



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE INDUSTRIAL ELECTRONICS N3

28 MARCH 2018

This marking guideline consists of 8 pages.

SECTION A**QUESTION 1**

1.1	1.1.1	True	(10 × 1)	(10)
	1.1.2	False		
	1.1.3	False		
	1.1.4	False		
	1.1.5	False		
	1.1.6	False		
	1.1.7	True		
	1.1.8	False		
	1.1.9	True		
	1.1.10	True		
1.2	1.2.1	low	(10 × 1)	(10)
	1.2.2	reducing		
	1.2.3	reverse		
	1.2.4	maximum		
	1.2.5	voltage		
	1.2.6	inversely		
	1.2.7	zero		
	1.2.8	Line		
	1.2.9	unmonitored		
	1.2.10	Kirchoff's		
				[20]
TOTAL SECTION A:				20

SECTION B**QUESTION 2**

Minimise the currents in the circuit: $I_3 = (I_1 - I_2)$

Loop ABEFA

$$12 = 6 I_1 + 8(I_1 - I_2) + 2I_1$$

$$12 = 16 I_1 - 8 I_2 \dots\dots\dots (1) \quad \checkmark \quad \checkmark$$

Loop BCDEB**(Any other loops can be used)**

$$0 = 4 I_2 + 3 I_2 + 5 I_2 - 8(I_1 - I_2)$$

$$0 = -8 I_1 + 20 I_2 \dots\dots\dots (2) \quad \checkmark \quad \checkmark$$

$$(2) \times 2: 0 = -16 I_1 + 40 I_2 \dots\dots\dots (3) \quad \checkmark$$

$$12 = 16 I_1 - 8 I_2 \dots\dots\dots (1) \quad \checkmark$$

$$(3) + (1): 12 = 32 I_2$$

$$\frac{12}{32} = I_2$$

$$\xrightarrow{\quad} I_2 = 0,375 \text{ A} \quad \checkmark$$

For I_1 , substitute $I_2 = 0,375 \text{ A}$ into..... (1)

$$12 = 16 I_1 - 8(0,375)$$

$$\xrightarrow{\quad} I_1 = 0,938 \text{ A} \quad \checkmark$$

Current $I_3 = (I_1 - I_2)$

Therefore $I_3 = (0,938 - 0,375)$

$$\xrightarrow{\quad} I_3 = 0,563 \text{ A} \quad \checkmark \quad \checkmark$$

[10]

QUESTION 3

3.1 3.1.1

$$I_T = \sqrt{I_R^2 + (I_C - I_L)^2}$$

$$= \sqrt{5^2 + (3,5 - 2,8)^2} \quad \checkmark \quad \checkmark$$

$$I_T = 5,049 \text{ A} \rightarrow \checkmark \quad (3)$$

3.1.2

$$\tan \theta = \frac{I_X}{I_R}$$

$$\theta = \tan^{-1} \frac{0,7}{5} \quad \checkmark$$

$$\theta = 7,97^\circ \rightarrow \checkmark$$

(Or any other applicable way)

(2)

3.1.3

$$X_C = \frac{V_T}{I_C}$$

$$= \frac{120}{3,5} \quad \checkmark$$

$$X_C = 34,286 \Omega \rightarrow \checkmark$$

And therefore:

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

$$C = \frac{1}{2 \times 3,142 \times 50 \times 34,286} \quad \checkmark$$

$$C = 92,828 \mu\text{F} \rightarrow \checkmark$$

(4)

3.1.4

$$X_L = \frac{V_T}{I_L}$$

$$= \frac{120}{2,8} \quad \checkmark$$

$$X_L = 42,856 \Omega \rightarrow \checkmark$$

And therefore:

$$X_L = 2\pi f L$$

$$L = \frac{42,856}{2 \times 3,142 \times 50} \quad \checkmark$$

$$L = 136,397 \text{ mH} \rightarrow \checkmark$$

(4)

3.1.5

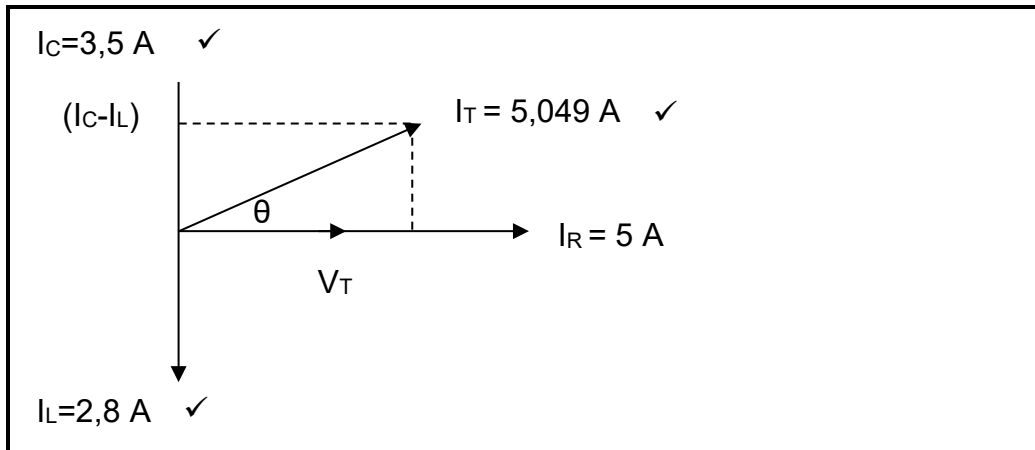
$$R = \frac{V_T}{I_R}$$

$$= \frac{120}{5} \quad \checkmark$$

$$R = 24 \Omega \rightarrow \checkmark$$

(2)

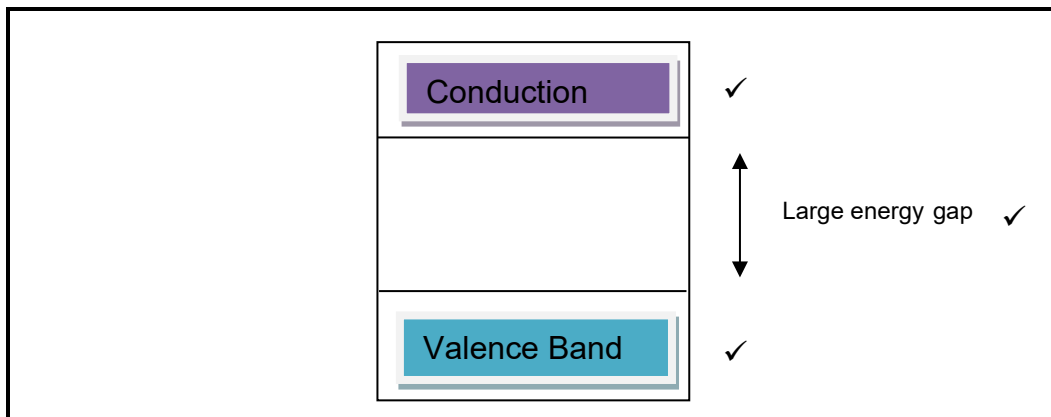
3.2

(3)
[18]**QUESTION 4**

- 4.1 As soon as a pentavalent atom (atom with 5 valence electrons) is added into silicon✓ or germanium (atom with 4 valence electrons), covalent bonding takes place between adjacent electrons but one electron is left✓ unbounded; as soon as this free electron is lost to other atoms a hole is created in the pure material.✓ These holes are able to attract electrons and are therefore referred to as acceptor doping.✓

(4)

4.2



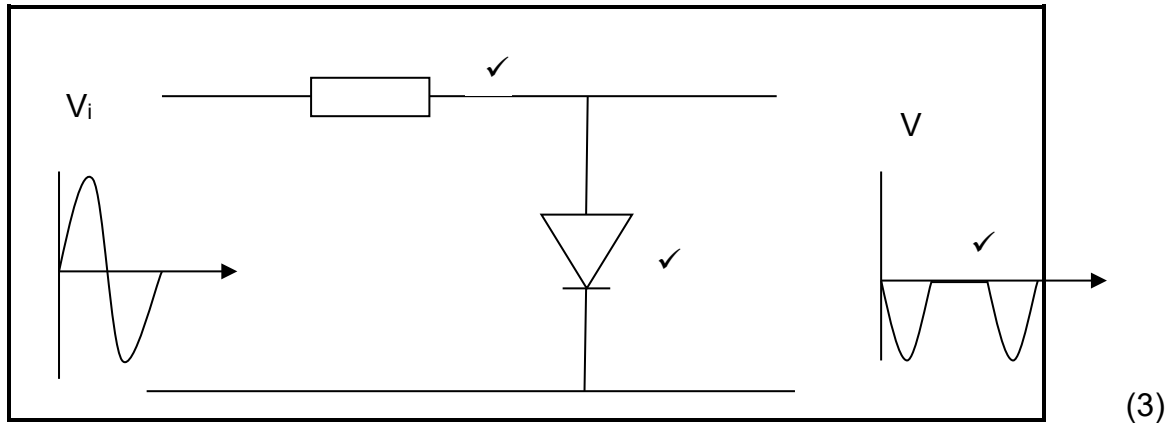
(3)

- 4.3 When the positive✓ signal is applied into the circuit the diode becomes reverse✓ biased. During this time there is no current flow through the diode and therefore the output voltage equals the input voltage.✓

(3)
[10]

QUESTION 5

5.1



(3)

5.2 Reverse bias

(1)

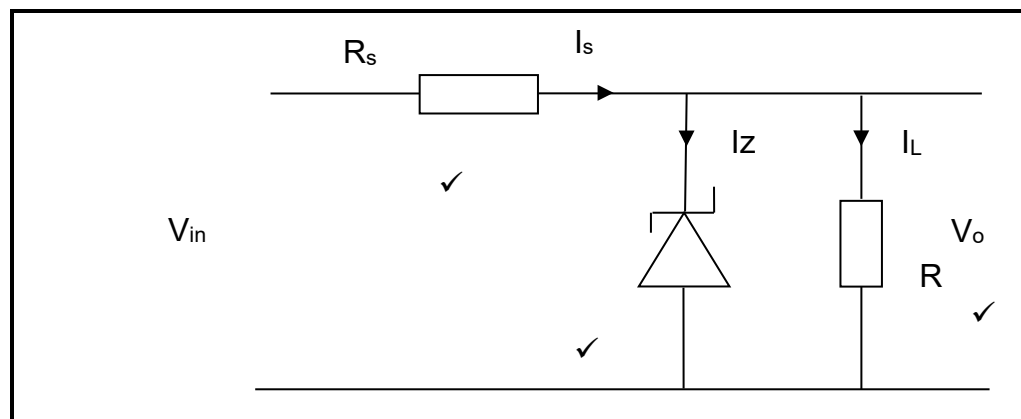
5.3 Zener diode

(1)

5.4 Reverse bias

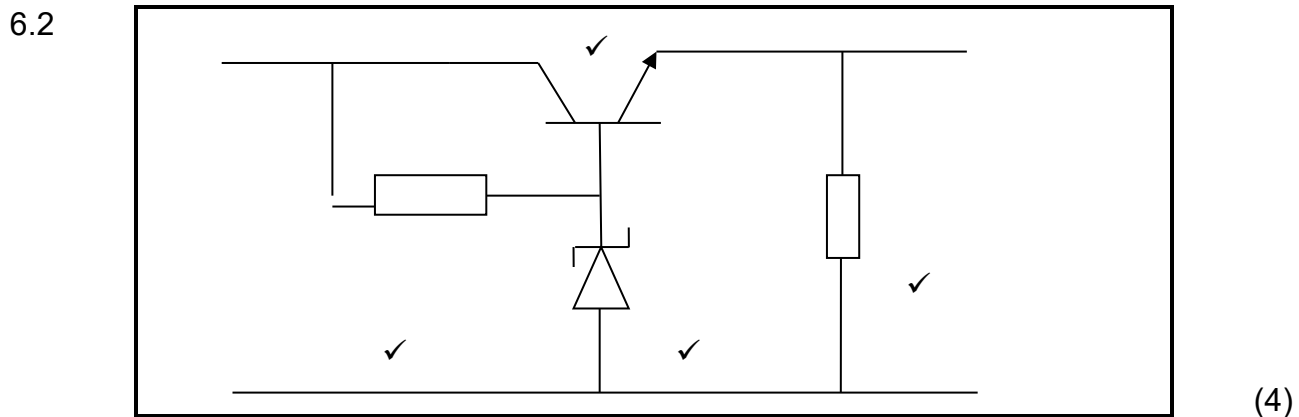
(1)

5.5

(3)
[9]

QUESTION 6

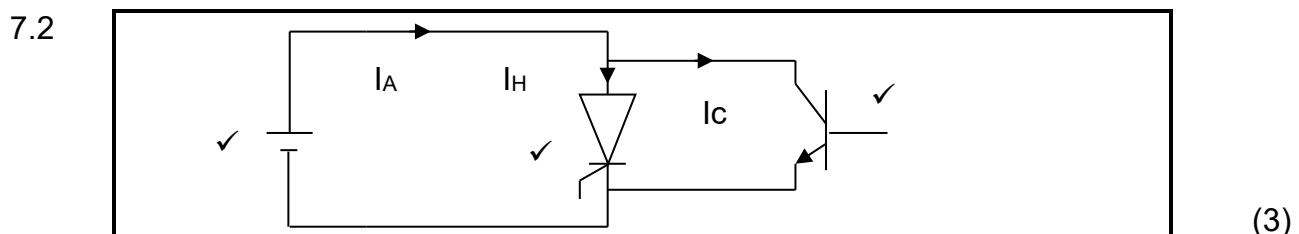
- 6.1
- Improves stability of the circuit.
 - Reduces its gain.
 - Increases its operating bandwidth.
 - Reduces distortion.
 - Reduces noise.
 - Increases the input impedance and reduces the output impedance.
- (Any 4 × 1) (4)



- 6.3 In the absence of the gate current, the anode to cathode voltage is increased to the extent that the breakover voltage of the SCR is reached. An avalanche breakdown occurs and the SCR switches on by a regenerative process.
- (3)
[11]

QUESTION 7

- 7.1 L-C filters reduce the effect of the transient by means of smoothing. The capacitor is used to smooth the voltage while the inductor is used to suppress the change in current.
- (3)



- 7.3
- 7.3.1 The output will be negative.
- 7.3.2 The output will be positive.
- 7.3.3 The output will be zero.
- (3 × 2) (6)
[12]

QUESTION 8

- 8.1 The capacitance will increase since both plates are immersed in the liquid.✓
The liquid acts as a dielectric material between the plates of the capacitor.✓ (2)
- 8.2 The capacitance of the capacitor will decrease since both plates are removed from the liquid material✓ which serves as a dielectric material.✓ (2)
[4]

QUESTION 9

- 9.1 $V_{(P-P)} = \text{number of vertical divisions} \times V/\text{div}$

$$V/\text{div} = \frac{V(p-p)}{\text{number of divisions}} \quad \checkmark$$

$$V/\text{div} = \frac{1,6}{8}$$

$$V/\text{div} = 0,2 \text{ V} \quad \checkmark$$

- 9.2 $T = \text{number of horizontal divisions} \times t/\text{div}$

$$t/\text{div} = \frac{T}{\text{number of divisions}} \quad \checkmark$$

$$t/\text{div} = \frac{60 \times 10^{-6}}{6 \text{ divisions}}$$

$$t/\text{div} = 10 \mu\text{s} \quad \checkmark$$

- 9.3 $V_{\text{RMS}} = \frac{V(p-p)}{2} \times 0,707$

$$V_{\text{RMS}} = \frac{1,6}{2} \times 0,707 \quad \checkmark$$

$$V_{\text{RMS}} = 0,566 \text{ V} \quad \checkmark$$

(3 × 2) [6]
[80]

TOTAL SECTION B: 80
GRAND TOTAL: 100