Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2012

ELECTRICAL TECHNOLOGY

MARKS: 200

TIME: 3 hours

This question paper consists of 15 pages, including a formula sheet.

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Sketches and diagrams must be large, neat and fully labelled.
3. All calculations must be shown, and correct to two decimal places.
4. Answers must be clearly numbered.
5. A formula sheet is provided at the end of the paper.
6. Non-programmable calculators may be used.

QUESTION 1: TECHNOLOGY, SOCIETY AND THE ENVIRONMENT

1.1 South Africa is requires people to be entrepreneurs, so that they can survive the job loss that is happening. Discuss TWO competencies a person requires, to be a successful entrepreneur in the manufacturing of electronic toys. (2)

1.2 South Africa is currently experiencing a power shortage which has led to load shedding. Load shedding occurs when Eskom needs to shut down power to non-essential services in order to keep the powergrid up and running.

List FOUR precautions you could take to limit the use of electrical energy thus assisting Eskom in limiting load shedding. (4)

1.3 Technology is expanding and growing every day. State ONE example of advancement in technology and explain how it has affected your life in a positive, as well as in a negative way. (3)

1.4 Name ANY skill that a successful entrepreneur should possess. (1)

[10]

QUESTION 2: TECHNOLOGICAL PROCESS

2.1 Mention ANY THREE steps to be followed when designing an artefact. (3)

2.2 People walking and cycling along the side of the road after dark, are not easily seen by passing traffic. Such an action my cause fatal accidents. These people need an electronic warning sign that they can wear to alert the traffic and thus protect themselves.

2.2.1 Write the design brief for the above-mentioned problem. (3)

2.2.2 Develop ANY TWO specifications for the design solution to the problem. (4)

[10]

QUESTION 3: OCCUPATIONAL HEALTH AND SAFETY

3.1 Define safety in the Technology Workshop. (2)

3.2 Name TWO safety acts you should observe in a workshop. (2)

3.3 Name TWO safety conditions that you should observe in a workshop. (2)

3.4 In your school you are required to work using a portable drilling machine. Name TWO safety acts you should observe when working with a portable drill. (2)

3.5 Briefly explain what precautions you will take when a learner is being electrocuted because they touched an open live conductor. (2)

[10]

QUESTION 4: INSTRUMENTS

FIGURE 4.1 indicates the current flow through a resistor and the voltage across the same resistor. The scale setting is as follows:

Vertical : 10 V/division
Horizontal : 2,5 ms/division

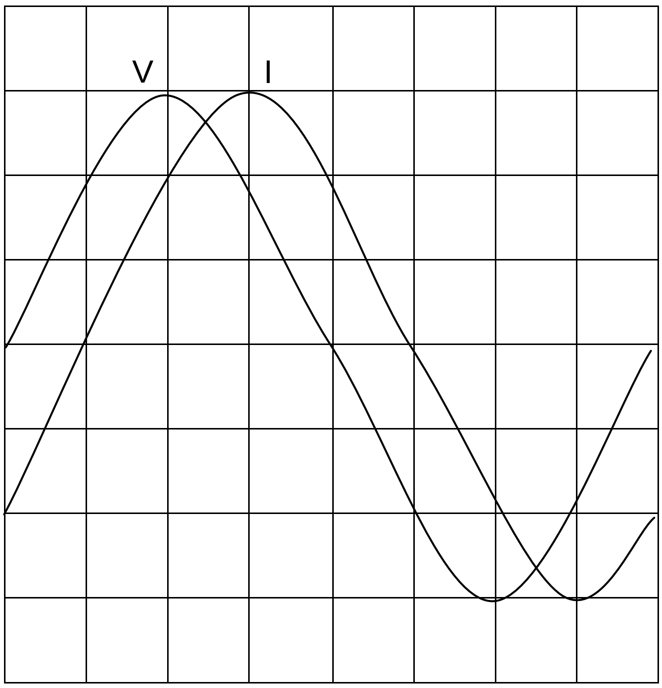


FIGURE 4.1

4.1 Determine the phase angle between the voltage and the current. (2)

4.2 Calculate the maximum value of the voltage. (2)

4.3 Determine the time taken to complete ONE cycle. (3)

4.4 Calculate the effective value of the voltage. (3)
[10]

QUESTION 5: PRINCIPLE OF SINGLE-PHASE GENERATION

5.1 Describe what happens when a conductor loop rotates through a two-pole magnetic field. (2)

5.2 When is the maximum EMF induced in a loop that rotates through a two-pole magnetic field? (1)

5.3 An alternating current wave form is represented by the following equation:

$$i = 12 \sin 314t$$

Using this equation, calculate the following:

5.3.1 The average value of the waveform (2)

5.3.2 The value of the current after 1,5 ms (3)

5.4 In South Africa the municipalities supply single phase domestic ac power at 230 V (r.m.s.) at 50 Hz. Use this information and calculate the following:

5.4.1 The maximum value of the household voltage (2)

5.4.2 The average value of the household voltage (2)

5.4.3 The period it takes to complete ONE cycle (3)
[15]

QUESTION 6: RLC CIRCUITS

6.1 Explain the term *impedance* with reference to an RLC circuit. (3)

6.2 In an RLC circuit the increase or decrease in frequency plays a vital role for various applications.

What will happen to the resistance and reactance values of the following components if the frequency increases?

6.2.1 A resistor (1)

6.2.2 A capacitor (1)

6.2.3 An inductor (1)

6.3 The tuning circuit of a radio/TV consists of a 75 mH coil, 220 µf capacitor and a 22 Ω resistor, all connected in series across a 24 V, 50 Hz supply.

Calculate the following:

6.3.1 The total impedance of the circuit (9)

6.3.2 The total current flow in the circuit (3)

6.3.3 The phase angle between the supply current and the voltage (3)

6.3.4 Draw the phasor diagram. (Not to scale) (4)

6.4 List TWO characteristics of a circuit in resonance. (2)

6.5 Give TWO practical applications an RLC circuit. (2)

6.6 Is the capacitive reactance of a capacitor dependent upon frequency? (1)

[30]

QUESTION 7: SEMI-CONDUCTOR DEVICES

7.1 When transistors are utilised as amplifiers, reference is made to the gain of the transistor. Make use of your knowledge of amplifiers to determine the gain of the amplifier shown in FIGURE 7.1. (3)

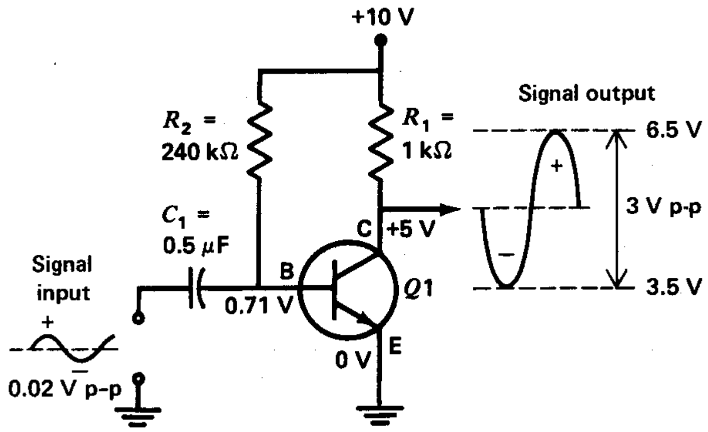


FIGURE 7.1: TOUCH SWITCH CIRCUIT

7.2 List TWO uses of a transistor in an electrical/electronic circuit. (2)

7.3

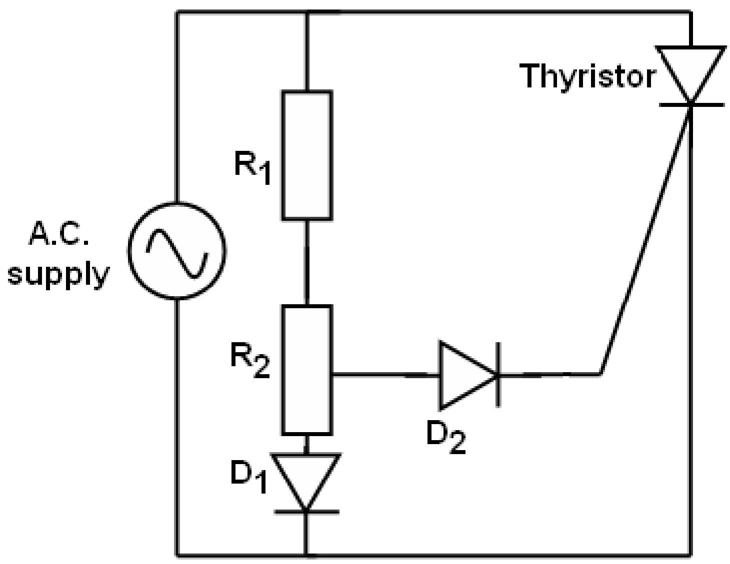


FIGURE 7.3

FIGURE 7.3 shows a thyristor controlled lamp dimming circuit.

Explain its basic operation. (5)

[10]

QUESTION 8: AMPLIFIERS

8.1

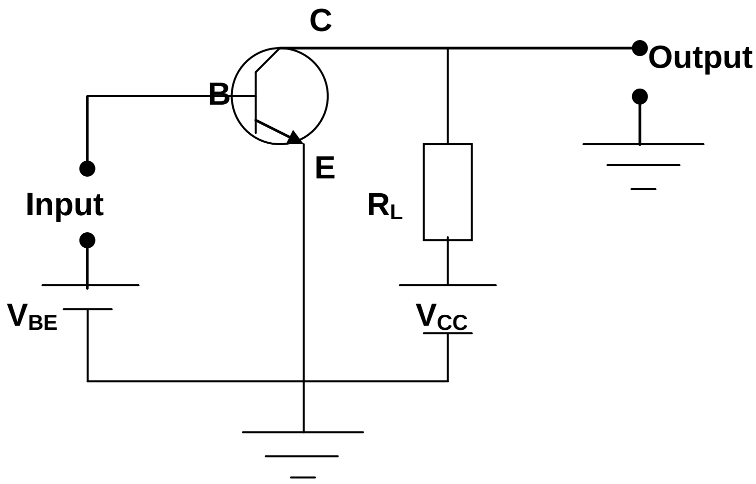


FIGURE 8.1

Identify the type of circuit used in FIGURE 8.1 and list TWO other types of transistor configurations. (3)

8.2

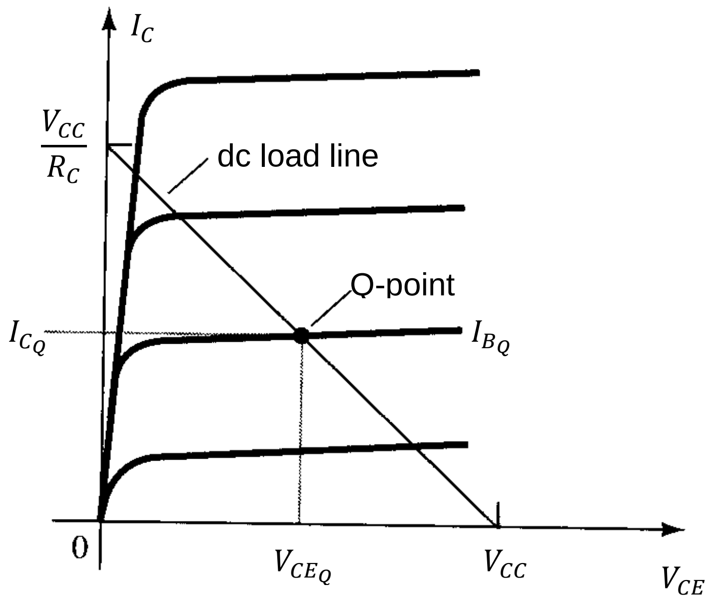


FIGURE 8.2

Refer to FIGURE 8.2 to determine the value of the load resistor (Rc) to be utilised with a transistor that has a maximum collector current (Ic) of 150 mA and a supply voltage of 24 volts. NOTE: (Vcc = Vce). (3)

8.3 Determine the capacitor that is required for frequencies of 100 Hz and higher to bypass the emitter resistor if the capacitive reactance is 33 Ω. (4)

[10]

QUESTION 9: TRANSFORMERS

9.1 Name TWO applications of transformers. (2)

9.2 Mr Manana's dwelling is supplied by a single-phase transformer. When he uses all the appliances, the transformer supplying his dwelling gets hot. The transformer used is a 11 000 V/230 V. Transformer is rated at 1 100 kVA.

9.2.1 What could be the reasons for the transformer getting too hot? (2)

9.2.2 There are different methods used to cool transformers. Name THREE methods used to cool a transformer. (3)

9.2.3 Calculate the maximum current that can be drawn by the transformer from the supply. (3)

9.2.4 Calculate the current that can be supplied by the transformer. (3)

9.3 In the world of technology there are many different types of transformers. Give TWO types of transformers. (2)

[15]

QUESTION 10: POWER SUPPLY

Power supply circuits are designed to provide electronic circuits with a stable voltage and current source.

10.1 List FOUR stages of a power supply. (4)

10.2 Describe the function of the capacitor across the load output in a power supply. (2)

10.3

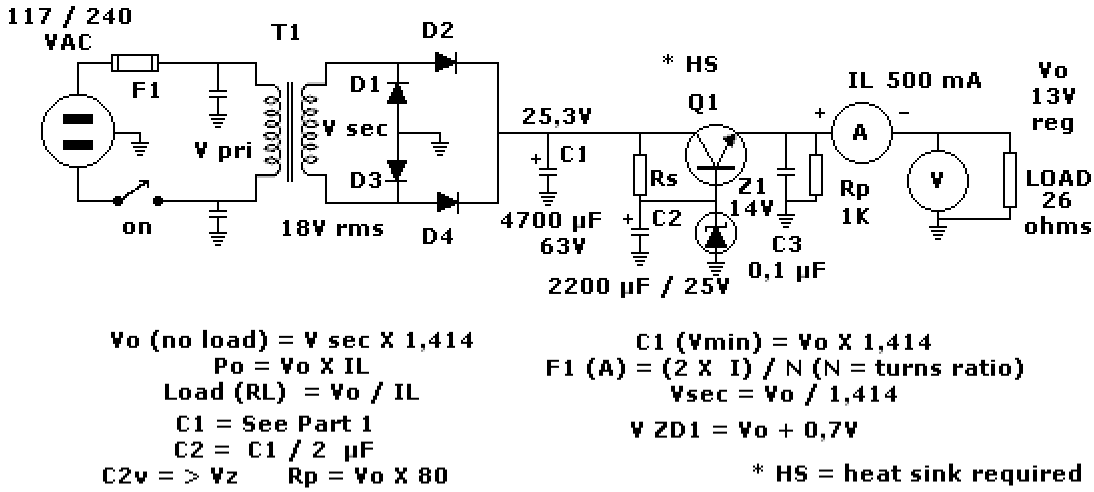
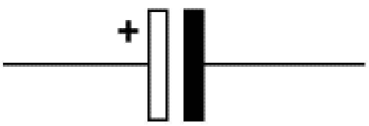


FIGURE 10.4

FIGURE 10.4 shows a series voltage-regulator circuit. Make use of your knowledge of Zener diodes to explain what happens with the Zener diode when the input voltage to the regulator rises. (5)

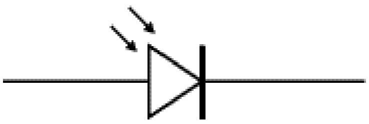
10.4 Identify the following components:

10.4.1



(1)

10.4.2



(1)

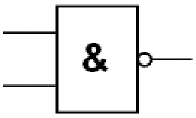
10.5 Draw and label TWO waveforms to illustrate the difference between full wave and half wave rectification. (2)

[15]

QUESTION 11: LOGIC CIRCUITS

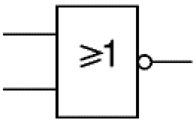
11.1 Identify the following logic gates:

11.1.1



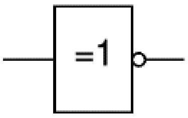
(1)

11.1.2



(1)

11.1.3



(1)

11.2 Draw the logic circuit for the following Boolean Expression:

$$F = \overline{\overline{A+B}+B.C}$$

(5)

11.3 Simplify the Boolean expression in QUESTION 11.2. (4)

11.4 Study the Logic circuit in FIGURE 11.4 and use it to answer the following questions.

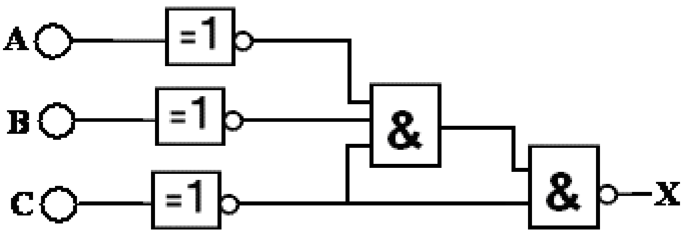


FIGURE 11.4

11.4.1 Determine the logic state (1 or 0) of X if:
A=1
B=0
C=0 (1)

11.4.2 Determine the logic state (1 or 0) of X if:
A=0
B=1
C=0 (1)

11.4.3 Determine the logic state (1 or 0) of X if:
A=0
B=0
C=1 (1)

11.5 List TWO applications of logic gates. (2)

11.6 Complete the following Boolean algebra rules:

11.6.1 $X + \overline{X}\,Y =$ (1)

11.6.2 $1 + X =$ (1)

11.6.3 $1 \cdot X =$ (1)

[20]

QUESTION 12: PROTECTIVE DEVICES

FIGURE 12.1 shows the cross-sectional view of an MCB.

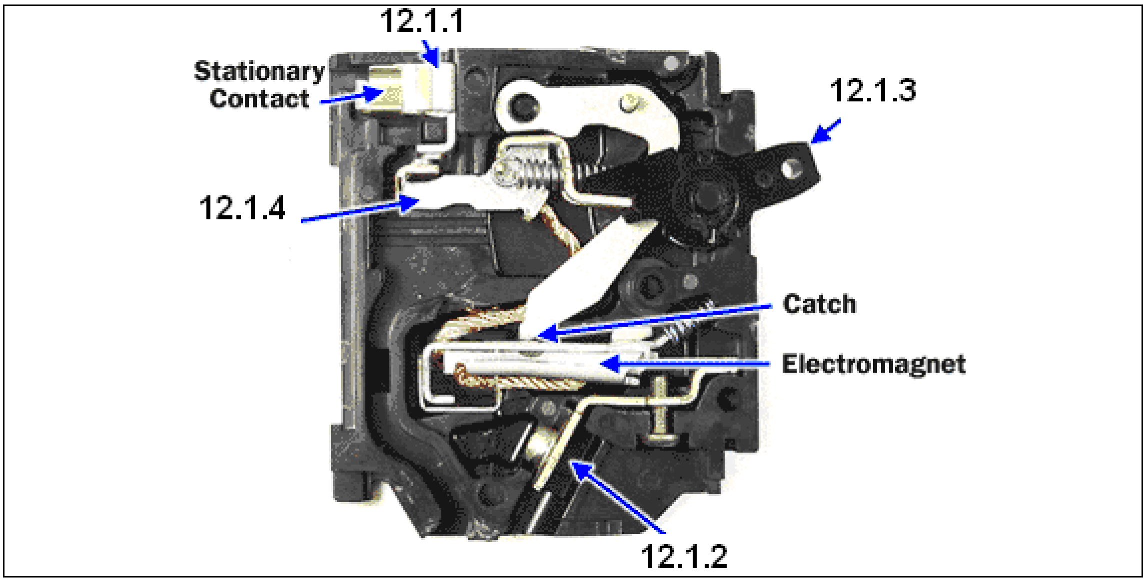


FIGURE 12.1

12.1 Label 12.1.1 to 12.1.4. (4)

12.2 State the MCB current ratings for the following sub-circuits according the accepted code of practice as regulated by SABS 0142 regulations.

12.2.1 Stove (1)

12.2.2 Socket outlets (1)

12.3 Describe the function of an earth leakage relay unit. (2)

12.4 Explain TWO advantages of an MCB when it is compared to a fuse. (2)

[10]

QUESTION 13: OPERATING PRINCIPLES OF SINGLE-PHASE MOTORS

FIGURE 13.1 shows the single-phase electrical motor.

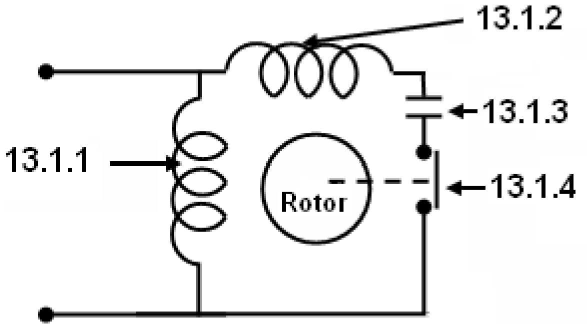


FIGURE 13.1: ELECTRICAL MOTOR

13.1 Label 13.1.1 to 13.1.4. (4)

13.2 Identify the electrical motor in FIGURE 13.1. (1)

13.3 Explain the function of the centrifugal switch. (2)

13.4 State the application of the motor in FIGURE 13.1. Include examples of where it is used. (3)

13.5 What will happen to the motor if the capacitor is defective and it is an open circuit? (2)

13.6 Show by means of TWO sketches how the direction of rotation of this motor can be changed. (4)

13.7 What is the function of the two capacitors used in a single phase capacitor-start capacitor-run motor? (4)

13.8 Draw the control circuit of a direct-on-line starter. (5)

[25]

QUESTION 14: ELECTRONIC COMMUNICATION

Electronic communication is one of the most important facets of modern society. One of the most important mediums of communication is through radio communication. To send data through radio, it is important to modulate the radio signal.

14.1 Briefly explain the principle of *modulation*. (2)

14.2 Do cellular phones incorporate any form of radio transmitters? (1)

14.3 FIGURE 14.2 below shows a capacitor is added to the output. Explain the purpose of this. (2)

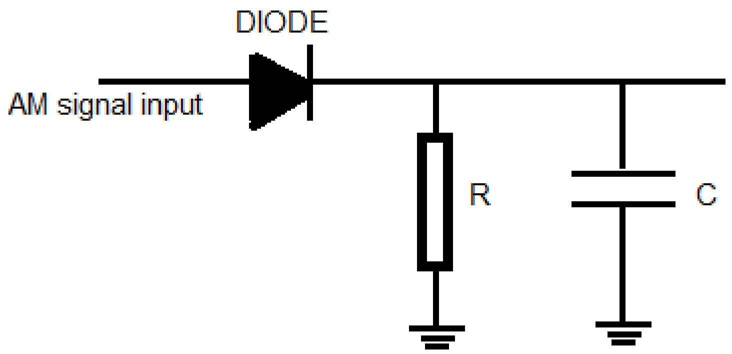


FIGURE 14.2: DIODE DETECTOR CIRCUIT WITH CAPACITOR

14.4 Draw and label the block diagram of a radio receiver. (5)
[10]

TOTAL: 200

ELECTRICAL TECHNOLOGY GRADE 11
ELEKTRIESE TEGNOLOGIE GRAAD 11

FORMULA SHEET / FORMULEBLAD

$$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots\ldots \frac{1}{Rn}$$

$$Rs = R1 + R2 + R3 + \ldots\ldots\ldots Rn$$

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

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

$$V = I \times R$$

$$P = V \times I$$

$$P = I^2 \times R$$

$$P = \frac{V^2}{R}$$

$$R_t = R_o(1 + \infty_o t)$$

$$R = \frac{\rho l}{a}$$

$$\tau = R \times C$$

$$\tau = \frac{R}{L}$$

$$a = \frac{\pi d^2}{4}$$

Pf = Cos θ

$$V_{RB} = Vcc - V_B$$

$$e = EmSin\theta$$

$$\omega = 2\pi F$$

$$E_{rms} = Em \times 0.707$$

$$E_{ave} = Em \times 0,637$$

$$E_{wgk} = Em \times 0,707$$

$$E_{gem} = Em \times),637$$

$$X_L = 2\pi FL$$

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

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$I_Z = \sqrt{{I_R}^2 + (I_{XL} - I_{XC})^2}$$

$$V_Z = \sqrt{{V_R}^2 + (V_{XL} - V_{XC})^2}$$

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

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

$$Wins = \frac{Vuit}{Vin}$$

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

$$\frac{Ns}{Np} = \frac{Vs}{Vp} = \frac{Ip}{Is}$$

$$S = Vp \times Ip$$

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

$$T = \frac{1}{F}$$

$$V = V/Div \times Div$$

$$Iz = \frac{Vz}{Z}$$

$$P = V.I.Cos\theta$$

$$P_S = VI$$

$$V_O = V_{Zener} - V_{basis}$$

$$V_{CE} = V_I - V_O$$

END/EINDE