GAUTENG DEPARTMENT OF EDUCATION / *GAUTENGSE DEPARTEMENT VAN ONDERWYS*

SENIOR CERTIFICATE EXAMINATION / *SENIORSERTIFIKAAT-EKSAMEN*

TECHNIKA (ELECTRONICS) SG / *TECHNIKA (ELEKTRONIES) SG*

QUESTION 1 / *VRAAG 1*

1.1.1 $X_{L1} = 2\pi FL_1 = 2\ \pi\ 50 \times 100\ H = 31{,}41\Omega$

$$Xc_1 = \frac{1}{2\pi FC_1} = 63{,}66\ \Omega$$

$R_1 = 100\ \Omega$

$$I_R = \frac{V_T}{R_L} = \frac{100}{100} = 1\ amp$$

$$I_L = \frac{V_T}{X_{L1}} = \frac{100}{31{,}41} = 3{,}18\ amp$$

$$IL = \frac{V_T}{X_{C1}} = \frac{100}{63{,}66} = 1{,}57\ amp$$

(17)

1.1.2 $IT = \sqrt{IR^2 + (I_L - I_C)^2}$

$= \sqrt{(1)^2 + (3{,}18 - 1{,}57)^2}$

$= \sqrt{1^2 + 1{,}61^2}$

$= \sqrt{1^2 + 2{,}59}$

$= \sqrt{3{,}59}$

= 1,9 amp (3)

1.1.3 $Z = \frac{VT}{IT}$

$= \frac{100}{1,9}$

$= 52,63\Omega$ (3)

1.2 $XI_1 = 2\pi FL_1 = 2 \times \pi \times 88\,000 \times 0,15 \times 10^{-6} = 0,0829\ \Omega$
$XI_2 = 2\pi FL_2 = 2 \times \pi \times 98\,000 \times 0,15 \times 10^{-6} = 0,0892\ \Omega$

$Xc = \frac{1}{2\pi FC}$

$Xc = 2\pi FC = 1$ $Xc = XI$ resoneer

$C = \frac{1}{2\pi FX_c}$

$\therefore \quad C_1 = \frac{1}{2 \times \pi \times 88\,000 \times 0,0829}$
$= 21,8\ \mu F$

$C_2 = \frac{1}{2\pi FXc_2}$

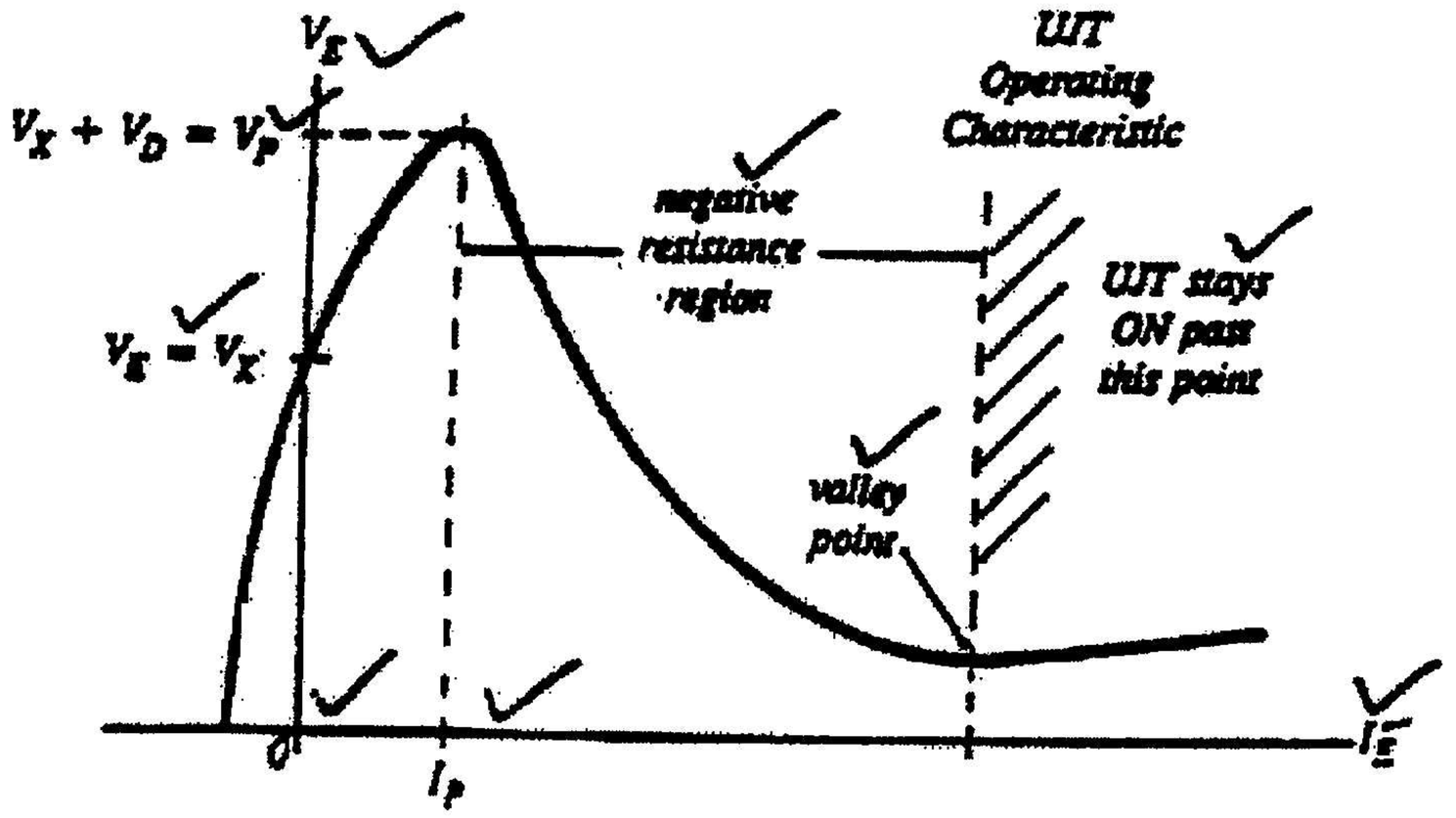
$= \frac{1}{2 \times \pi \times 98\,000 \times 0,0924}$
$= 17,57\ \mu F$

The range must be between 21,8 µF and 17,57 µF

QUESTION 2 / *VRAAG 2*

2.1.1 680 kΩ resistor (3)
2.1.2 NPN Transistor (2)
2.1.3 0,01 µF Capacitor (2)
2.1.4 Diode (2)
2.1.5 PNP Transistor (2)

2.2



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 reaches 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.

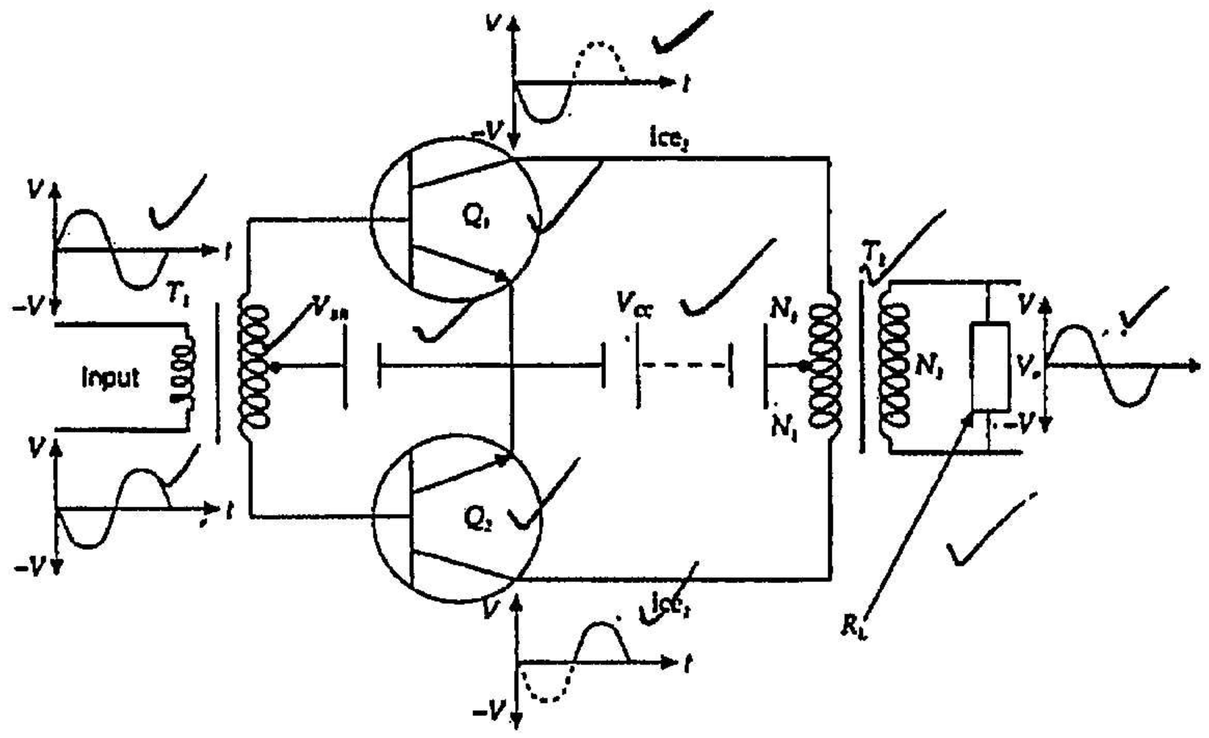
3. As V_E rises above V_x, the diode is still not forward-biased, and a small forward current flows. (15)

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

2.3 Light dimming circuits
Speed-control circuits (2)

QUESTION 3

3.1



PUSH-PULL AMPLIFIER / BALANSVERSTERKER

OPERATION:

Transistors Q1 and Q2 conduct when their bases become positive with respect to their emitters.

Thus the transistors conduct one half cycle at a time.

The centre-tapped output transformer combines the two half-cycles to produce one complete cycle.

Vbb serves as the biasing voltage.

Vcc serves as the supply voltage.

Has a fixed gain.

WERKING:

Transistors Q1 en Q2 gelei wanneer hul onderskeie basisse positief word ten opsigte van hul emitters.

Die transistors gelei dus een halfsiklus om die beurt.

Die middeltap-uitsettransformator kombineer die twee halfsiklusse om sodoende een volledige uitset-sein te lewer

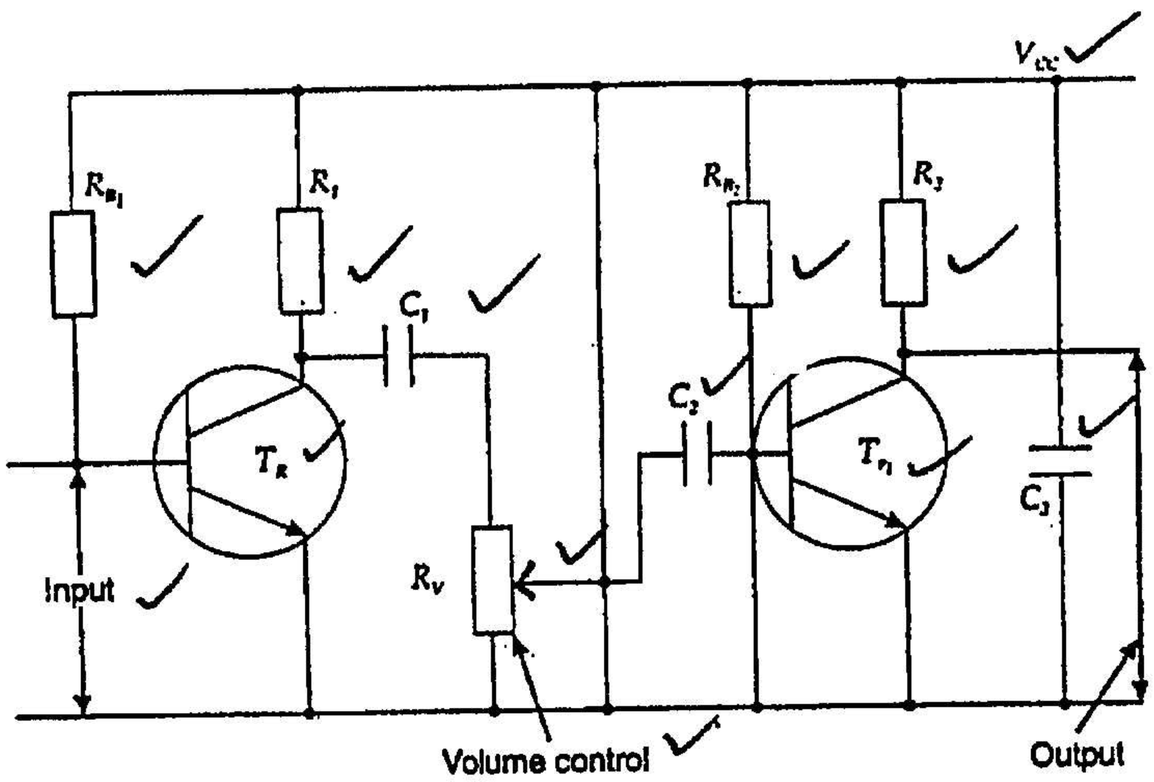
Vbb dien as voorspanning vir die transistors.

Vcc dien as die toevoerspanning.

Het 'n konstante wins. (20)

OR

3.1



RADIO-FREQUENCY AMPLIFIER / *RADIOFREKWENSIE-VERSTERKER*

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 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 T2 and amplified.

WERKING:

Die wins mag voordurend verander word.

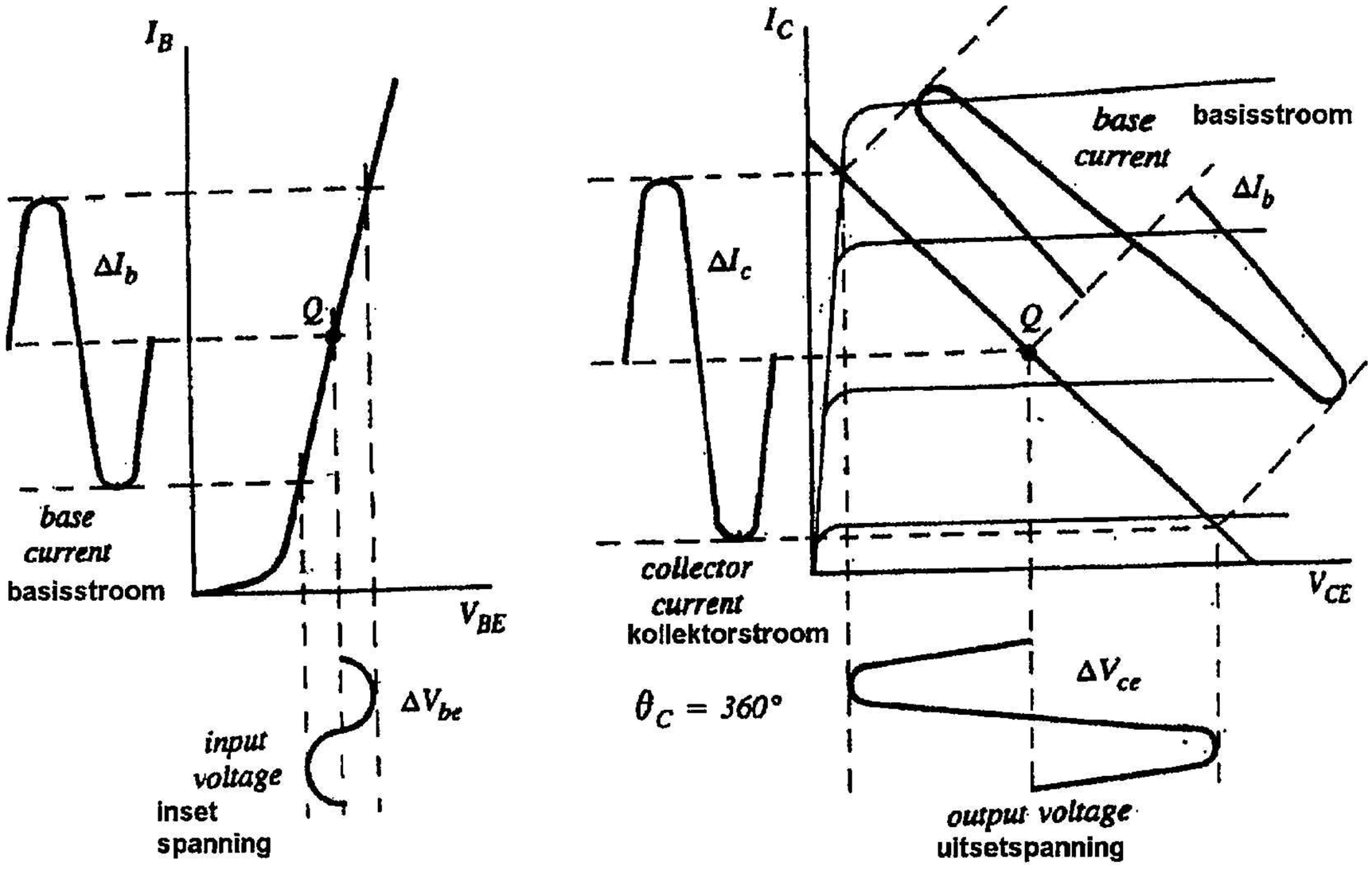
Die verstelbare weerstand (volume-beheer) word gebruik om die wins te verander.

Enige verstelling beïnvloed nie die GS-voorspanning van die transistor nie.

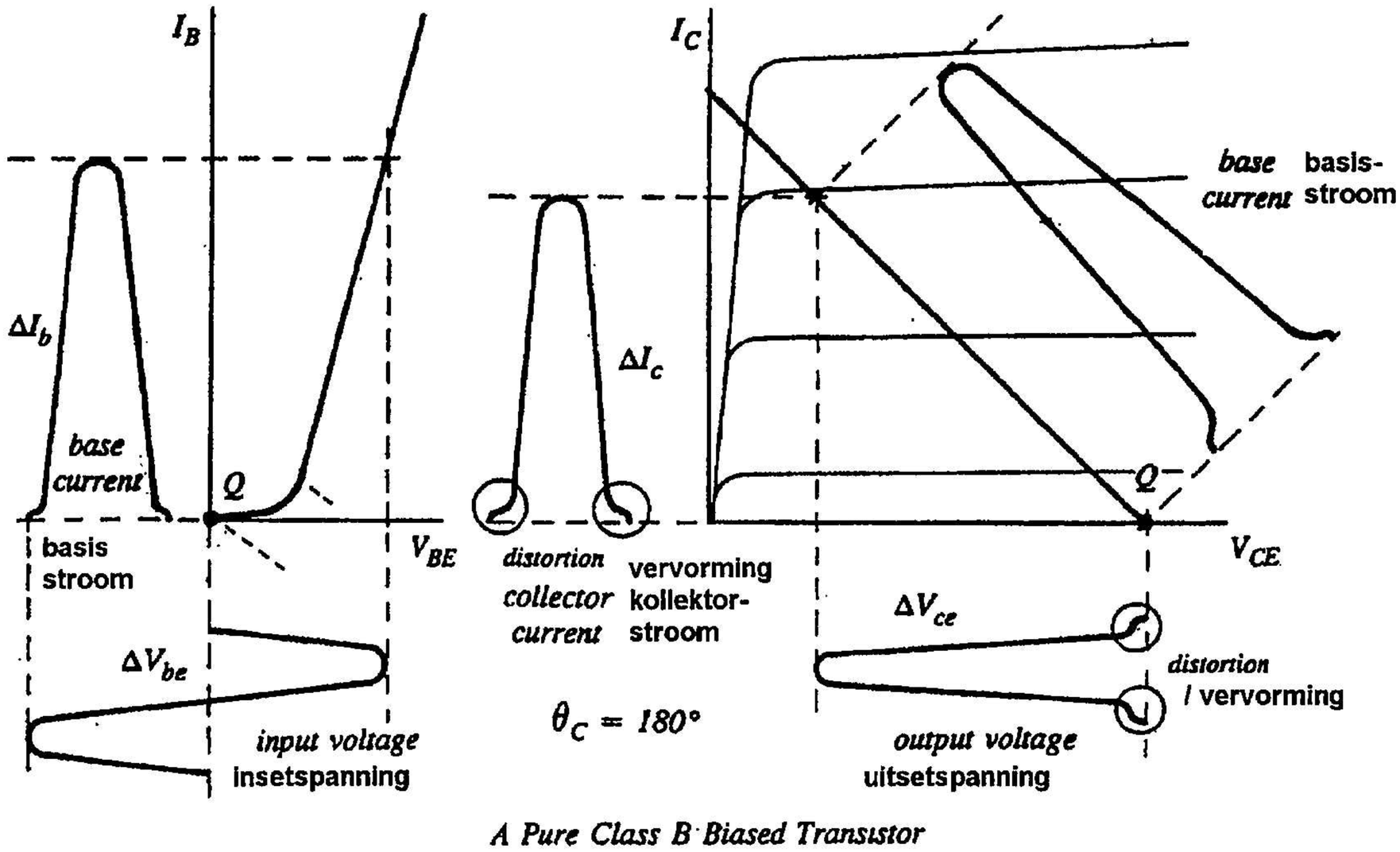
Die totale seinstroom ontwikkel oor Rv.

Wanneer die glyer van die verstelbare weerstand opwaarts beweeg word, sal dit 'n groter ws-seinspanning tussen die aarde en die geleier tot gevolg hê wat. na transistor T2 se inset gevoer word en versterk word. (20)

3.2



Class A biased Transistor (Mid-point Biased) which produces a Maximum Un-distorted Output



A Pure Class B Biased Transistor

(10)

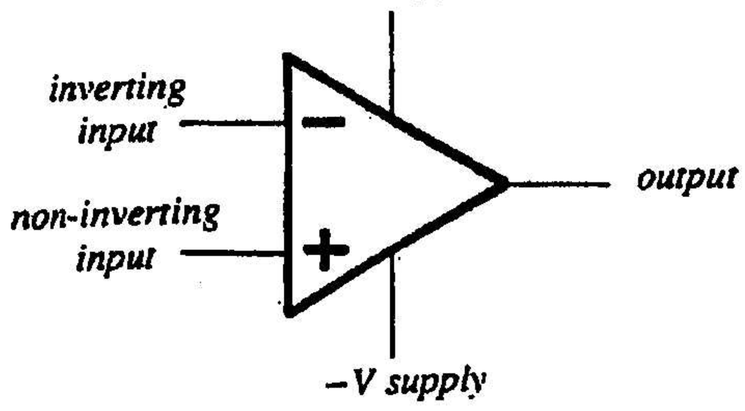
3.3 Negative feedback
- Output is 180° out of Phase with input
- Result in gain is unity OR less than maximum gain. – Gain is effectively reduced.
- More stable ITO gain & temperature
- Less noise.
- Broader band width

3.4 The characteristics of an "ideal" OP AMP are:

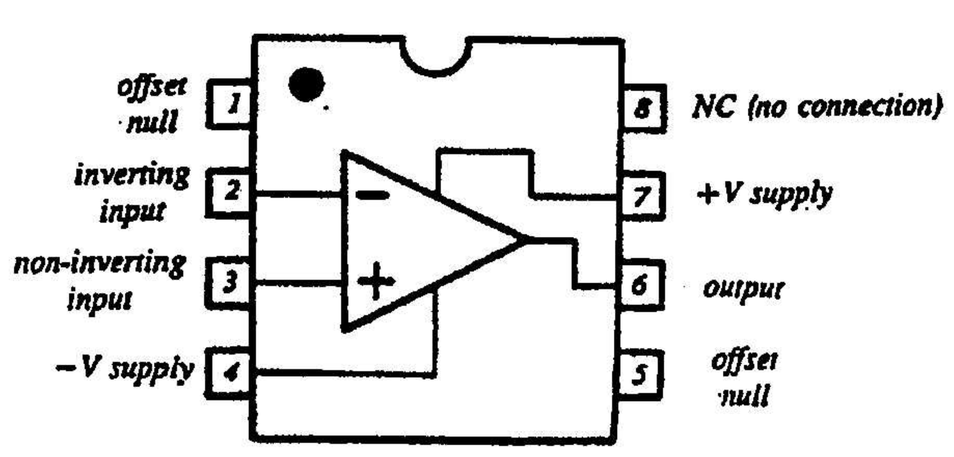
1. $A_v \approx \alpha$: infinite open loop voltage gain (they have more gain than necessary which can be sacrificed using feedback and in turn improve a number of other properties).
2. $Z_{in} \approx \alpha$: infinite input impendance (Z_{in}) (this will not "load down" a high -impedance signal source).
3. $Z_{out} \approx 0$: zero output impedance (Z_{out}) (they are able to deliver a signal to a low-impedance source).
4. Bandwith $\approx \alpha$: infinite bandwith.
5. unconditionally stable
6. differential inputs (ie : two inputs).
7. Common-mode rejection (this gives them the ability to reduce hum and noise).

(5)

3.5



Operational Amplifier Circuit Symbol



(5)

3.6 $V_x = V_{out} \times \frac{R2}{R1+R2}$

$V_x = 4V$
$V_{out} = ?$
$R_1 = R_F = 250 \times 10^{+3}\Omega$
$R_2 = R_{in} = 50 \times 10^{3}\Omega$

$$V_x = V_{out} \times \frac{R2}{R1+R2}.$$

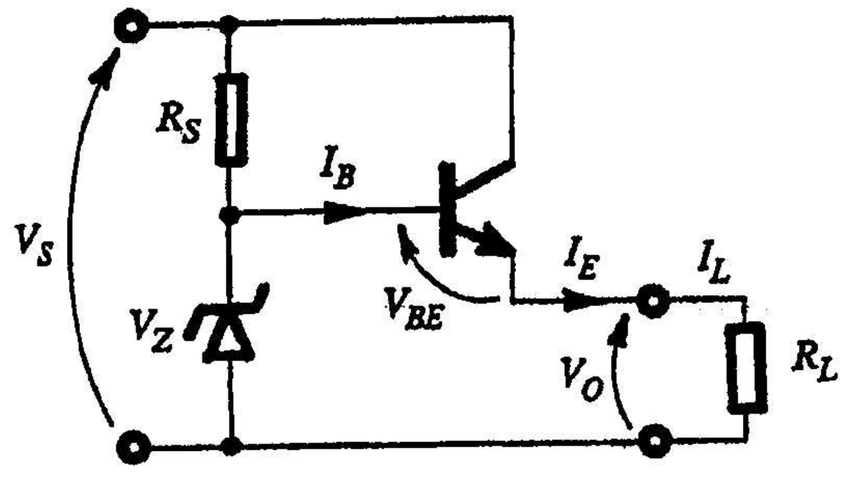
$$V_{out} = V_x \times \frac{50000}{250\,000+50\,000}$$

$$= 4 \times \frac{50\,000}{300\,000}$$

$$= 0{,}66\ V \qquad (4)$$

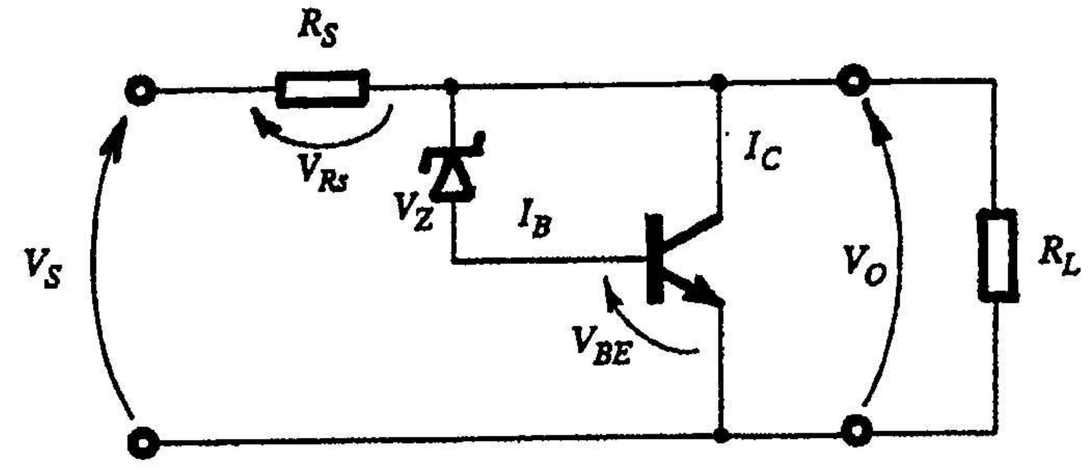
QUESTION 4 / *VRAAG 4*

4.1 Series voltage regulator



SHUNT VOLTAGE REGULATOR

In this circuit the transistor is placed across the output terminals in parallel with the load.

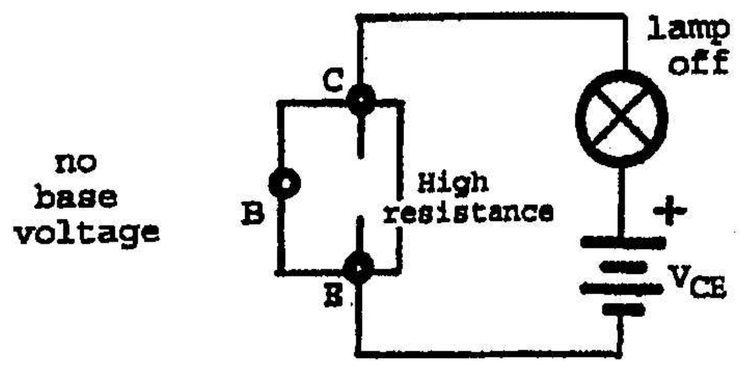


(10)

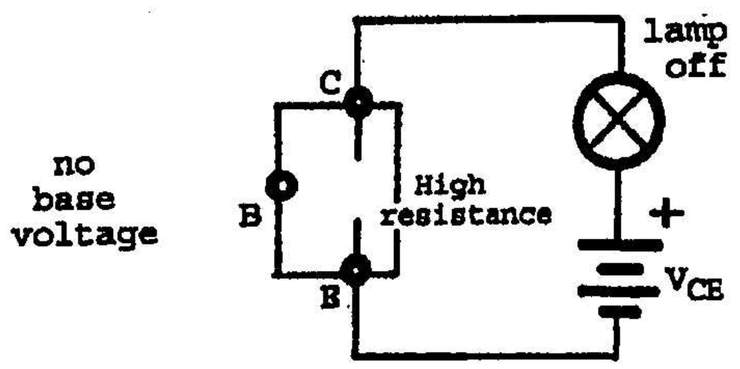
4.2 THE TRANSISTOR OPERATING AS A VARIABLE RESISTOR

If the transistor is viewed as a variable resistor connected in series with a load (here a lamp), the biasing of the emitter-base becomes important.

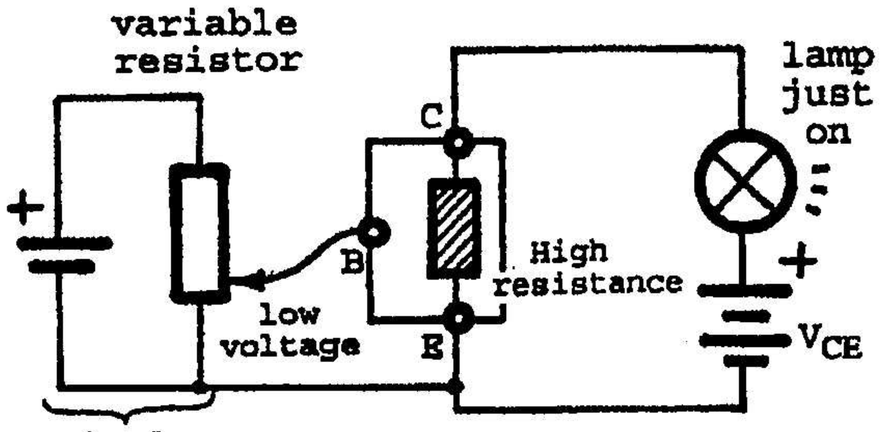
With no emitter-base biasing voltage the e-b junction remains reversed and there is no current flow through the transistor. The transistor appears as a high resistance and the lamp remains "off".



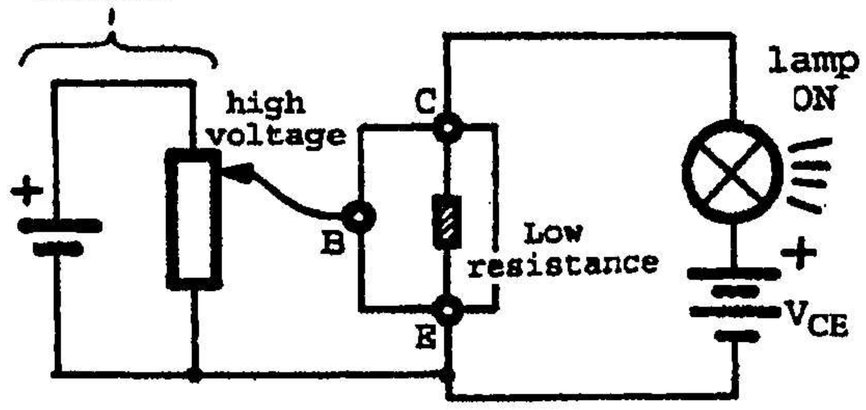
With an emitter-base biasing voltage added, the e-b junction becomes conductive and the transistor begins to conduct. It appears as a **low resistance** allowing current to flow through the collector and the lamp, turning it "on".



If the emitter-base voltage was made variable, then by **reducing** this voltage the e-b junction would slowly shut down making the transistor appear as an **increasing resistance**. The brightness of the lamp reduces as there would be less collector current flowing.

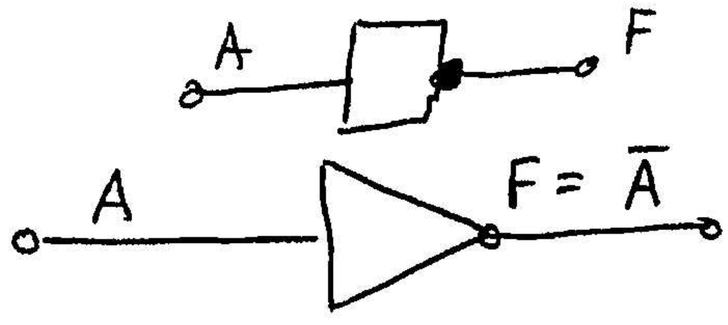


And as the emitter-base biasing voltage was **increased**, more collector current would flow, making the transistor appear as a **decreasing resistance** to current flow, turning the lamp on to its full brightness.



This shows the extent to which the emitter-base biasing circuit has control over the collector circuit's current. It also shows how, by changing this emitter-base voltage, it affects the transistor current flow to make it appear as a "variable resistor". (12)

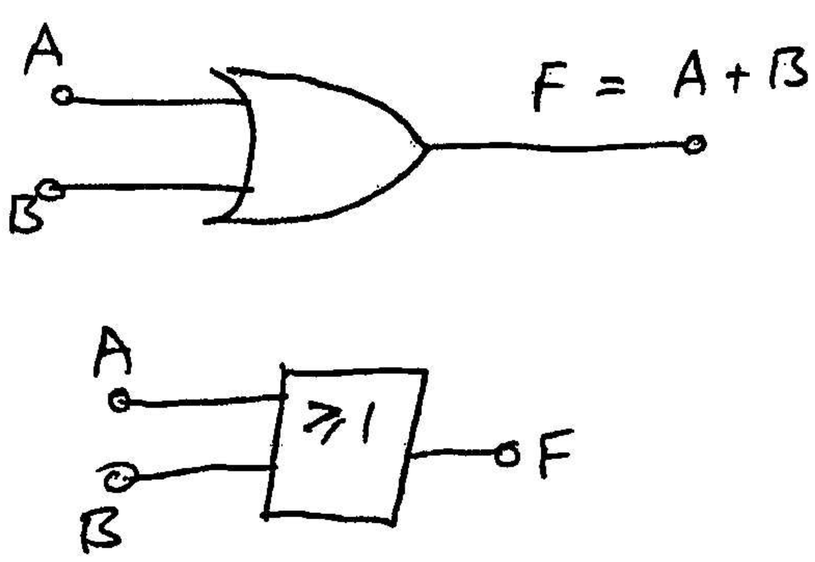
5.1.1



A	Ā
0	1
1	0

(4)

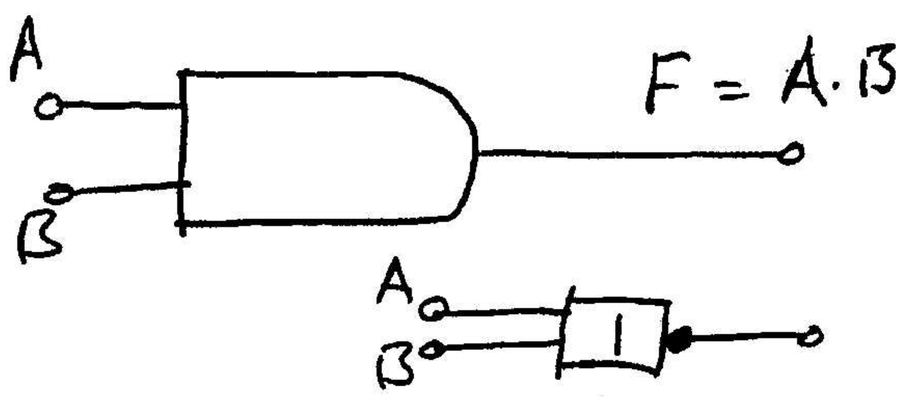
5.1.2



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

(6)

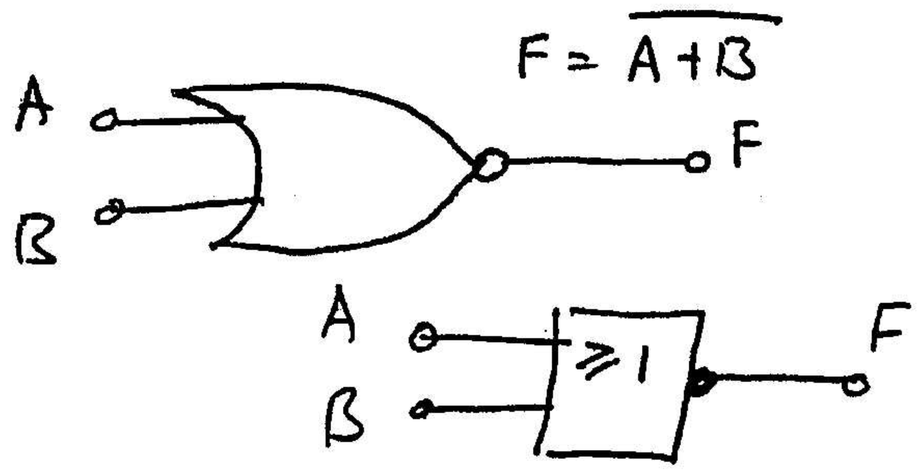
5.1.3



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

(6)

5.1.4



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

(6)

5.2 $A + B(A.\overline{B}) = A$

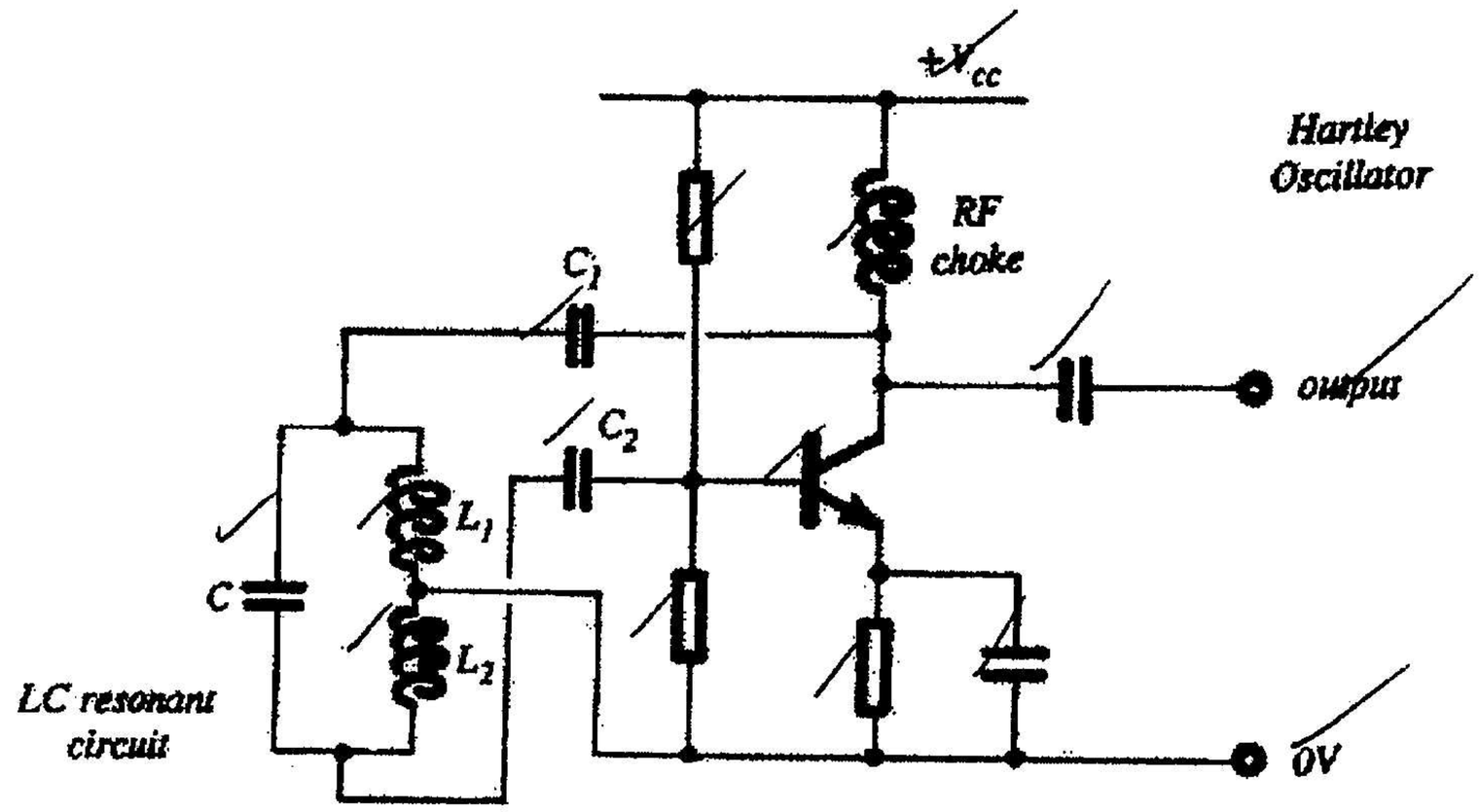
$A + AB.\overline{B}\,B = A$

$A + O = A$

$A = A$

(10)

QUESTION 6 / *VRAAG* 6



(15)

QUESTION 7 / *VRAAG 7*

7.1 Time = 5 cm x 100 µs
= 500 µs

$$f = \frac{1}{time}$$

$$= \frac{1}{500 \times 10^{-6}}$$

= 2 000 Hz = 2 kHz (7)

7.2 Em = 3.2 cm x 10V
= 32 V

Rms = Em x 0,707
= 32 x 0, 707
= 22, 62 V (6)

QUESTION 8 / *VRAAG 8*

8.1 * *Verseker dat alle draagbare toerusting buigsame kernbedrading het.*
* *Alle verbindingspunte moet meganies 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:* (5)

(E) Grond = *groen en geel*
(N) Neutraal = *blou*
(L) Lewendig = *bruin.*

8.2 * Do not work without permission.
* Do not work at unsafe speeds.
* Do not place objects in dangerous places.
* Do not work with the wrong tools.
* Do not wear loose clothing.
* Do not play in the workshop. (5)

8.3 *By ingange*
By stoorkamers
By plekke waar daar 'n brandgevaar kan wees
By gasstoorplek (3)

TOTAL / *TOTAAL* 200

END / *EINDE*