Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2011

ELECTRICAL TECHNOLOGY

MARKS: **200**

TIME: **3 hours**

This question paper consists of 13 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 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 power grid up and running.

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

1.2 Your teacher instructed you and your fellow students to do a small project in the workshop. Whilst you were busy working you notice that your fellow pupil cut him-/herself. Taking cognisance of HIV/Aids, do you have a responsibility to help him/her? Give ONE precaution you should take. (2)

1.3 South Africa is requiring people to be entrepreneurs in order to limit unemployment. Discuss TWO competencies that a successful entrepreneur, manufacturing electronic toys, must possess. (4)

[10]

QUESTION 2: TECHNOLOGICAL PROCESS

At your school you were taught to solve problems using the technological process. Answer the following questions keeping the technological process in mind.

2.1 Mention FIVE steps to be followed when designing an artefact. (5)

2.2 Mr. Mbhuda, a retired Electrical Technology educator, is repairing portable domestic electrical appliances as a hobby to supplement his pension. A gang raided his workshop at his home and has taken all his testing instruments. Mr. Mbhuda now finds it extremely difficult to do fault finding on the appliances and he is not in a financial position to buy new test instruments.

2.2.1 Write the problem statement. (3)

2.2.2 Write the possible solution. (2)

[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. Give TWO safety acts you should observ when working with a portable drill. (2)

3.5 Name the type of fire extinguisher which can be used for the following classes of fire.

CLASS	CHARACTARISTICS OF FIRE EXTINGUISHER (TYPE)
Fires occurring in the presence of live electrical installation	3.5.1
Flammable liquids and greases e.g. alcohol, benzene, oil, paraffin, petrol	3.5.2

(2)

[10]

QUESTION 4: INSTRUMENTS

FIGURE 4.1 indicates an oscillogram showing 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

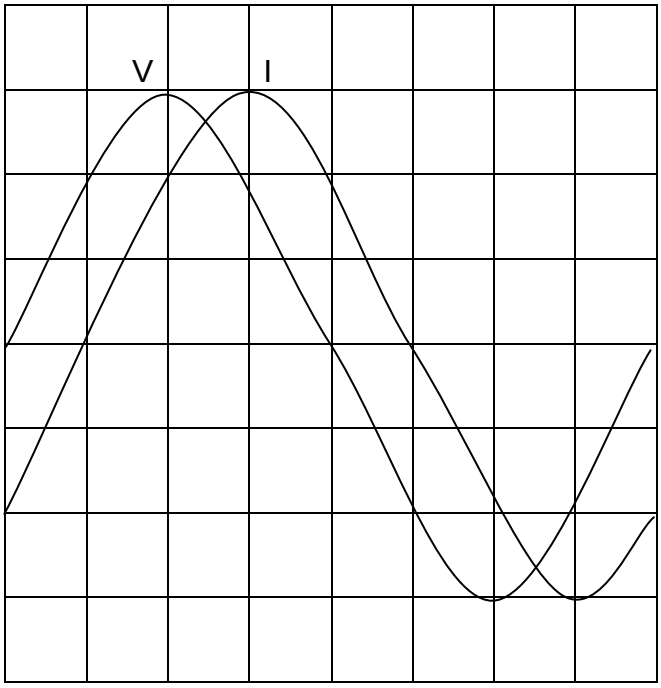


FIGURE 4.1

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 Determine the effective value of the voltage. (3)

[10]

QUESTION 5: PRINCIPLE OF SINGLE-PHASE GENERATION

5.1 Describe what will happen if a conductor loop is rotating through a two-pole magnetic field. (3)

5.2 When is the maximum EMF induced in a loop rotating 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 A.C. power at 230 V (r.m.s.) 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 a RLC circuit. (3)

6.2 In a RLC circuit, increasing or decreasing the frequency affects the circuit. What will happen to the following if the frequency increases?

6.2.1 Resistance (1)

6.2.2 Capacitive reactance (1)

6.2.3 Inductive reactance (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. Answer the following:

6.3.1 Calculate the total impedance of the circuit (9)

6.3.2 Calculate the total current flow in the circuit (3)

6.3.3 Calculate 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)

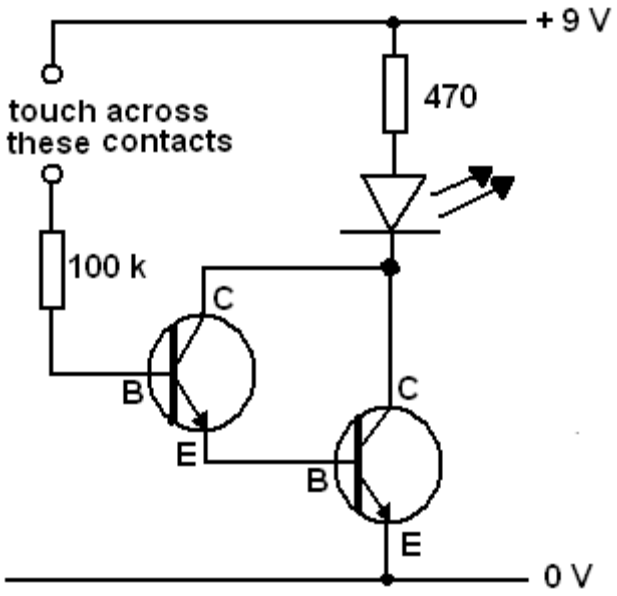
6.5 Give TWO practical applications where RLC circuitry is used. (2)

6.6 Is the capacitance 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 FIGURE 7.1 and explain how the total current-gain is achieved.

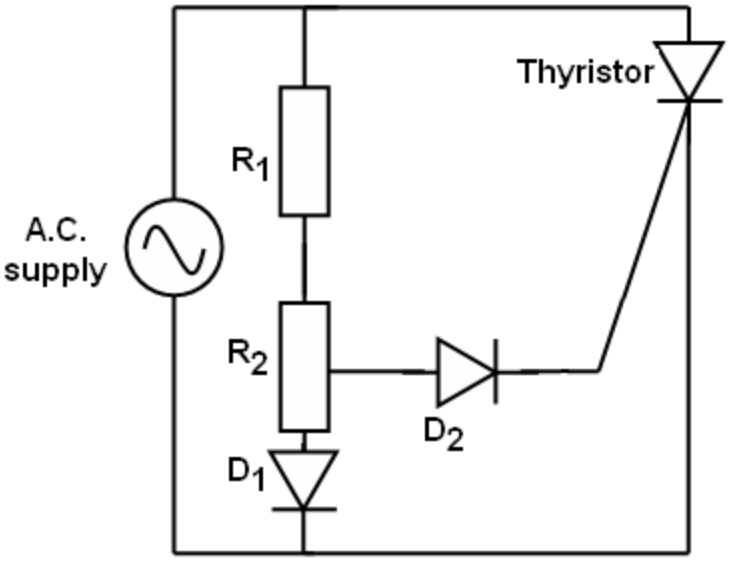


(3)

FIGURE 7.1 TOUCH SWITCH CIRCUIT

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

7.3



(2)

FIGURE 7.3

7.3.1 FIGURE 7.3 shows a thyristor controlled lamp dimming circuit. Explain its basic operation. (5)

[10]

QUESTION 8: AMPLIFIERS

8.1

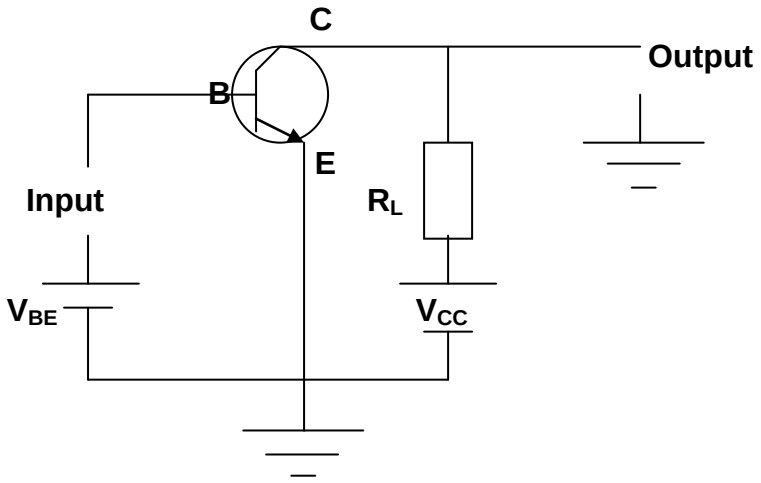


FIGURE 8.1

8.1.1 Identify the configuration of the circuit in FIGURE 8.1 and name the other TWO types of transistor configurations. (3)

8.2

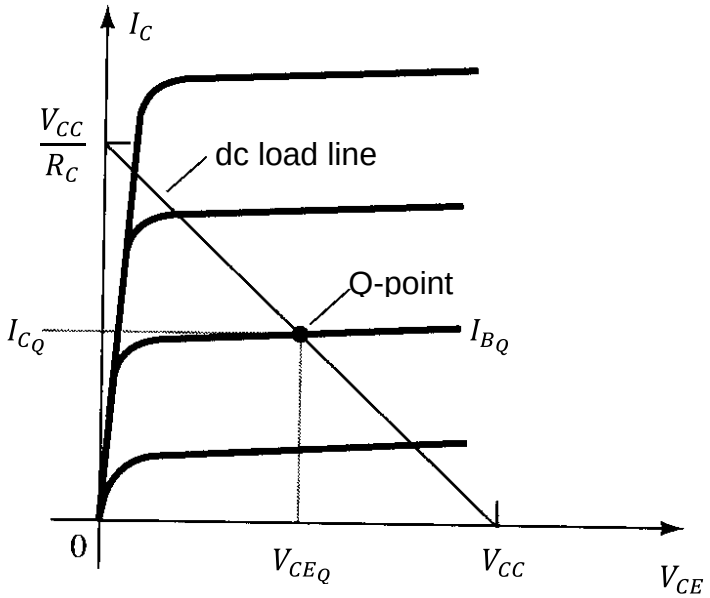


FIGURE 8.2

8.2.1 Refer to FIGURE 8.2 and determine the value of the load resistor (R_C) to be utilised with a transistor that has a maximum collector current (I_C) of 150 mA and a supply voltage of 24 volts. (3)

8.3 Determine the value of 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 What is the function 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.

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 if the kVA rating of the transformer is given as 1 100 kVA. (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 a current source.

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

10.2 Draw the wave after the rectifier stage. (1)

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

10.4

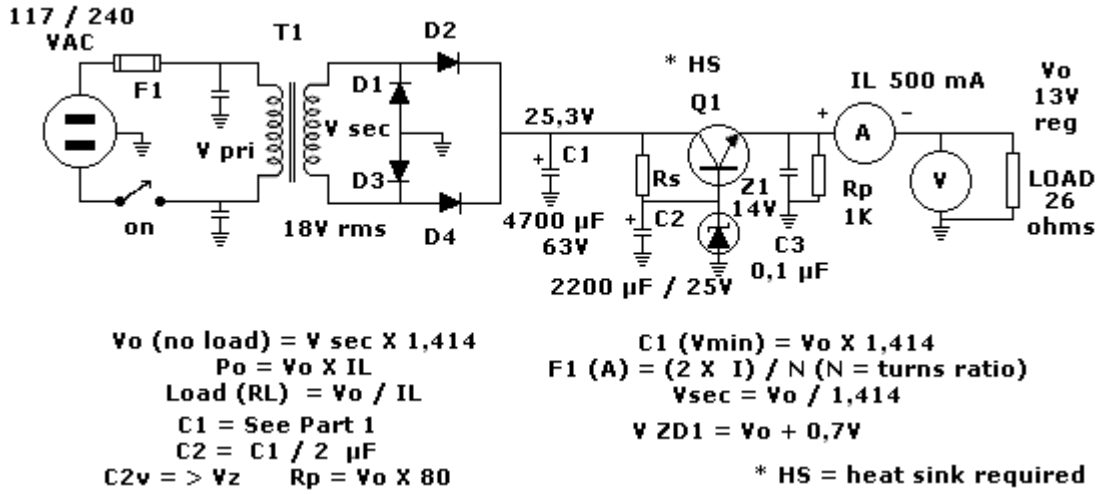
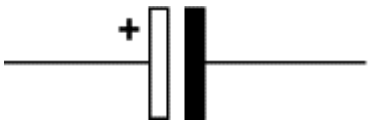
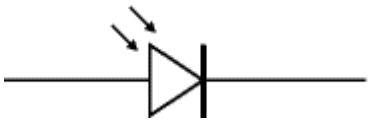


FIGURE 10.4

10.4.1 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. (2)

10.5 Identify the following components:

10.5.1  (1)

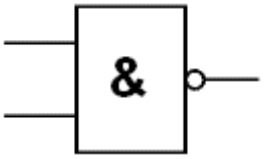
10.5.2  (1)

10.6 Draw and label TWO waveforms to illustrate the difference between full wave and half wave rectification. (4)

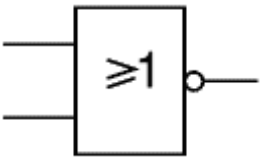
[15]

QUESTION 11: LOGIC CIRCUITS

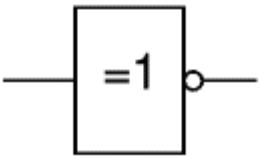
11.1 Identify the following logic gates:

11.1.1 

(1)

11.1.2 

(1)

11.1.3 

(1)

11.2 Draw the logic circuit for the following Boolean expression:

$$F = \overline{\overline{A+B}+B.C}$$
(8)

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.

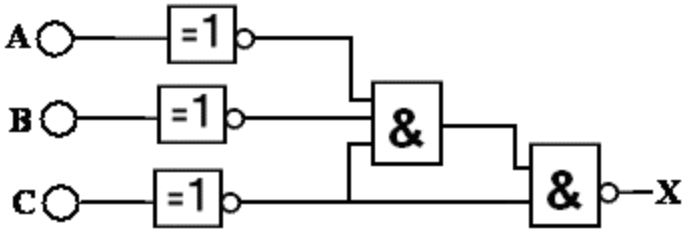


FIGURE 11.4

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)

[20]

QUESTION 12: PROTECTIVE DEVICES

FIGURE 12.1 shows the cross-sectional of an MCB.

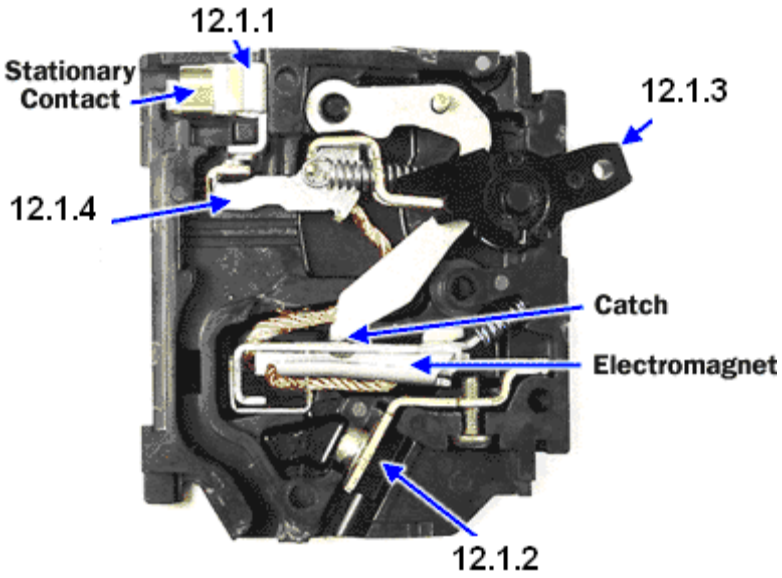


FIGURE 12.1

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.

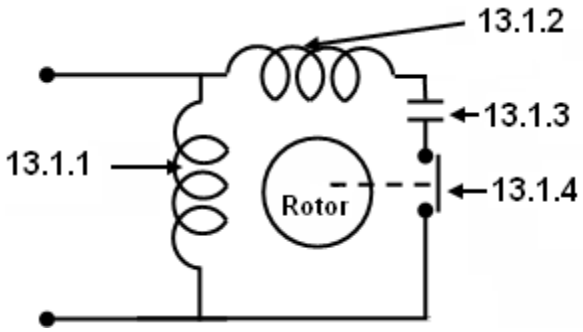


FIGURE 13.1 ELECTRICAL MOTOR

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 and 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 Give ONE advantage optical cable has over the copper cable. (2)

14.3 Draw and label the block diagram of a radio receiver. (6)

[10]

TOTAL: 200

ELECTRICAL TECHNOLOGY GRADE 11
ELEKTRIESE TEGNOLOGIE GRAAD 11

FORMULA SHEET

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

$$Rs = R1 + R2 + R3 + ...Rn$$

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

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

$$V = I \times R$$

$$P = V \times I$$

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

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

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

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

$$\tau = R \times C$$

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

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

$$Pf = \cos\theta$$

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

FORMULEBLAD

$$e = EmSin\theta$$

$$\omega = 2\pi F$$

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

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

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

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

$$X_L = 2\pi FL$$

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

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

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

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

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

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

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

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

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

$$S = Vp \times Ip$$

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

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

$$V = {}^{V}\!/_{Div} \times Div$$

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

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

$$P_S = VI$$

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

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

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