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
	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

(10 × 1) (10)

1.2	1.2.1	low
	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

(10 × 1) (10)
[20]

TOTAL SECTION A: 20

SECTION B

QUESTION 2

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

Loop ABEFA

$12 = 6\,I_1 + 8(I_1 - I_2) + 2I_1$
$12 = 16\,I_1 - 8\,I_2$ .... 1 ✓ ✓

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

$0 = 4\,I_2 + 3\,I_2 + 5\,I_2 - 8(I_1 - I_2)$
$0 = -8\,I_1 + 20\,I_2$.............................. 2 ✓ ✓

2 × 2: $0 = -16\,I_1 + 40\,I_2$ .... 3 ✓
$12 = 16\,I_1 - 8\,I_2$................. 1 ✓

3 + 1 : $12 = 32\,I_2$

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

$\rightarrow I_2 = 0{,}375$ A ✓

For I_1, substitute I_2= 0,375 A into..... 1

$1_2 = 16\,I_1 - 8(0{,}375)$

$\rightarrow I_1 = 0{,}938$ A ✓

Current $I_3 = (I_1 - I_2)$
Therefore $I_3 = (0{,}938 - 0{,}375)$
$I_3 = 0{,}563$ A $\rightarrow$ ✓ ✓

[10]

QUESTION 3

3.1 3.1.1

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

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

$I_T = 5{,}049$ A ✓ (3)

3.1.2 $\tan\theta = \frac{I_X}{I_R}$

$\theta = \tan^{-1}\frac{0{,}7}{5}$ ✓

(Or any other applicable way)

$\theta = 7{,}97^\circ$ ✓ (2)

3.1.3 $X_C = \frac{V_T}{I_C}$

$= \frac{120}{3{,}5}$ ✓

$X_C = 34{,}286\ \Omega$ ✓

And therefore:

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

$C = \frac{1}{2\times3{,}142\times50\times34{,}286}$ ✓

$C = 92{,}828\ \mu F$ ✓ (4)

3.1.4 $X_L = \frac{V_T}{I_L}$

$= \frac{120}{2{,}8}$ ✓

$X_L = 42{,}856\ \Omega$ ✓

And therefore:

$X_L = 2\times\pi\times f\times L$

$L = \frac{42{,}856}{2\times3{,}142\times50}$ ✓

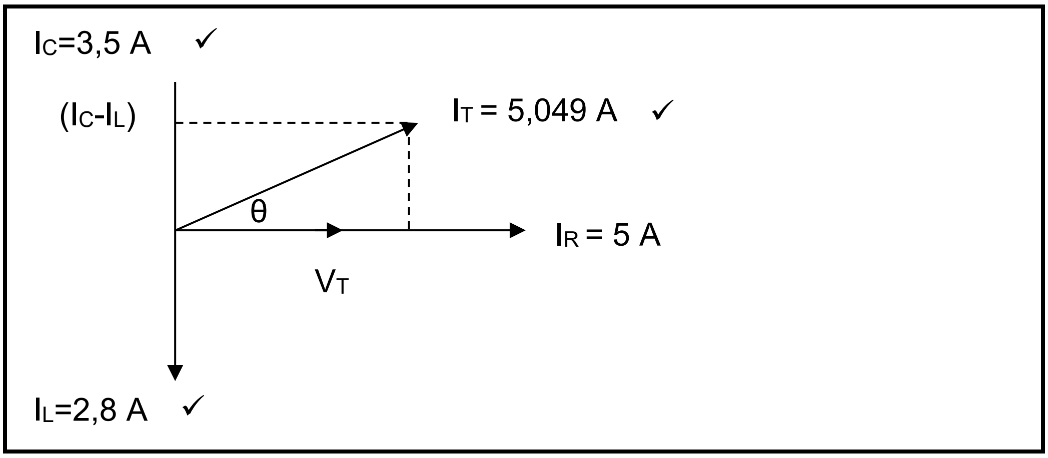
$L = 136{,}397$ mH ✓ (4)

3.1.5 $R = \frac{V_T}{I_R}$

$= \frac{120}{5}$ ✓

$R = 24\ \Omega$ ✓ (2)

3.2

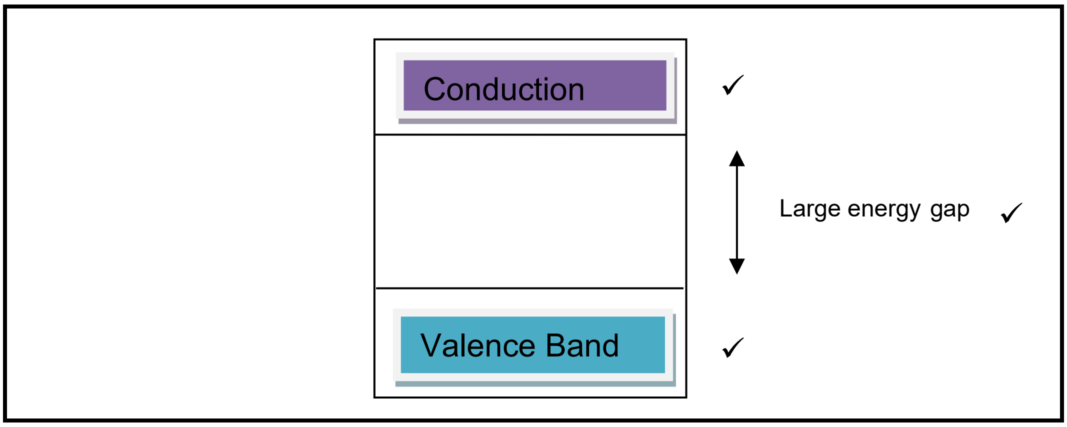


(3)
[18]

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

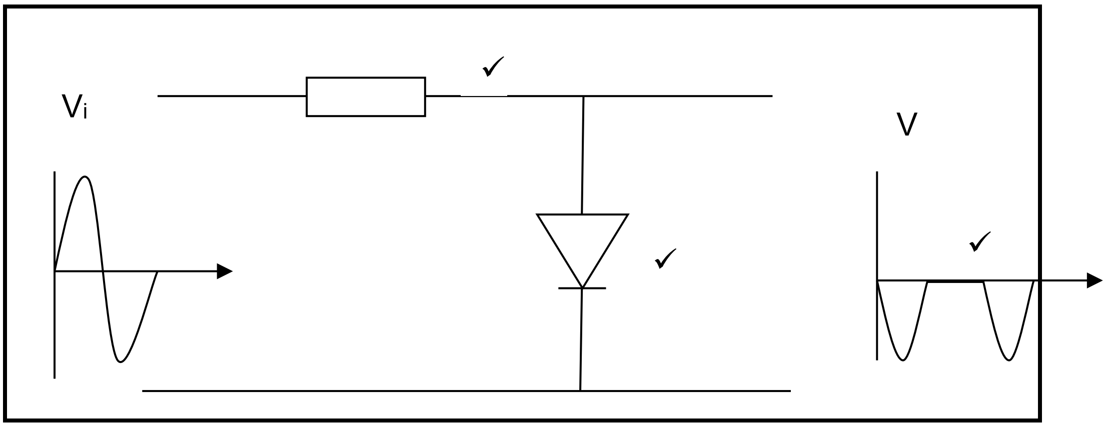


(3)

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



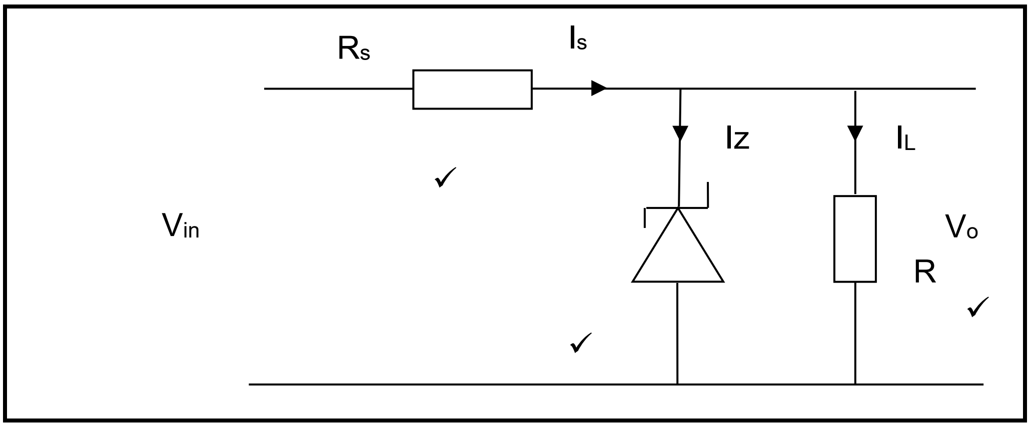
(3)

5.2 Reverse bias (1)

5.3 Zener diode (1)

5.4 Reverse bias (1)

5.5



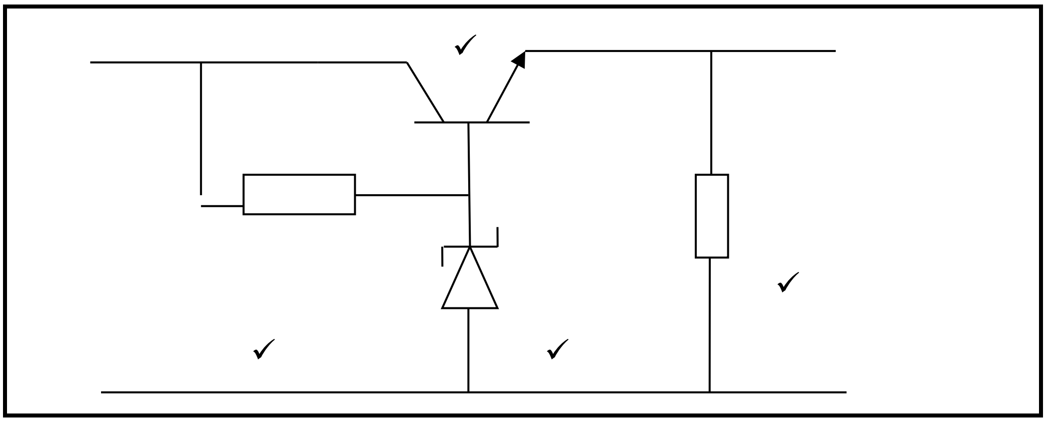
(3)
[9]

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)

6.2



(4)

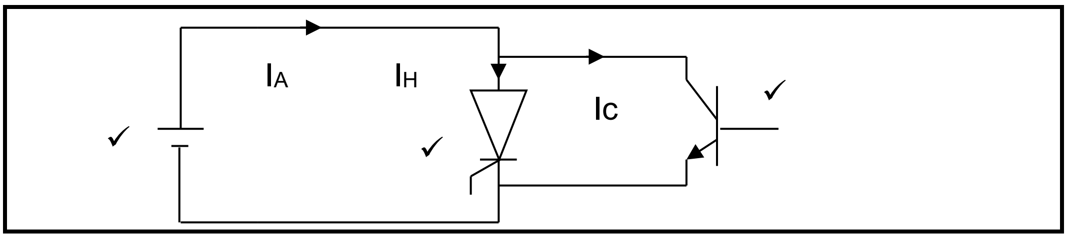
6.3 In the absence of the gate current, the anode to cathode voltage is increased to the extent that the breakover✓ voltage of the SCR is reached.✓ An avalanche breakdown occurs and the SCR switches on by a regenerative process.✓ (3)

[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)

7.2



(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 $V_{(P-P)}$ = number of vertical divisions × V/div

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

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

V/div = 0,2 V ✓

9.2 T = number of horizontal divisions × t/div

$t/div = \frac{T}{number\ of\ divisions}$ ✓

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

t/div = 10 µs ✓

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

$V_{RMS} = \frac{1,6}{2} \times 0,707$ ✓

$V_{RMS} = 0,566$ V ✓

(3 × 2) **[6]**

[80]

TOTAL SECTION B: 80
GRAND TOTAL: 100