredig is aan die stroomvloei in die kollektorkring, volgens Ohm se wet. Na gevolg die stroom op en af deur die transistor verander, sal die spanning oor die weerstand ook verander.* (2)

[29]

QUESTION 5 / *VRAAG 5*
SWITCHING AND CONTROL CIRCUITS / *SKAKEL- EN BEHEERKRINGE*

5.1



(6)

* The rectifier bridge supplies the field winding of the motor.
* The diode short circuits the back emf developed by the motor during the non-conducting phase, in order to protect the SCR.
* The SCR conducts during the one half-cycle of the input. (4)

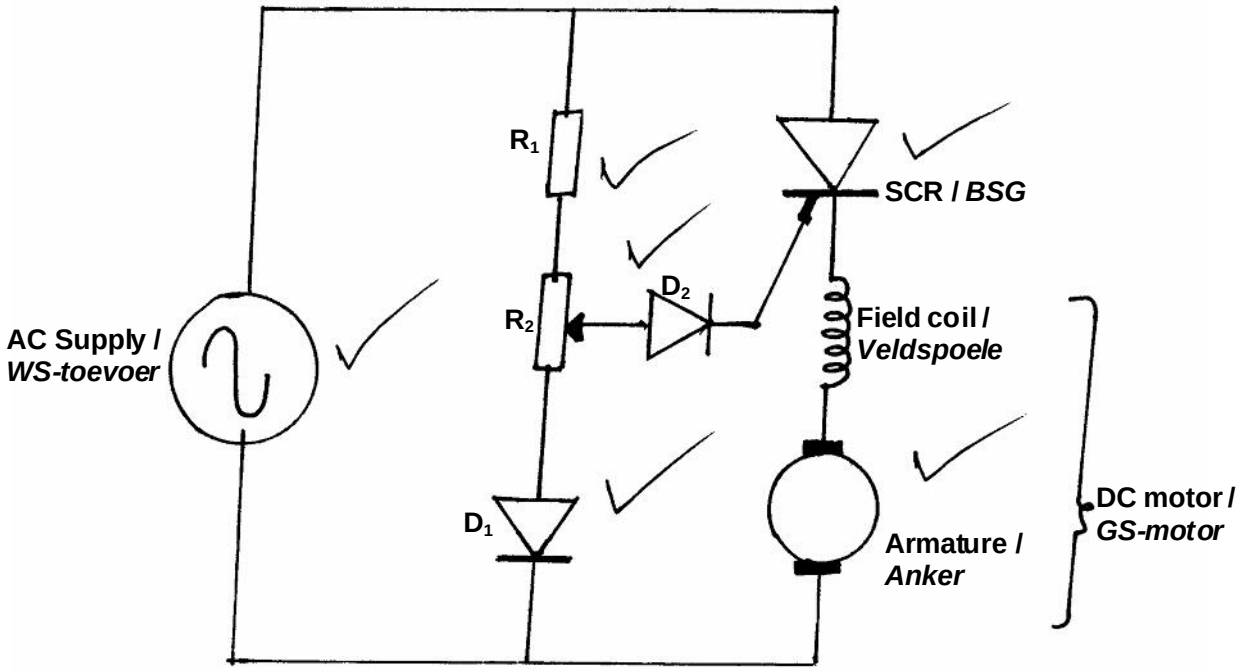
* *Die gelykrigterbrug voorsien die veldwikkeling van die motor.*
* *Die diode laat die teen emk, wat deur die motor gedurende die niegeleidingsfase opgewek word, uitklink om die BSG te beskerm.*
* *Die BSG gelei vir ? halfsiklus aan die inset.* *(4)*

* The remaining part of the cycle is passed through the armature of the motor.
* The motor will turn in one direction, depending on the power of the cycle that passes through it.
* The faster the gate signal is received by the SCR, the more of the cycle passes through the armature of the motor, with the result that more power is received by the motor.

* *Die oorblywende deel van die siklus word deur die anker van die motor gestuur.*
* *Die motor sal in een rigting draai, afhangende van die krag van die siklus wat daardeur vloei.*
* *Hoe gouer die heksein deur die BSG ontvang word, hoe meer van die siklus vloei deur die anker van die motor sal vloei, wat daartoe sal lei dat die motor meer krag ontvang.*

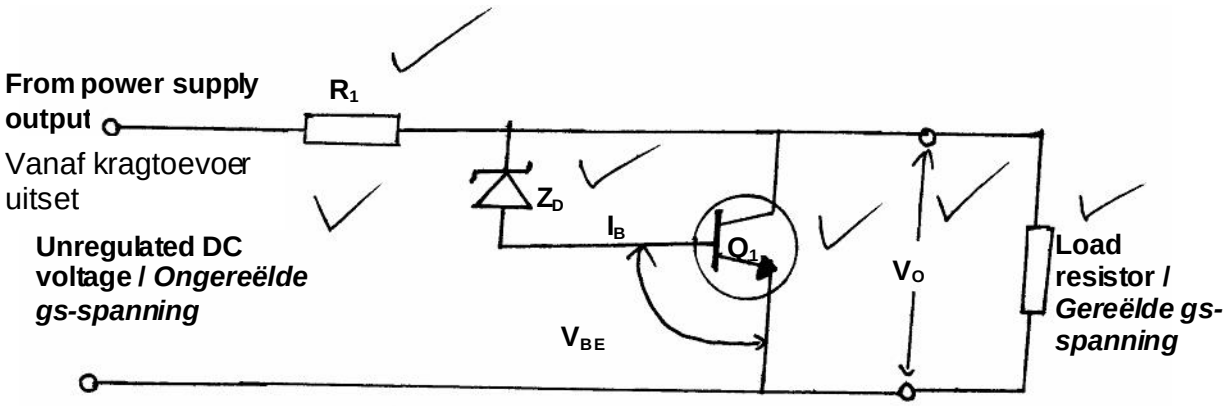
OR / *OF*

Speed control of DC motor / *Spoedbeheer van WS-motor*



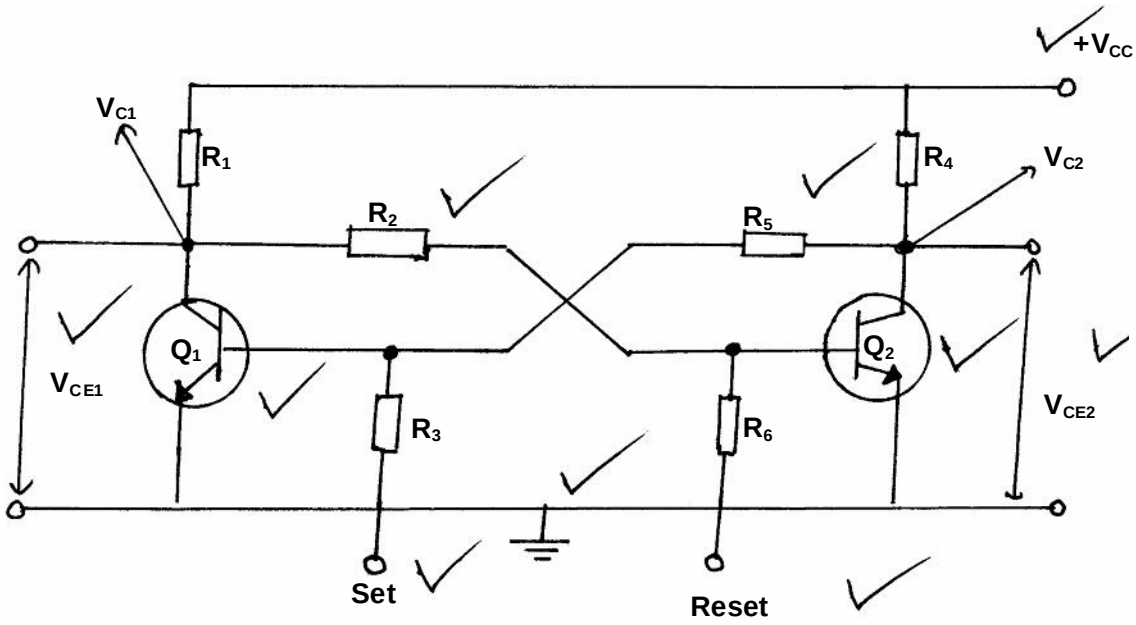
(6)

5.2

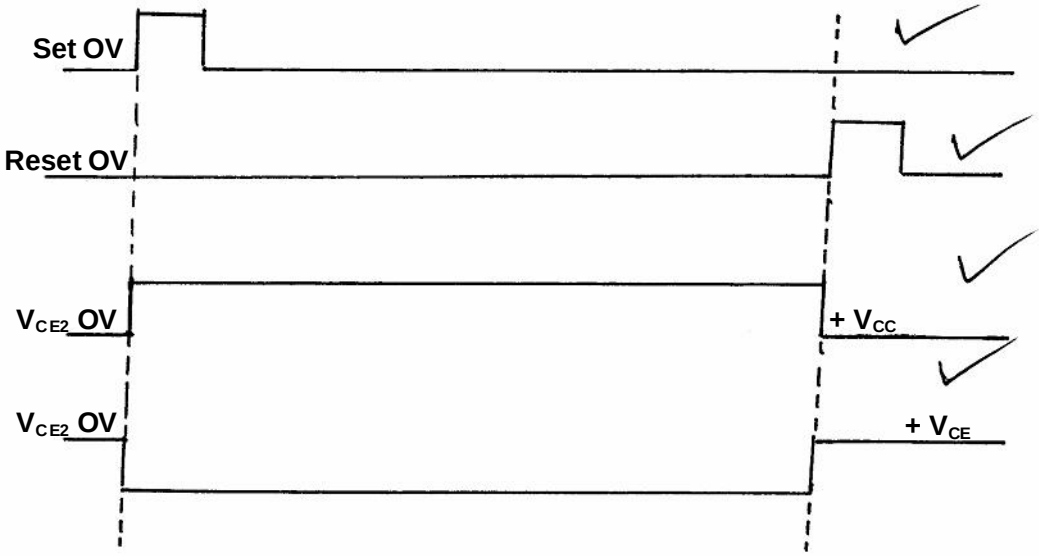


(6)

5.3



(10)



(4)

OR / *OF*

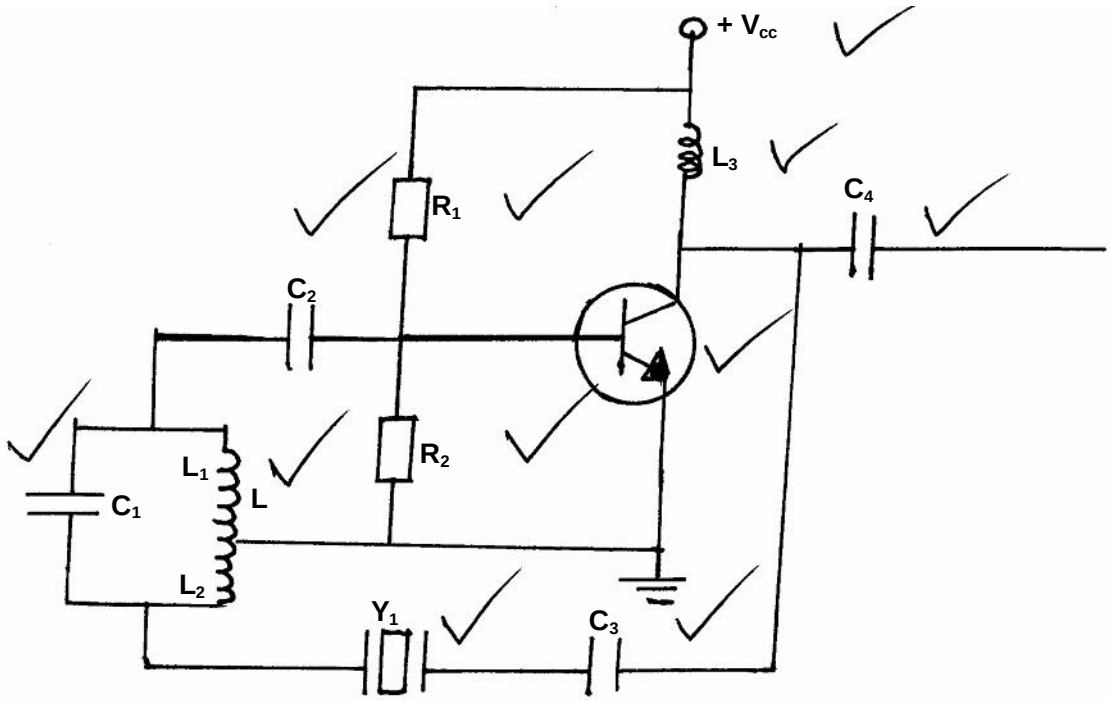
It can be changed by putting a positive pulse on the base of the non-conducting transistor. This transistor will start conducting which causes the collector current to increase and the voltage drop across the resistor, in series with the collector, will also increase, collector voltage will decrease. The decrease in voltage will be carried forward to the base of the still conducting transistor. This will cause the transistor to switch off.

Die multivibrator kan geskakel word van een stabiele staat na ? ander deur ? positief op die basis van die transistor wat af is aan te lê. Hierdie puls sal die transistor aanskakel. Die transistor se kollektorstroom sal drasties vermeerder en daarmee ook die spanningsval oor die weerstand in serie met die kollektor wat die kollektorspanning sal laat daal. Die daling word oorgedra na die basis van die transistor wat steeds gelei en dit skakel af.

[30]

QUESTION 6 / *VRAAG 6*
OSCILLATORS / *OSSILLATORS*

6.1 Crystal-controlled oscillator / *Kristalbeheerde ossillator*



(11)

Operation:

* Makes use of a crystal to control the frequency of the oscillator.
* The 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 maximum resulting in maximum feedback.

Werking:

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

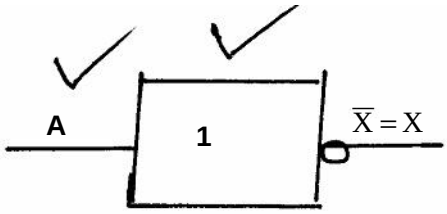
* *Die kristal word gebruik om lae en hoë frekwensie te blokkeer wanneer die impedansie van die kristal verhoog word.*

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

[14]

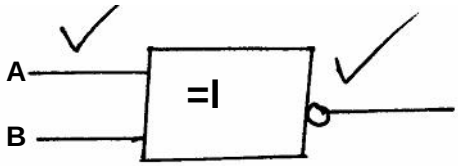
QUESTION 7 / *VRAAG 7*
COMPUTER PRINCIPLES / *REKENAARBEGINSELS*

7.1.1 NOT GATE: / *NIE-HEK:*



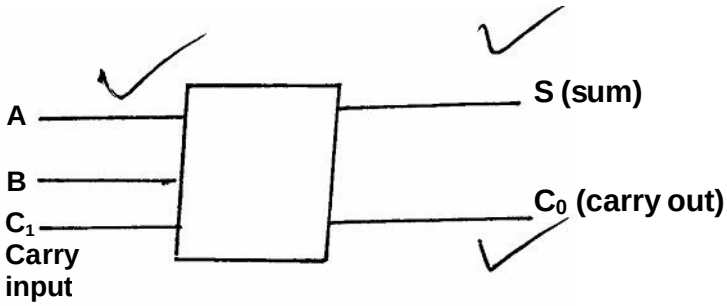
(2)

7.1.2 NOR GATE: / *NOF-HEK:*



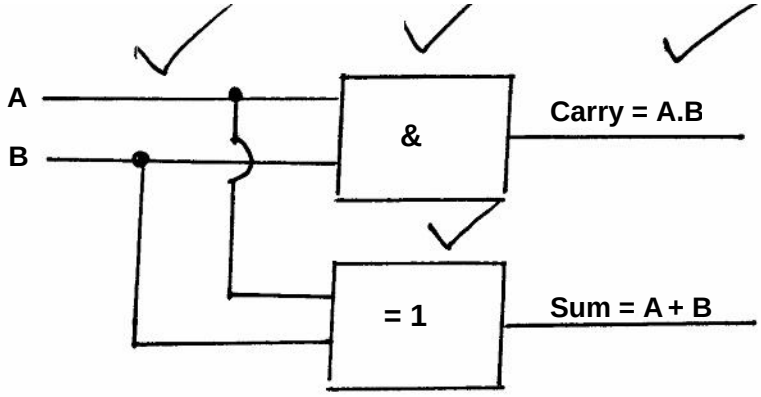
(2)

7.1.3 FULL ADDER / *VOLOP-TELLER*



(3)

7.2 HALF-ADDER CIRCUIT / *HALFOPTELLER-KRING*



(4)

Truth table
Waarheidstabel

A	B	E	C_O
0	0	0	0
1	0	1	0
0	1	1	0
1	1	0	1

(4)

7.3

$x + xy = x$

$R.H.S. = x + xy$

$R.H.S = xy(y = y) + xy$ $\qquad y + y = 1$

$R.H.S. = xy + xy + xy$

$R.H.S. = xy + xy$ $\qquad (xy + xy = xy)$

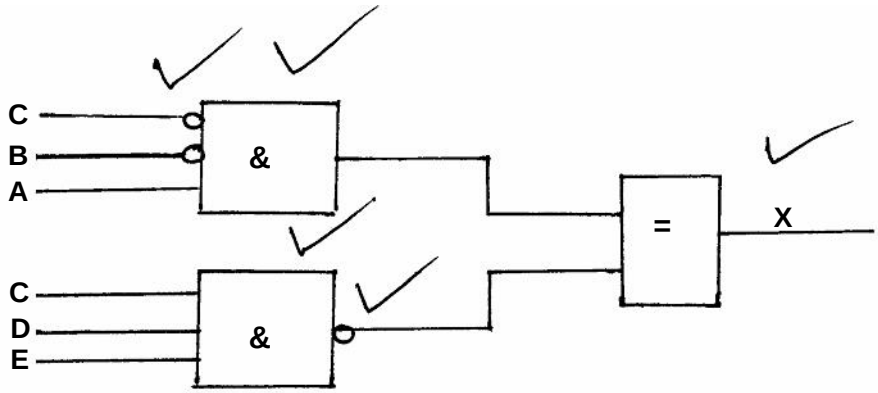
$R.H.S. = x(y + y)$

$R.H.S. = x.1$

$R.HH.S. = L.H.S.$

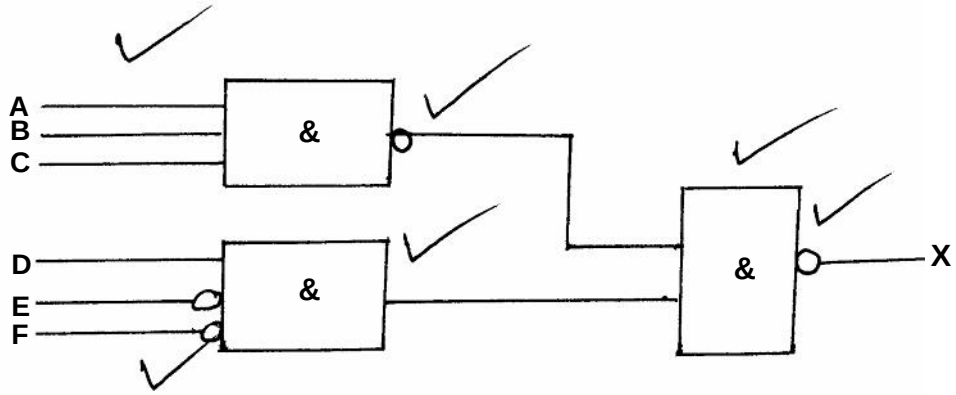
(4)

7.4.1



(5)

7.4.2



(6)
[30]

QUESTION 8 / *VRAAG 8*
ELECTRONIC APPARATUS / *ELEKTRONIESE APPARAAT*

8.1.1 Period = number of divisions x seconds / div
Period = 5 V x 2 ms / div
Period = 10 ms (3)

Periode = getal verdelings x sek / div
Periode = 5 div x 2 ms / div
Periode = 10 ms

8.1.2

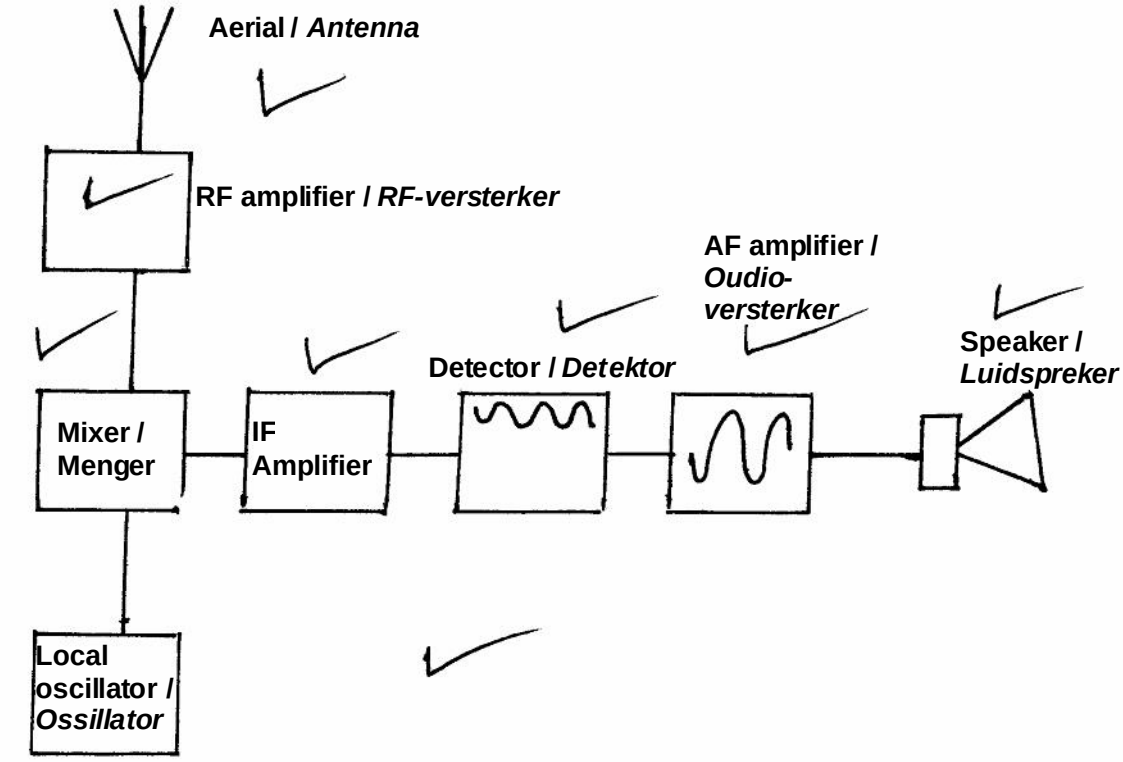
$$\text{frequency / } \textit{frekwensie} = \frac{1}{\text{period}} = \frac{1}{p}$$

$$F = \frac{1}{10\,\text{ms}}$$

$$F = \frac{1}{10 \times 10^{-3}}$$

$$F = 100\,\text{Hz}$$ (3)

8.2 *AM-ONTVANGER*



(8)

8.3.1 Buffer amplifier – Amplify the Rf signal. / *Bufferversterker – Versterk die Rf-sein.* (2)

8.3.2 Oscillator – generates the Rf signal / *Ossillator – verskaf Rf-sein wat as dragolf dien.* (2)
[18]

QUESTION 9 / VRAAG 9
OCCUPATIONAL SAFETY PRECAUTIONS / *BEROEPSVEILIGHEIDSMAATREËLS*

9.1
* Readily available place
* Where there is a fire hazard
* Be placed so that a fire hazard would not isolate it

* *Mees bereikbare plek*
* *Plek waar daar ? brandgevaar kan bestaan*
* *Moet so geplaas word dat dit nie deur ? brandgevaar afgesny kan word nie* (3)

9.2
* Do not enter or leave the workshop without the educator's permission
* Do not wear loose clothing
* Do not use the machines or tools without the educator's permission.
* Keep the workshop clean and tidy.

3 marks only. Any acceptable answer.

* *Moenie die werkswinkel binnegaan of verlaat sonder die toestemming van die opvoeder nie.*
* *Moenie los klere dra nie.*
* *Moenie die masjiene of die gereedskap gebruik sonder die opvoeder se toestemming nie.*
* *Hou die werkswinkel altyd skoon.*

Slegs 3 punte. Enige aanvaarbare antwoord. (3)

9.3 Educator / *Opvoeder* (2)

9.4 * 10111
* 999 (2)

[10]

TOTAL / *TOTAAL*: 200