Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2022

ELECTRICAL TECHNOLOGY: ELECTRONICS MARKING GUIDELINE (EXEMPLAR)

MARKS: 200

This marking guideline consists of 14 pages.

INSTRUCTIONS TO MARKERS

1. All calculations 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 learners 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: MULTIPLE-CHOICE QUESTIONS

1.1	1.1	B ✓	(1)
	1.2	A ✓	(1)
	1.3	C ✓	(1)
	1.4	C ✓	(1)
	1.5	D ✓	(1)
	1.6	B ✓	(1)
	1.7	B ✓	(1)
	1.8	A ✓	(1)
	1.9	C ✓	(1)
	1.10	B ✓	(1)
	1.11	B ✓	(1)
	1.12	D ✓	(1)
	1.13	A ✓	(1)
	1.14	A ✓	(1)
	1.15	C ✓	(1)
			[15]

QUESTION 2: OCCUPATIONAL HEALTH AND SAFETY

2.1 2.1.1
- Seating position ✓
- Standing position
- Regular movement
- Organisation of work (Any 1 x 1) (1)

2.1.2
- Temperature ✓
- Lighting
- Reflection and glare
- Humidity
- Noise
- Space (Any 1 x 1) (1)

2.2 Inadequate lighting leads to decreased visibility and movement ✓ which could lead to injury to yourself or others. ✓ (2)

2.3 It protects the worker ✓ from unnecessary or avoidable hazards. ✓ (2)

2.4 They are warning signs ✓ that make people aware of potential hazards in an area. ✓ (2)

2.5 Regulations are necessary to control the conditions under which work is done ✓ in order to protect everyone in the workplace. ✓ (2)

[10]

QUESTION 3: TOOLS AND MEASURING INSTRUMENTS

3.1 Clean regularly to remove any build-up of dust or dirt. ✓
Check that connecting leads are in good working order. ✓
Store safely in a dry place when not in use. ✓ (3)

3.2 3.2.1 $V_{max} = \frac{V}{div} \times$ no. of divisions ✓
$= 5 \times 3$ ✓
$= 15\ V$ ✓ (3)

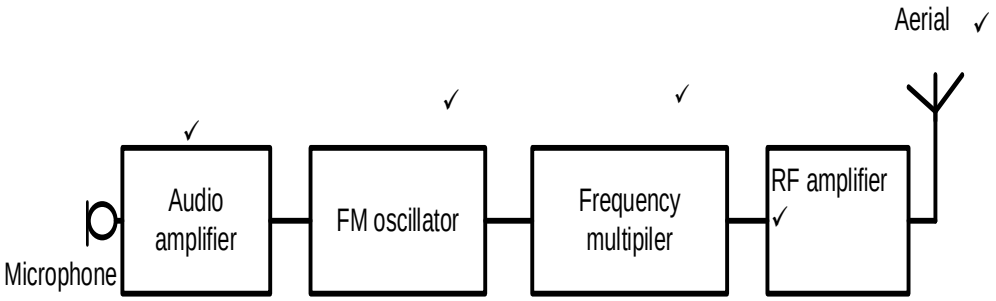
3.2.2 $T = \frac{T}{div} \times$ no. of divisions
$= 2 \times 10^{-3} \times 5$ ✓
$= 10 \times 10^{-3} s = 10\ ms$ ✓
$f = \frac{1}{T}$
$= \frac{1}{10 \times 10^{-3}}$ ✓
$= 100\ Hz$ ✓ (4)
[10]

QUESTION 4: COMMUNICATION SYSTEMS

4.1 Modulation in radio transmission is to change a high frequency signal in a way that it is able to carry information. ✓✓ (2)

4.2
- Frequency modulation ✓
- Amplitude modulation (1)

4.3



(5)

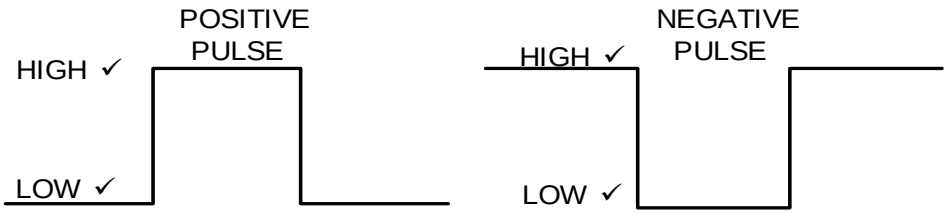
4.4 4.4.1 Modulator adds useful information to the carrier wave. ✓ (1)

4.4.2 Antenna ✓ (1)
[10]

QUESTION 5: WAVEFORMS

5.1
- Magnetic field ✓
- Electric field ✓ (2)

5.2



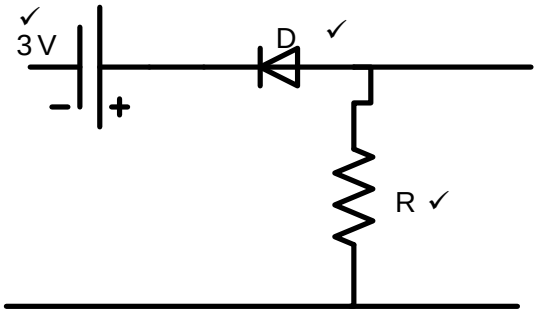
(4)

5.3 5.3.1 The time it takes for a pulse to change from a low state ✓ to a high state. ✓ It is measured between the 10% and 90% points of the completed pulse. ✓ (2)

5.3.2 The relationship between the high time ✓ and the low time ✓ of a pulse. (2)

5.3.3 The continuous train ✓ of regular square wave pulses. ✓ (2)

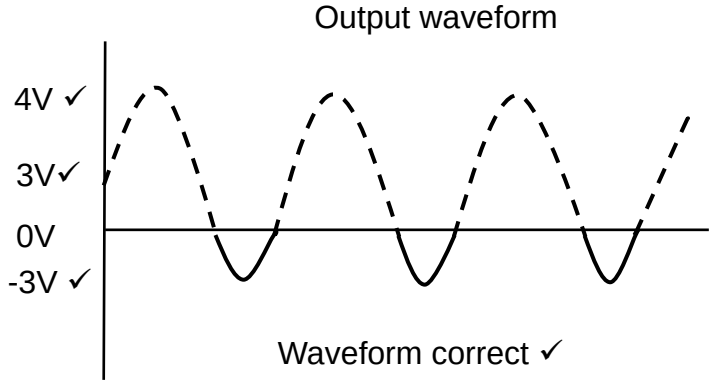
5.4 5.4.1



Circuit correct ✓

(4)

5.4.2



(4)

5.5 $Vpeak = \frac{V_{RMS}}{0,707}\ V$ ✓

$= \frac{12,8}{0,707}$ ✓

$= 18,1\ V$ ✓ (3)

5.6 $T = \frac{1}{f}\ sec$ ✓

$= \frac{1}{2\,750}$ ✓

$= 0,36\ msec$ ✓ (3)

5.7 $Form\ factor = \frac{RMS}{AVE}$ ✓

$= \frac{12,8 \times 0,707}{12,8 \times 0,636}$ ✓✓

$= 1,11$ ✓ (4)

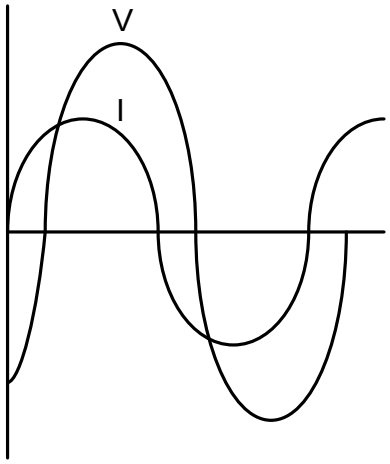
[30]

QUESTION 6: RLC CIRCUITS

6.1 The current leads the voltage. ✓ (1)

6.2 The inductive reactance will increase. ✓ (1)

6.3



Shape of voltage waveform larger than current waveform ✓
Phase difference showing current leading voltage ✓ (2)

6.4 It is the ratio ✓ of the real power to the apparent power in a circuit. ✓ (2)

6.5 The increase in frequency will cause a decrease in the capacitive reactance. ✓ This will cause a decrease in the impedance of the RC circuit, ✓ which will cause the current to increase. ✓ (3)

6.6 $\cos\theta = \frac{P}{S}$

$P = S\cos\theta$ ✓

$= 5 \times 0,75$ ✓

$= 3,75\ W$ ✓ (3)

6.7 6.7.1 $X_C = \frac{1}{2\pi fC}$ ✓

$= \frac{1}{2 \times \pi \times 100 \times 75 \times 10^{-6}}$ ✓

$= 21{,}22\ \Omega$ ✓ (3)

6.7.2 $Z = \sqrt{R^2 + (X_L - X_C)^2}$ ✓

$= \sqrt{22^2 + (31{,}43 - 21{,}22)^2}$ ✓

$= 24{,}25\ \Omega$ ✓ (3)

6.7.3 $I = \frac{V}{Z}$ ✓

$= \frac{110}{24{,}25}$ ✓

$= 4{,}54\ A$ ✓ (3)

6.7.4 $S = VI$ ✓

$= 110 \times 4{,}54$ ✓

$= 498{,}97\ VA$ ✓ (3)

6.7.5 $X_L = 2\pi fL$

$L = \frac{X_L}{2\pi f}$ ✓

$= \frac{31{,}43}{2 \times \pi \times 100}$ ✓

$= 0{,}05\ H = 50\ mH$ ✓ (3)

6.7.6 $\cos\theta = \frac{p}{s}$ ✓

$= \frac{400}{498{,}97}$ ✓

$= 0{,}8$ ✓ (3)

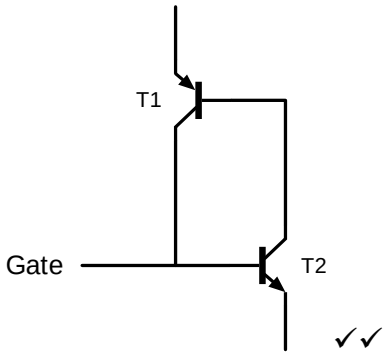
[30]

QUESTION 7: SEMICONDUCTOR DEVICES

7.1 When P-type and N-type materials are joined, holes of the P-type and electrons of the N-type combine to form covalent bonds. ✓ The electrons diffuse and occupy the holes in the P-type material. A small region of the N-type near the junction loses electrons and behaves like intrinsic semiconductor material. ✓ In the P-type, a small region get filled up by holes and behaves like an intrinsic semiconductor material. ✓ This thin intrinsic region is called the depletion region, since it is depleted of charge and offers high resistance. ✓ (4)

7.2 In simple voltage regulators. ✓ (1)

7.3 '+' on anode, '-' on cathode ✓



✓✓

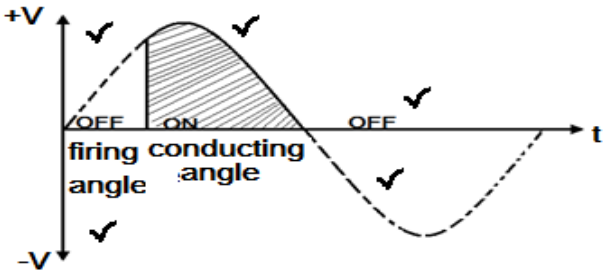
'+' pulse on the gate switches TR2 on causing collector of TR2 to become more negative. ✓
This switches TR1 on, its collector going positive which keeps TR2 on even though the '+' pulse on gate has been removed.✓
Current will continue to flow until either the supply is removed between the anode and cathode, or the current falls below the holding current. ✓ (6)

7.4 The Q-point on the load line is the point at which DC bias is provided to the transistor ✓ to ensure that it operates, ✓ depending upon the class of the transistor amplifier. ✓ (3)

7.5 Diode must be removed from the circuit before testing. ✓
Diode should be tested in both directions and it should only give a reading in one direction and it is acceptable. ✓ (2)

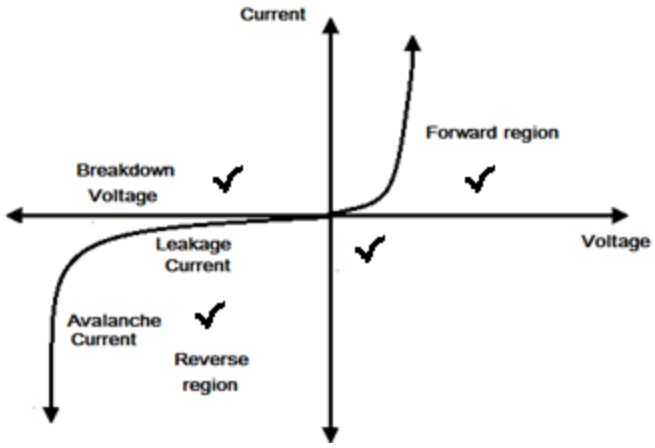
7.6
- Cut-off ✓
- Active ✓
- Saturation ✓ (3)

7.7


+V
OFF
ON
OFF
t
firing angle
conducting angle
-V

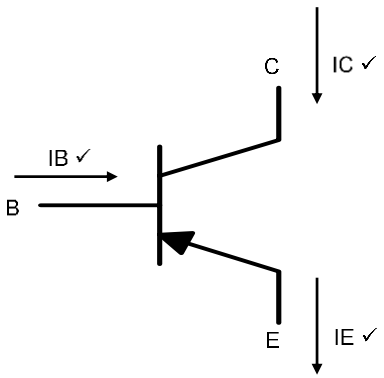
(5)

7.8


Current
Forward region
Breakdown Voltage
Voltage
Leakage Current
Avalanche Current
Reverse region

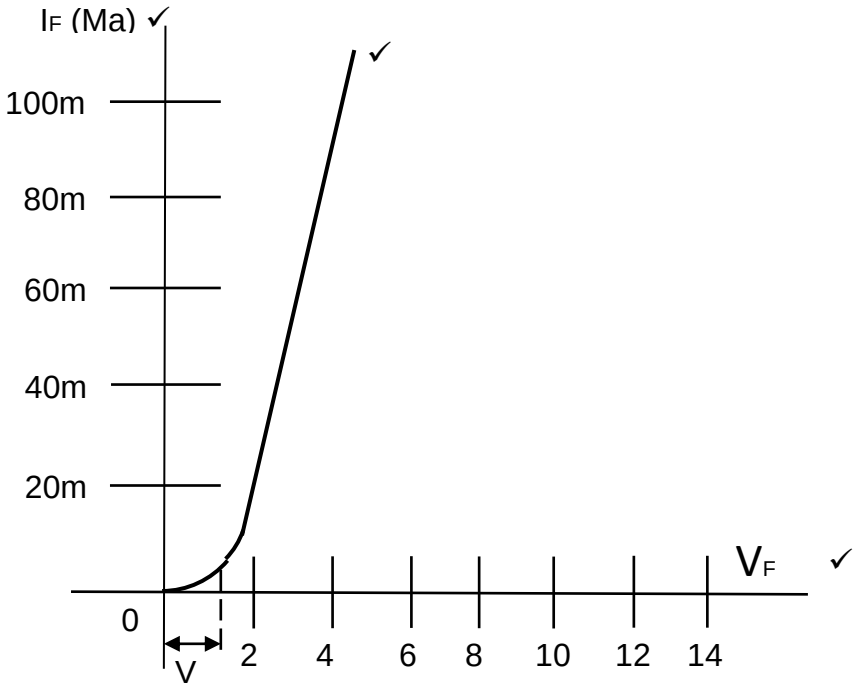
(4)

7.9


C
IC ✓
IB ✓
B
E
IE ✓

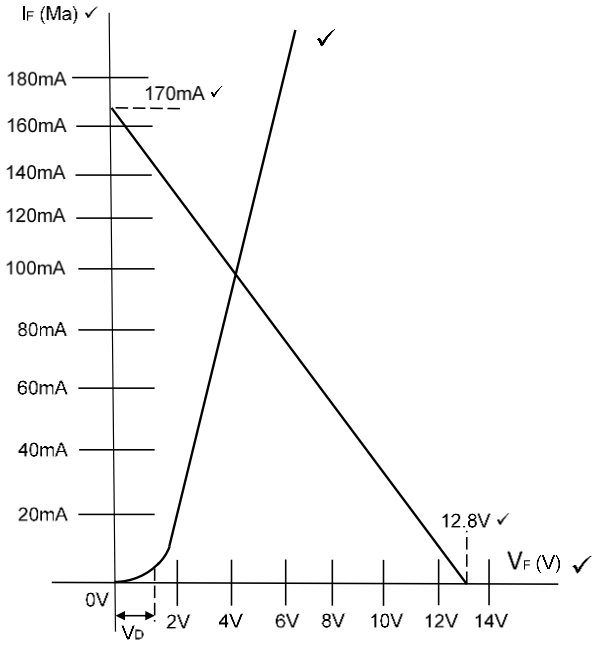
(3)

7.10.1



(3)

7.10.2



(5)
[40]

QUESTION 8: SENSORS AND TRANSDUCERS

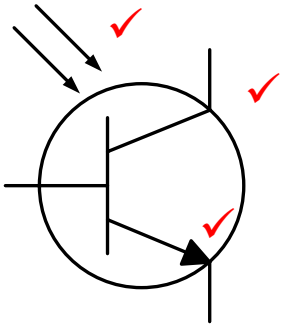
8.1 The ability of certain crystal materials to generate an electric charge ✓ across the opposite faces when the material is subjected to mechanical stress. ✓ (2)

8.2 A sensor is a device that detect or senses ✓ and reacts to and measure physical quantities ✓ while a transducers changes energy ✓ from one form to another. ✓ (4)

8.3 The brighter the light on the surface, the lower the resistance. ✓ The darker the light on the surface, the higher the resistance. ✓ (2)

8.4 This device interconnects two electrical circuits ✓ transferring electrical signals via light. ✓ (2)

8.5



(3)

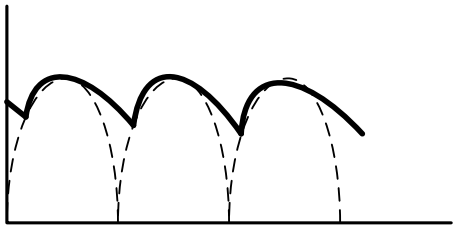
8.6 Negative Temperature Coefficient will have a decrease in electrical resistance, ✓ as the temperature of the device increases. ✓ (2)

[15]

QUESTION 9: POWER SUPPLIES

9.1 9.1.1 A – AC mains input voltage ✓
B – rectifier ✓
C – regulator ✓ (3)

9.1.2



1 mark for dashed line showing pulsating waveform ✓
1 mark for ripple waveform ✓ (2)

9.1.3 The Zener diode holds the output voltage ✓ at a fixed value. ✓ (2)

9.2 Forward biasing occurs when a supply with a voltage larger than the junction voltage ✓ is connected to the diode with the positive lead to the P-region (anode) and the negative lead to the N-region (cathode). ✓ This allows the diode to conduct electricity freely. ✓ (3)

9.3
- Using a centre tap transformer and two diodes ✓
- Using four diodes as a bridge rectifier ✓ (2)

9.4 $\gamma = \frac{1}{2\sqrt{3}CfR_L}$

$R_L = \frac{1}{2\sqrt{3}Cf\gamma}$ ✓

$= \frac{1}{2\times\sqrt{3}\times100\times10^{-6}\times50\times1,15}$ ✓

$= 50,2\ \Omega$ ✓ (3)

[15]

QUESTION 10: AMPLIFIERS

10.1 An amplifier is an electronic device or circuit that increases the voltage, current or power of a signal. ✓ (1)

10.2 Class AB commonly used as a push pull amplifier in audio system. ✓ (1)

10.3 $Vrc = Ic \times Rc$ ✓
$= 8 \times 10^{-3} \times 1000$ ✓
$Vrc = 8\,V$ ✓

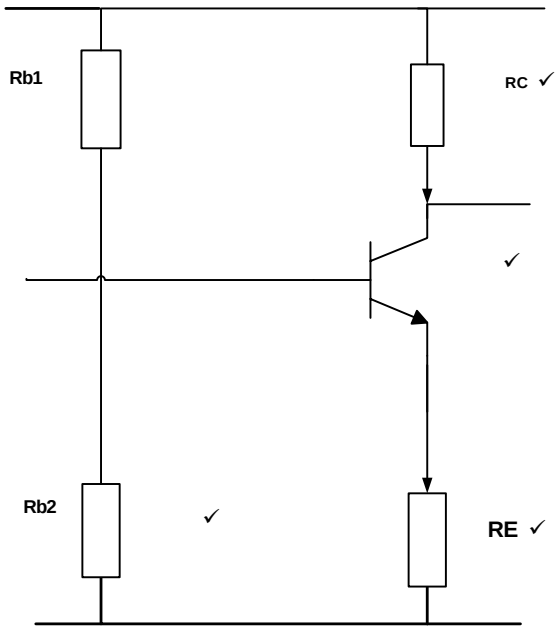
$V\,ce = Vcc - Vrc$ ✓
$= 16 - 8$ ✓
$= 8\,V$ ✓

If Ic = 8 mA, V_{out} = 8 V
$Vrc = Ic \times Rc$ ✓
$= 12 \times 10^{-3} \times 1000$ ✓
$= 12\,V$ ✓

$Vce = Vcc - Vrc$ ✓
$= 16 - 12$ ✓
$= 4\,V$ ✓

If Ic = 12 mA, V_{out} = 4 V (12)

10.4



(4)

10.5
- Common base ✓
- Common emitter ✓
- Common collector ✓ (3)

10.6 10.6.1 $IB = \frac{Vcc-VBE}{RB}$ ✓

$= \frac{10 - 0,6}{235\ 000}$ ✓

$IB = 40\ \mu A$ ✓ (3)

10.6.2 $Ic = \beta Ib$ ✓

$= 250 \times 40 \times 10^{-6}$ ✓

$= 10\ m\ A$ ✓ (3)

10.6.3 $VCE = Vcc - IcRc$ ✓

$= 10 - (10\ mA \times 500)$ ✓

$= 5$ V ✓ (3)

[30]

TOTAL: 200