Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2018

ELECTRICAL TECHNOLOGY: ELECTRONICS MARKING GUIDELINE

MARKS: **200**

This marking guideline consists of 14 pages.

INSTRUCTIONS TO THE MARKERS

1. All questions with multiple answers imply that any relevant, acceptable answer should be considered.

2. Calculations

   2.1 All calculations must show the formulae.

   2.2 Substitution of values must be done correctly.

   2.3 All answers MUST contain the correct unit to be considered.

   2.4 Alternative methods must be considered, provided that the correct answer is obtained.

   2.5 Where an incorrect answer could be carried over to the next step, the first answer will be deemed incorrect. However, should the incorrect answer be carried over correctly, the marker has to re- calculate the values, using the incorrect answer from the first calculation. If correctly used, the candidate should receive the full marks for subsequent calculations.

   2.6 Markers should consider that candidates' answers may deviate slightly from the marking guideline depending on how and where in the calculation rounding off was used.

3. These marking guidelines are only a guide with model answers.

4. Alternative interpretations must be considered and marked on merit. However, this principle should be applied consistently throughout the marking session at ALL marking centres.

QUESTION 1: OCCUPATIONAL HEALTH AND SAFETY

1.1 Regulations are a set of rules ✓that clarify or support the OHS act. ✓ (2)

1.2
- Poor housekeeping ✓
- Poor ventilation
- Excessive noise ✓
- Faulty tools or equipment (Any relevant answer) (2)

1.3
- Horseplay ✓
- Throwing things
- Running in the workshop
- Spilling a liquid or oil and not cleaning it up (1)

1.4
- Keep person lying down. ✓
- Cover the person to maintain body heat.
- Do not move the person in case of neck or spine injuries.
- If unconscious, put them on their side (recovery p position)

(Any relevant answers) (1)
[6]

QUESTION 2: TOOLS AND MEASURING INSTRUMENTS

2.1
- Phase measurement ✓
- Frequency measurement ✓
- Voltage measurement
- Display waveforms (2)

2.2 When the tip is in contact with a live wire and the metal cap is touched, a path for a small current to flow to the ground is created. ✓ This makes the neon bulb to glow, indicate that the line is live ✓ (2)

2.3 A jigsaw is used for cutting and shaping of materials. (1)

2.4 To bend or deform lugs, ferrules and plugs in order to join them to wires. ✓ (1)
[6]

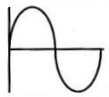
QUESTION 3: WAVE FORMS

3.1 The alternating electric field ✓ and the magnetic field ✓combine to form a radio wave (2)

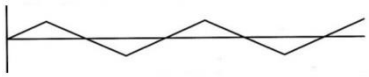
3.2
- Communication ✓
- Broadcasting
- Computer network
- Radar navigation

(Any ONE) (1)

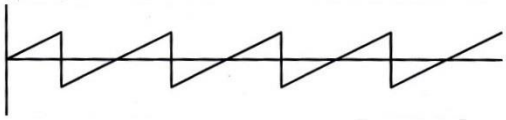
3.3



Sine wave ✓



triangular wave ✓



Saw tooth wave ✓ (6)

3.4 Is the time a rising pulse takes to make a change from 0V to 5V. ✓ It is measured between the 10% and 90% points of the amplitude. ✓ (2)

3.5 3.5.1 1 – peak- to peak ✓
2 – peak value ✓
3 – instantaneous value ✓ (3)

3.5.2 $20ms$ ✓ (1)

3.5.3 $Vpk = Vmax \times 2$ ✓
$= 30\ mV \times 2$ ✓
$= 60\ mV$✓ (3)

3.5.4 $f = \frac{1}{T}$✓
$= \frac{1}{0.02}$
$= 50\ Hz$ ✓ (2)

3.5.5 $V_{ave} = Vmax \times 0.637$ ✓
$30\ mV \times 0.637$ ✓
$19{,}11\ mV$✓ (3)

3.5.6 $V_{rms} = Vmax \times 0.707$ ✓

$= 30\ mV \times 0.707$ ✓

$= 21{,}21\ mv$ ✓ (3)

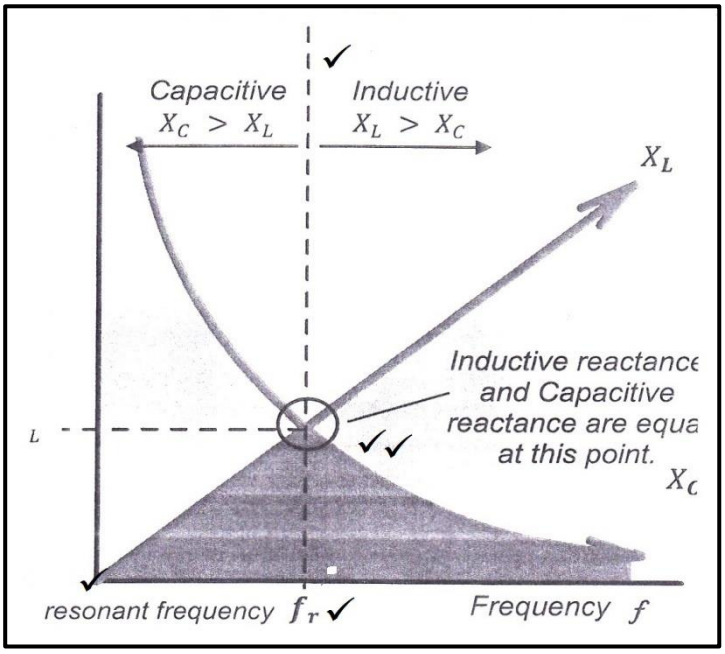
[26]

QUESTION 4: RLC

4.1 The frequency ✓and the value of the inductor ✓ (2)

4.2 Impedance is the total resistance offered ✓ to the flow of current in an AC circuit which contains resistive and reactive components. ✓ (2)

4.3



(4)

4.4 XL = XC ✓
R = Z ✓
VL= VC ✓
$COS\ \theta = 1$ ✓
I is at a maximum
Z is at a minimum
$\theta = 0^o$
V_R=V_S (Any THREE) (3)

4.5 4.5.1 $XL = 2\pi fL$ ✓
$= 2\pi \times 50 \times 400 \times 10^{-3}$✓
$= 125{,}66\ \Omega$ ✓ (3)

4.5.2 $Xc = \frac{1}{2\pi fc}$✓
$= \frac{1}{2\pi \times 50 \times 47 \times 10^{-6}}$✓
$= 67{,}73\ \Omega$ ✓ (3)

4.5.3 $Z = \sqrt{R^2 + (XL - XC)^2}$✓
$= \sqrt{30^2 + (125{,}66 - 67{,}73)^2}$✓
$= 65{,}237\ \Omega$✓ (3)

4.5.4

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

$$= \frac{1}{2\pi\sqrt{(400\times10^{-3}\times47\times10^{-6})}} \checkmark$$

$$= 36{,}71\ Hz \checkmark$$ (3)

4.6 XL is directly proportional to frequency. ✓ At frequencies, higher than resonant frequency (fr), the inductive reactance of the circuit will increase ✓ making the circuit more inductive. ✓ (3)

[26]

QUESTION 5: SEMICONDUCTOR DEVICES

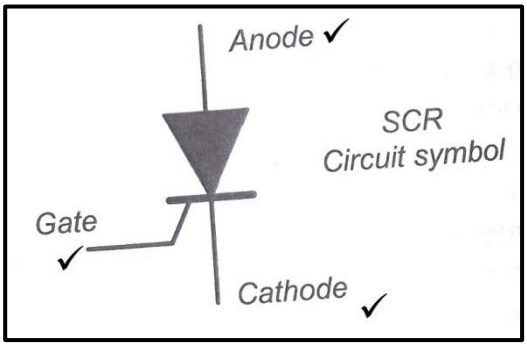
5.1 Semiconductor is a material of which the conductivity lies ✓ between that of a conductor and an insulator. ✓ (2)

5.2 Boron, ✓ gallium or indium ✓ (2)

5.3 5.3.1 The emitter base junction needs to be forward biased ✓✓ (2)

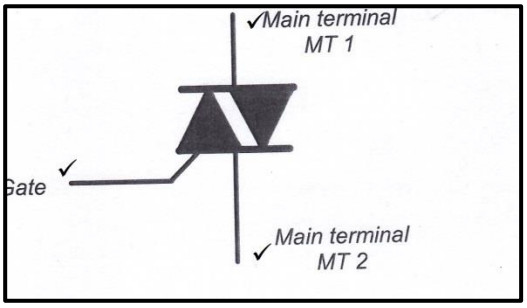
5.3.2 The collector base junction should be reverse biased ✓✓ (2)

5.4 5.4.1



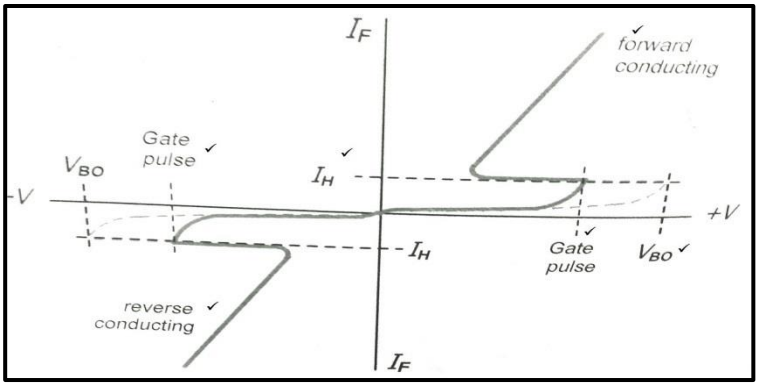
SCR (3)

5.4.2



TRIAC (3)

5.4.3



(6)

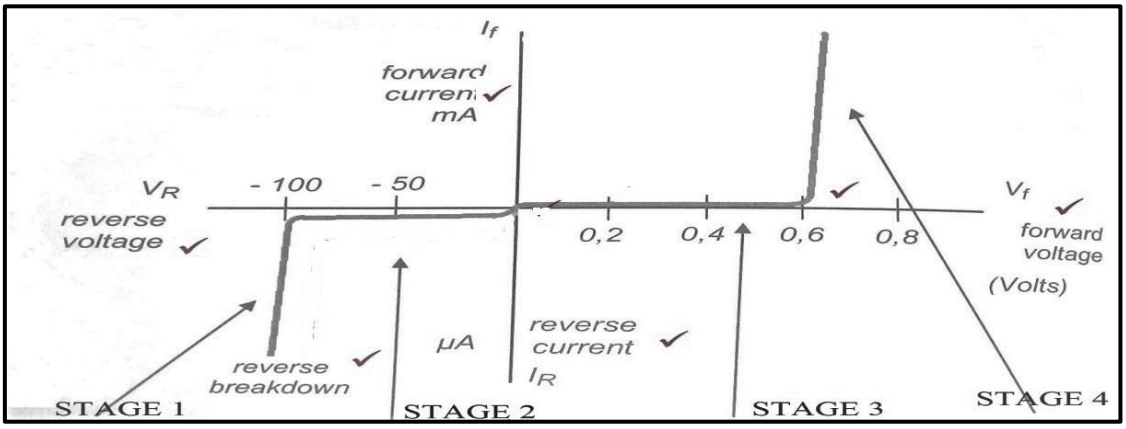
5.5 By reducing the SCR current bellow the holding current level the device will immediately reset and switch off. ✓**OR** remove the SCR from the supply. ✓

While conducting the SCR it also maintains a small voltage (V_{AK}) across the anode and cathode. If the SCR terminal voltage is pulled lower than V_{AK} or even down to zero it will pull the current below the holding current and the SCR will reset and switch off. ✓✓ (4)

5.6 1 – Break down voltage ✓
2 – V_{BO} ✓
3 – conducting voltage ✓
4 – latching current ✓
5 – holding current ✓ (5)

5.7 Full power can never be delivered to any load via a single SCR, ✓ The SCR can only conduct during the positive half cycle of the supply. During negative half cycle the SCR cannot conduct. ✓ when coupled to a mains circuit, the SCR is switching on and off 50 times a second ✓which generate large amounts of electric noise and interference into the circuit. ✓ (4)

5.8



In STATE 1 a voltage of less than 0,6 V is connected across it's ends. The diode does not conduct as its internal depletion region is still large enough to block any significant flow. ✓

STAGE 2 in this stage the diode needs some protection to limit the current flowing through it as it could easily overheat and burn out. ✓

STAGE 3 it is its reverse biased state, the very small reverse current which does flow is called reverse leakage. ✓

STAGE4 the reverse voltage rises so high that the PN junction cannot continue blocking current flow. The voltage level where this happens is called the reverse breakdown ✓ (10)

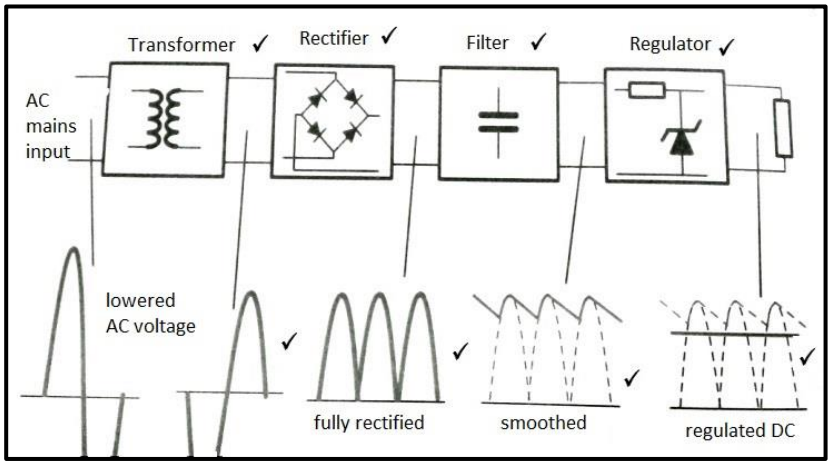
5.9 A DIAC is commonly used to trigger a TRIAC as it breaks down at precise voltage so giving the TRIAC a precise triggering voltage in both half cycles. ✓✓ (2)

5.10 Q point is the point of interstation between the diode characteristic and the circuit load line ✓ (1)
[46]

QUESTION 6: POWER SUPPLIES

6.1 It allows the source voltage to be stepped up or down as needed. Used to couple the AC input voltage from the source to the rest of the power supply circuit. ✓✓ (2)

6.2



(8)

6.3 6.3.1 $Epk = \frac{Erms}{0.707}$ ✓

$= \frac{17,1v}{0.707}$ ✓

$= 24,19\ V$ ✓ (3)

6.3.2 $Vpk = Epk - VD$ ✓

$= 24,19 - 0.6$ ✓

$= 23,59\ V$ ✓ (3)

6.3.3 $Vave = Vdc$ ✓ $= 0.636 \times Vpk$ ✓

$= 0,636 \times 23,59$ ✓

$= 15\ Volts$ ✓ (4)

[20]

QUESTION 7: AMPLIFERS

7.1 An amplifier is an electronic device that increases the power ✓ of a smaller input signal ✓ (2)

7.2 Used for audio amplifier ✓ (1)

7.3 Class C amplifiers are biased so that their transistors will only conduct for less than one-half of a cycle of the input signal. ✓✓ (2)

7.4
- Common emitter ✓
- Common base ✓
- Common collector ✓ (3)

7.5
- Fixed base biasing ✓
- Emitter feedback ✓
- Voltage divider (Any TWO) (2)

7.6 7.6.1 High current gain ✓ No voltage gain (1)

7.6.2 No current gain ✓ high voltage gain (1)

7.6.3 Medium voltage gain ✓ medium current gain high power gain (1)

7.7 7.7.1 $I_B = \frac{Vcc - V_{BE}}{R_B}$ ✓

$= \frac{10V - 0,6V}{235\,000}$ ✓

$= 40\ \mu A$ ✓ (3)

7.7.2 $I_B = \beta I_B$ ✓

$= 250 \times 40\ \mu$ ✓

$= 10\ mA$ ✓ (3)

7.7.3 $V_{CE} = V_{CC} - I_C R_C$ ✓

$= 10\ V - (10\ m \times 500)$ ✓

$= 5\ V$ ✓ (3)

7.7.4

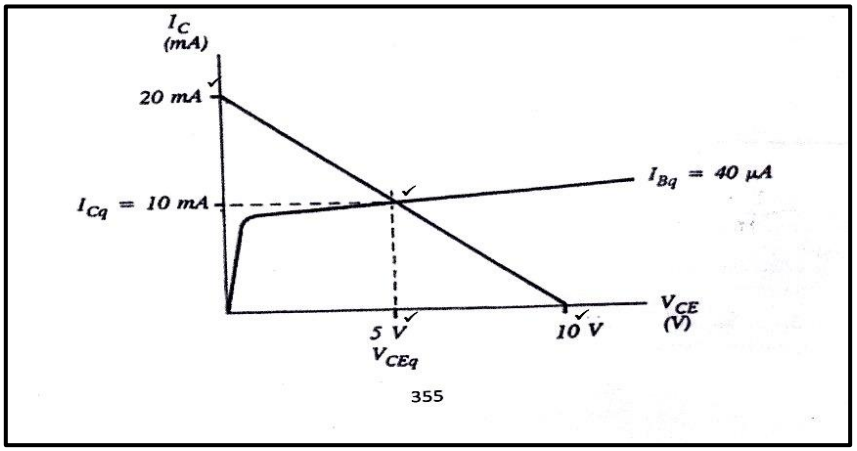
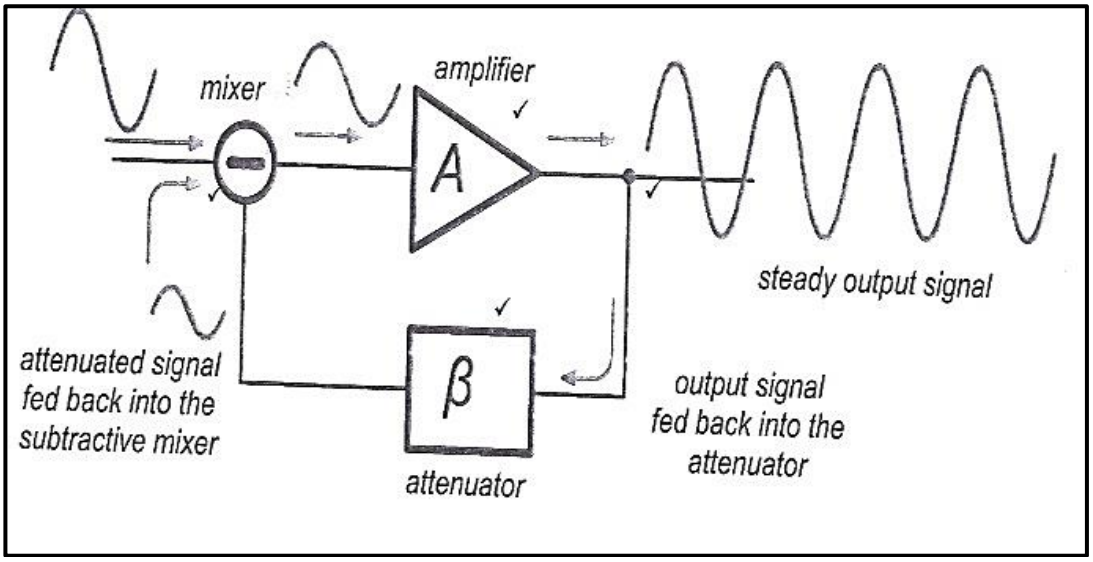


FIGURE 7.1 (4)

7.8
- Improved stability against changes in temperature ✓
- More reliable and constant voltage again ✓
- Decreased distortion of the output signal (Any TWO) (2)

7.9



(4)
[32]

QUESTION 8: SENSORS AND TRANSDUCERS

8.1 8.1.1 Is a device that detects or sense and reacts to and measures physical quantities. ✓✓ (2)

8.1.2 Is a device which detects an object without having any physical contact with the object ✓Once detected the sensor converts this information into an electrical signal ✓ (2)

8.2 The piezo-electric effect. ✓ Which is the generation of an electric charge by a quartz crystal across its opposite faces when it is subjected to mechanical stress. ✓✓ (3)

8.3 Temperature sensors range from simple on/ off devices which control a domestic hot water heating system to highly sensitive semiconductor types that can control extremely complex industrial devices. ✓It measures the amount of heat energy that is generated by a system, sensing any change to that temperature and producing a change in its output which can be monitored by an electronic system ✓ (2)

8.4
- Capacitive humidity sensor ✓
- Resistive humidity sensor ✓
- Thermal conductivity sensor ✓ (3)

[12]

QUESTION 9: COMMUNICATION SYSTEM

9.1 Modulation refers to the changing of a high frequency signal ✓ so that it is able to carry information. ✓ (2)

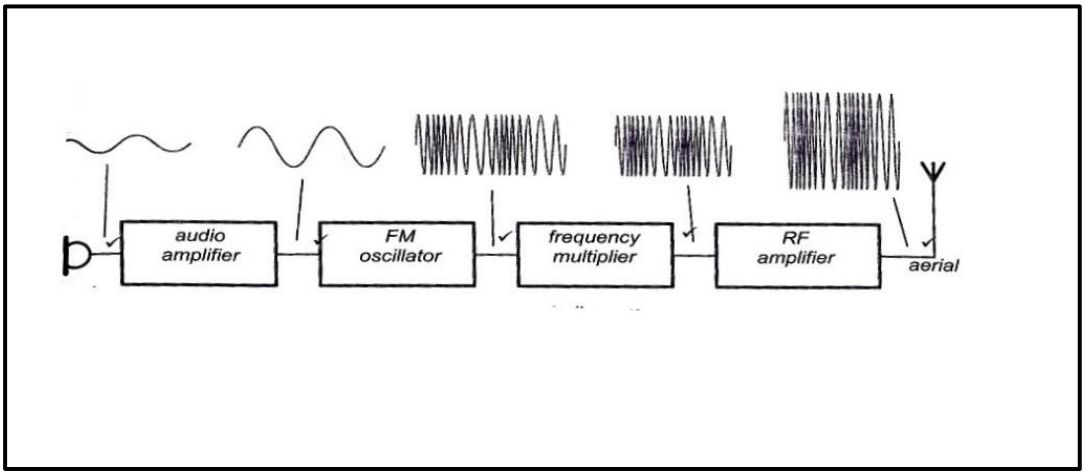
9.2
- RC oscillator ✓
- Colpitts oscillator ✓
- Hartley oscillator ✓ (2)

9.3 The main role of a voltage controlled oscillator is to generate an output frequency that is directly proportional to the input voltage ✓✓ (3)

9.4 When a small part of the audio output is fed back to the oscillator to ensure that its frequency remains stable and does not vary under conditions like temperature changes. ✓✓ (2)

9.5 Frequency modulation ✓
Amplitude modulation ✓ (2)

9.6



(5)

9.7 Single Sideband Suppressed Carrier Modulation ✓ (1)

9.8 9.8.1 RF amplifier: amplifies the received signal ✓ intercepted by the aerial. ✓ (2)

9.8.2 Oscillator: generates a fixed frequency signal ✓ that is fed to the mixer ✓ (2)

9.8.3 Mixer: receives both signals from the RF amplifier ✓ and from the oscillator ✓ (2)

9.8.4 FM demodulator: recovers the original audio signal from the changing frequency signal. ✓It generates a changing amplitude signal ✓ and discards the unwanted radio frequency carrier. ✓ (3)

[26]

TOTAL: 200