SENIOR CERTIFICATE EXAMINATION
SENIORSERTIFIKAAT-EKSAMEN

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TECHNIKA (ELECTRONICS)

TECHNIKA (ELEKTRONIES)

SG 714-2/0

9 pages
9 bladsye

TECHNIKA ELECTRONICS SG

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APPROVED BY UMALUSI / *GOEDGEKEUR DEUR UMALUSI*

GAUTENGSE DEPARTEMENT VAN ONDERWYS

SENIORSERTIFIKAAT-EKSAMEN

TECHNIKA (ELEKTRONIES) SG

TYD: 3 uur

PUNTE: 200

INSTRUKSIES:

- Beantwoord AL die vrae.
- Sketse en diagramme moet groot, netjies en benoem wees.
- Alle berekeninge moet getoon word.
- 'n Goedgekeurde sakrekenaar mag gebruik word.
- Antwoorde moet korrek genommer wees.
- 'n Formuleblad (bladsye 7-9) is aan die einde van die vraestel ingesluit.

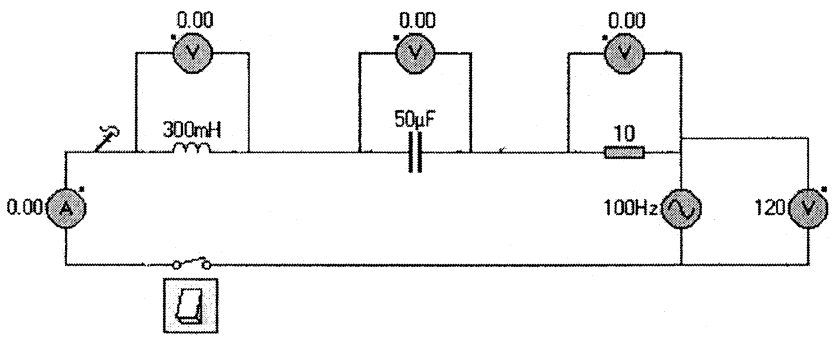
VRAAG 1
ELEKTRIESE STROOMTEORIE

1.1 **Figuur 1** is 'n tipiese RLC-kring met meters. Aanvaar dat die skakelaar gesluit is.

1.1.1 Bepaal die volgende:

(a)	Die stroomvloei in die kring	(9)
(b)	Die spanning oor die spoel	(3)
(c)	Die spanning oor die kapasitor	(3)
(d)	Die spanning oor die weerstand	(3)
(e)	Die fasehoek	(5)
(f)	Cos θ	(3)

1.1.2 Teken 'n volledig benoemde fasordiagram wat al die spannings en die fasehoek in die kring aantoon. (7)



Figuur 1
RLC-kring

GAUTENG DEPARTMENT OF EDUCATION

SENIOR CERTIFICATE EXAMINATION

TECHNIKA (ELECTRONICS) SG

TIME: 3 hours

MARKS: 200

INSTRUCTIONS:

- Answer ALL the questions.
- Sketches and diagrams must be large, neat and labelled.
- All calculations must be shown.
- An approved pocket calculator may be used.
- Answers must be clearly numbered.
- Formulae sheets (pages 7-9) are enclosed at the end of the paper.

QUESTION 1
ELECTRIC CURRENT THEORY

1.1 **Figure 1** is a typical RLC circuit with meters. Assume that the switch is closed.

1.1.1 Determine the following:

(a)	The current in the circuit	(9)
(b)	The voltage over the coil	(3)
(c)	The voltage over the capacitor	(3)
(d)	The voltage over the resistance	(3)
(e)	The phase angle	(5)
(f)	Cos θ	(3)

1.1.2 Sketch a fully labelled phasor diagram, showing all the voltages and the phase angle in the circuit. (7)

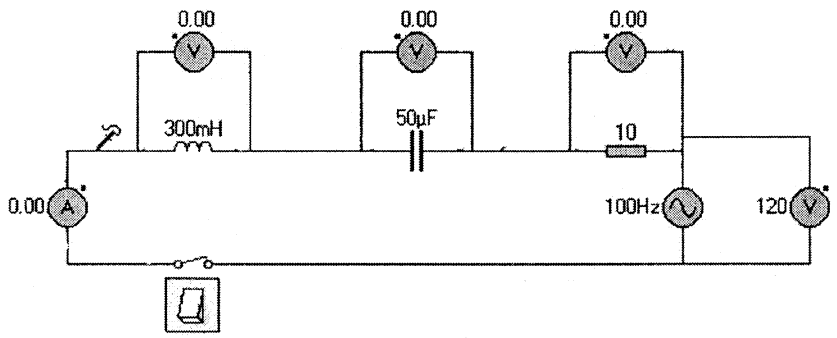


Figure 1
RLC Circuit

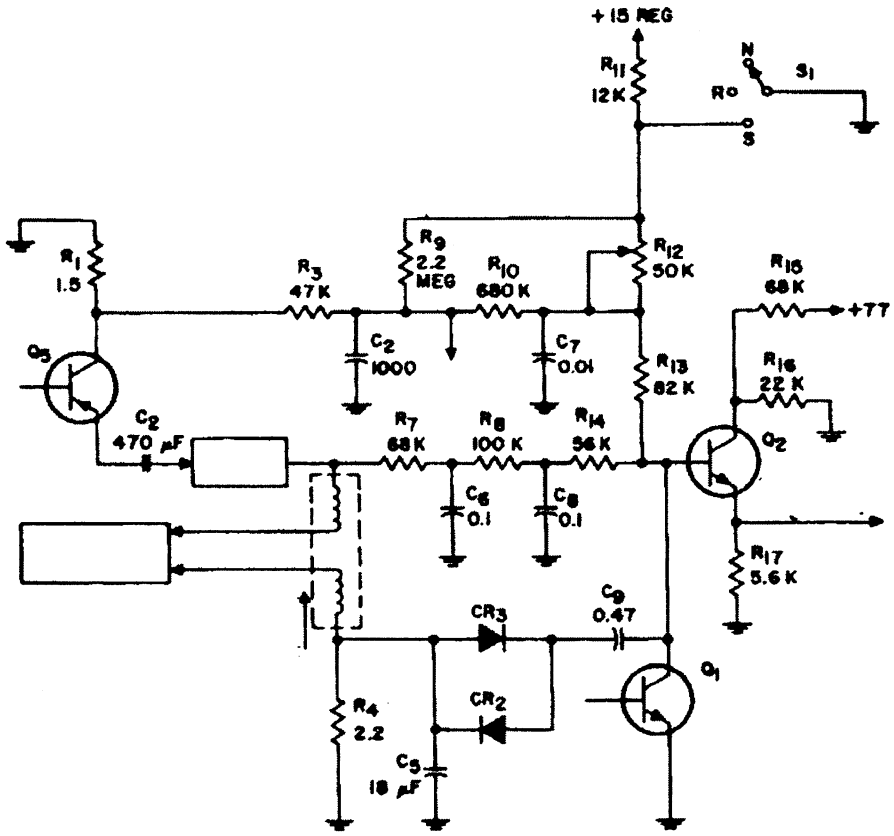
1.2 Verduidelik kortliks hoe die waarde van die kapasitiewe reaktansie verander kan word. (4)

1.3 Teken 'n grafiek (nie volgens skaal nie) van die X_C en X_L-waardes om aan te toon wanneer die resonante frekwensie verkry word. (5)

[42]

VRAAG 2
HALFGELEIER-TOESTELLE

2.1 Identifiseer die volgende elektroniese komponente met verwysing na die elektroniese kringdiagram in **Figuur 2**. Byvoorbeeld: R_{10} is 'n 680 000-ohm-resistor.



Figuur 2
Vertikale voorversterker met insette

2.1.1 R_{13} (3)
2.1.2 Q_5 (2)
2.1.3 C_6 (2)
2.1.4 CR_2 (2)
2.1.5 Q_1 (2)

2.2 Verduidelik kortliks hoe jy 'n diode sal toets met 'n analoog-multimeter. (Teken die nodige diagramme.) (10)

1.2 Explain briefly how you will change the value of the capacitive reactance. (4)

1.3 Draw a graph (not to scale) of the X_L and X_C values showing at which point the resonant frequency will be active. (5)

[42]

QUESTION 2
SEMICONDUCTOR DEVICES

2.1 Identify the following electronic components with reference to the electronic circuit diagram in **Figure 2**. For example: R_{10} is a 680 000 ohm resistor.

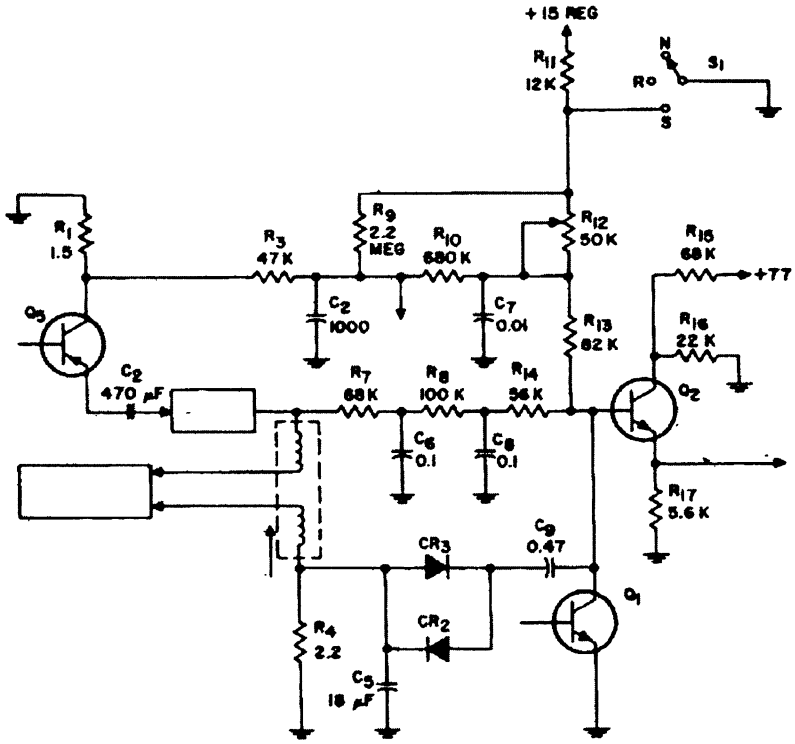


Figure 2
Vertical predriver with inputs

2.1.1 R_{13} (3)
2.1.2 Q_5 (2)
2.1.3 C_6 (2)
2.1.4 CR_2 (2)
2.1.5 Q_1 (2)

2.2 Explain briefly how you would test a diode by using an analogue multimeter. (Draw the necessary diagrams.) (10)

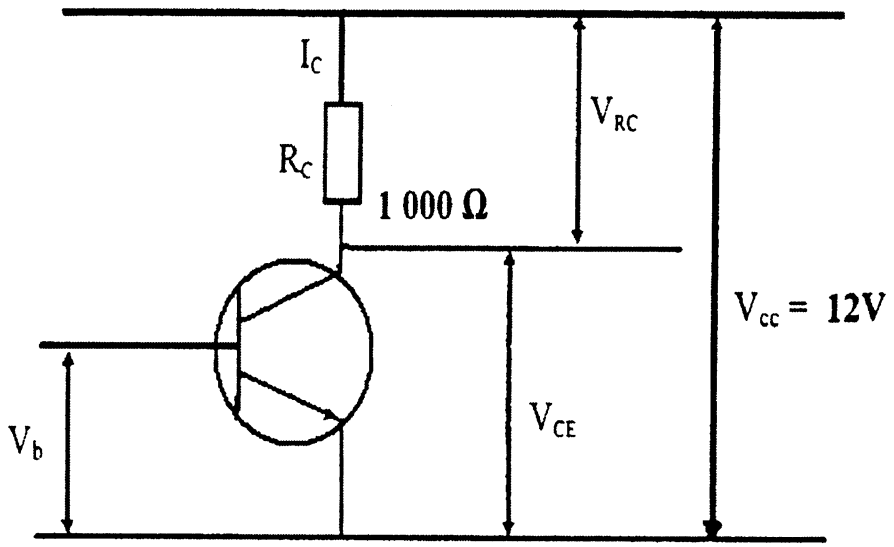
2.3 Maak netjiese, benoemde sketse om die basiese samestelling van die BSG te toon. Verduidelik die werkbeginsel van die BSG. (12)

2.4 Noem TWEE praktiese gebruike van 'n BSG. (2)
[35]

VRAAG 3
VERSTERKERS

3.1 Transistors word in verskillende stadiums met versterkers verbind om die vereiste versterking te verkry. Verduidelik aan die hand van 'n netjiese, benoemde diagram die basiese werkbeginsel van **óf** die resistor-kapasitor-gekoppelde versterker **óf** die transformator-gekoppelde versterker. (20)

3.2 Bereken die waardes vir en maak 'n netjiese benoemde skets van die laslyn vir die kring in **Figuur 3**. (10)



Figuur 3
Gemeenskaplike Emitterversterker

3.3 Verduidelik kortliks wat jy onder die term **negatiewe terugvoering** verstaan met verwysing na versterkerkringe. (4)

3.4 Noem VYF kenmerke van 'n ideale operasionele versterker. (5)

3.5 Omskryf die volgende terme met verwysing na die operasionele versterker:

3.5.1 Gemeenskaplike modus (2)
3.5.2 Verskilmodus (2)
[43]

2.3 Draw neatly labelled sketches to show the basic composition of the SCR. Explain the principle of operation of the SCR. (12)

2.4 Name TWO practical uses of an SCR. (2)
[35]

QUESTION 3
AMPLIFIERS

3.1 Transistors are connected in different stages in amplifiers. This is done in order to obtain the required amplification. Explain with the aid of a neat, labelled diagram the principle of operation of **either** the RC coupled amplifier **or** the transformer-coupled amplifier. (20)

3.2 Calculate the values for and make a neat, labelled sketch of the load line for the circuit in **Figure 3**. (10)

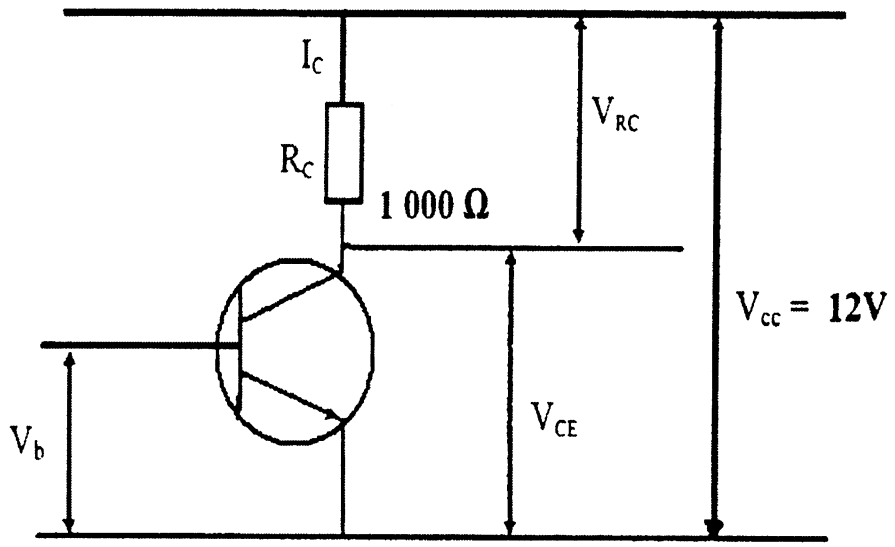


Figure 3
Common Emitter Amplifier

3.3 Explain briefly what you understand by the term **negative feedback** with reference to amplifier circuits. (4)

3.4 State FIVE characteristics of an ideal operational amplifier. (5)

3.5 Explain the following terms with reference to the operational amplifier:

3.5.1 Common mode (2)
3.5.2 Differential mode (2)
[43]

VRAAG 4
SKAKEL- EN BEHEERKRINGE

4.1 Teken 'n eenvoudige ligverdofkring wat met 'n diak en 'n triak werk. Toon die in- en uitsetgolwe, asook die hekpuls. (10)

4.2 Teken 'n eenvoudige skets van 'n bistabiele multivibrator. (10)
[20]

VRAAG 5
REKENAARBEGINSELS

5.1 Illustreer die basiese werkbeginsel van die **OF-hek** aan die hand van 'n netjiese, benoemde simbool, 'n waarheidstabel en die ekwivalente kring, bestaande uit 'n battery, skakelaars en 'n lamp. (12)

5.2 Bewys met Boole-algebra dat die volgende stelling waar is.

$$A + B(A.\overline{B}) = A$$ (10)
[32]

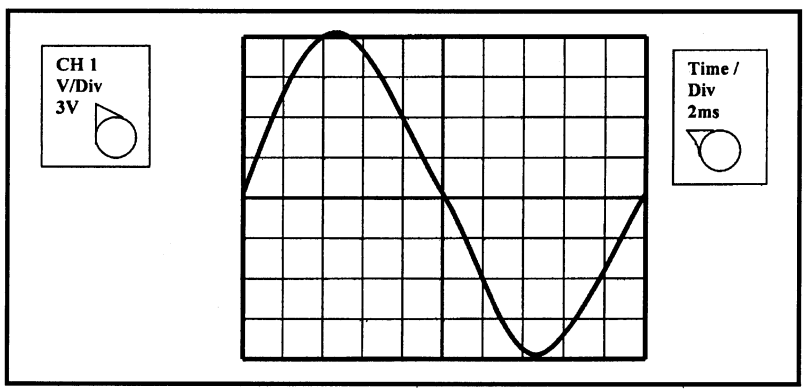
VRAAG 6
INLIGTINGOORDRAG

6.1 Teken 'n eenvoudige blokdiagram van 'n optiesevesel-telefoonstelsel. **[15]**

VRAAG 7
MEETINSTRUMENTE

7.1 **Figuur 4** toon 'n gesigplaat van 'n ossilloskoop. Bepaal vanuit die golfvorm die volgende:

7.1.1 Die frekwensie (2)
7.1.2 Die gemiddelde waarde (2)
7.1.3 Die waarde wat 'n voltmeter sal vertoon, indien dit aan die kring verbind sal word (2)
7.1.4 Die effektiewe waarde (wgk) van die golf (2)



Figuur 4
Die ossilloskoop **[8]**

QUESTION 4
SWITCHING AND CONTROL CIRCUITS

4.1 Draw a simple light dimmer circuit that uses a diac and a triac. The in and output waves as well as the gate pulse must be shown. (10)

4.2 Draw a simple sketch of a bistable multivibrator. (10)
[20]

QUESTION 5
COMPUTER PRINCIPLES

5.1 Illustrate the basic working principle of the **OR gate** by using a neat, labelled symbol, a truth table and the equivalent circuit consisting of a lamp, battery and switches. (12)

5.2 By using Boolean algebra, show that the following statement is true.

$$A + B(A.\overline{B}) = A$$ (10)
[32]

QUESTION 6
INFORMATION TRANSFER

6.1 Draw a simple block diagram showing a fibre-optic telephone system. **[15]**

QUESTION 7
MEASURING INSTRUMENTS

7.1 **Figure 4** shows a faceplate of an oscilloscope. Determine from the waveform the following:

(2)
7.1.1 The frequency (2)
7.1.2 The average value (2)
7.1.3 The value of the voltmeter if it is connected to the circuit. (2)
7.1.4 The effective value (RMS) of the wave

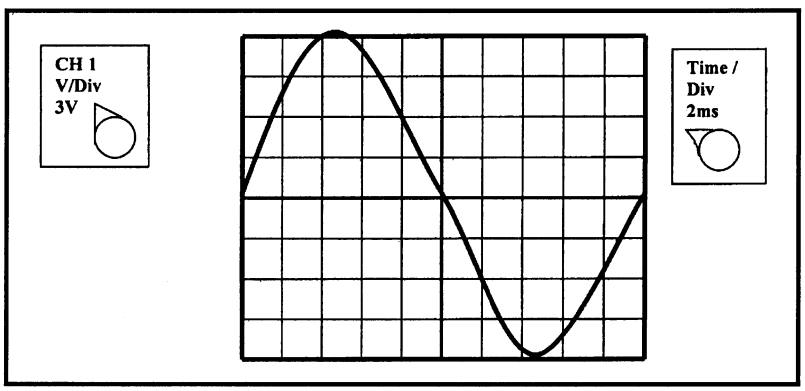


Figure 4
The Ossilloscope **[8]**

VRAAG 8
VEILIGHEIDSMAATREËLS

8.1 Noem EEN voorsorgmaatreël wat getref moet word om te verhoed dat Vigs opgedoen word, indien daar 'n werkswinkelongeluk plaasvind. (3)

8.2 Verduidelik, in DRIE stappe, wat jy sal doen as jy opmerk dat 'n persoon wat elektriese skok opgedoen het, bewusteloos is. (6)

8.3 Noem VIER aspekte waaraan daar besondere aandag geskenk moet word wanneer draagbare elektriese kraggereedskap geïnspekteer word. (4)

8.4 Noem enige TWEE noodnommers in Suid-Afrika. (2)
[15]

TOTAAL: 200

QUESTION 8
SAFETY PRECAUTIONS

8.1 State ONE safety precaution that must be taken to prevent contracting Aids in the event of a workshop accident. (3)

8.2 Explain, in THREE steps, what your reaction would be if you noticed that a person who received an electrical shock is unconscious. (6)

8.3 State FOUR aspects that must be taken into consideration when inspecting portable electrical power tools. (4)

8.4 State any TWO emergency numbers in South Africa. (2)
[15]

TOTAL: 200

INFORMATION SHEET / *INLIGTINGSBLAD*

ELECTRIC CURRENT THEORY / *ELEKTRIESE STROOMTEORIE*

$$I = \frac{V}{R} \text{ AMPS}$$

$$P = V \times I \text{ WATT}$$

$$t = \frac{1}{F} \text{ seconds / } \textit{sekondes}$$

$$V_{ave.} / _{gem.} = V_m \times 0{,}637$$

$$V_{mms.} / _{wgk.} = V_m \times 0{,}707$$

STAR / *STER*

$$V_L = \sqrt{3} \times V_P$$

$$I_L = I_P$$

DELTA

$$I_L = \sqrt{3} \times I_P$$

$$V_L = V_P$$

$$X_C = \frac{1}{2 \times \pi \times f \times C}$$

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

$$X_L = 2 \times \pi \times f \times L$$

$$f_r = \frac{1}{2 \times \pi} \times \sqrt{\frac{1}{LC} - \frac{R^2}{L^2}}$$

$$V_T = \sqrt{V_R^{\,2} + V_C^{\,2}}$$

$$Q = \frac{X_L}{R}$$

$$V_T = \sqrt{V_R^{\,2} + V_L^{\,2}}$$

$$Q = \frac{X_C}{R}$$

$$V_T = \sqrt{V_R^{\,2} + V_X^{\,2}}$$

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

$$V_X = V_L - V_C$$

$$\frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{I_2}{I_1}$$

$V_C = I_T \times X_C$

$V_L = I_T \times X_L$

$V_R = I_T \times R$

$V_T = \sqrt{V_R^2 + V_X^2}$

$V_X = V_C - V_L$

$I_T = \sqrt{I_R^2 + I_X^2}$

$I_X = I_C - I_L$

$\frac{N_1}{N_2} = \sqrt{\frac{Z_1}{Z_2}}$

$Z = \sqrt{R^2 + X_C^2}$

$Z = \sqrt{R^2 + X_L^2}$

$Z = \sqrt{R^2 + X_X^2}$

$X_X = X_L - X_C$

AMPLIFIERS / *VERSTERKERS*

$I_e = I_c + I_b$

$V_{cc} = V_{Rc} + V_{ce}$

$I_c = \frac{V_{cc}}{Rc}$

DECIBEL RATIOS / *DESIBELVERHOUDINGS*

$$G_I = 20 \text{ LOG } \frac{I_2}{I_1}$$

$$G_V = 20 \text{ LOG } \frac{V_2}{V_1}$$

$$G_P = 10 \text{ LOG } \frac{P_2}{P_1}$$

OPERATIONAL AMPLIFIERS / *OPERASIONELE VERSTERKERS*

$$A_V = -\frac{R_F}{R_1}$$

$$V_{OUT} = A_V \times V_I$$

$$A_V = 1 + \frac{R_F}{R_1}$$

$$V_{OUT} = A_V \times V_I$$

$$V_{OUT} = \frac{1}{RC} \int V_I \, dt$$

$$V_{OUT} = - RC \frac{dv}{dt}$$

$$V_{OUT} = - (V_1 \frac{R_F}{R_1} + V_2 \frac{R_F}{R_2} + V_3 \frac{R_F}{R_3})$$

COMPUTER PRINCIPLES / *REKENAARBEGINSELS*

$A.B = B.A$
$A + B = B + A$

$A.(B.C) = (A.B).C$
$A + (B + C) = (A + B) + C$

$A.(B + C) = AB + AC$
$A + (B.C) = (A + B) + (A + C)$

$A(A + B) = A + B$
$A + (AB) = A.B$

$A + 0 = A$
$A + 1 = 1$
$A.0 = 0$
$A.1 = A$
$A + \underline{A} = A$
$A + A = 1$
$A.\underline{A} = A$
$A.A = 0$

END / *EINDE*