higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N3

27 July 2021

This marking guideline consists of 10 pages.

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SECTION A

QUESTION 1

1.1 B
1.2 B
1.3 A
1.4 C
1.5 B

(5 × 1) **[5]**

QUESTION 2

2.1 True
2.2 False
2.3 False
2.4 True
2.5 False

(5 × 1) **[5]**

QUESTION 3

3.1 B
3.2 F
3.3 A
3.4 C
3.5 E

(5 × 1) **[5]**

QUESTION 4

4.1 P-Type
4.2 Common emitter
4.3 Three
4.4 Zero
4.5 Electrons

(5 × 1) **[5]**

TOTAL SECTION A: 20

SECTION B

QUESTION 5

5.1 $V = I_1.R_1 + I_2.R_4 + I_1.R_5$

$9 = 100I_1 + 33I_2 + 25I_1$ ✓

$9 = 125I_1 + 33I_2$ _____(1) ✓ (2)

5.2 $V = I_1.R_1 + (I_1 - I_2).(R_2 + R_3) + I_1.R_5$

$9 = 100I_1 + 206(I_1 - I_2) + 25I_1$ ✓

$9 = 331I_1 - 206I_2$ _____(2) ✓ (2)

5.3 $(1) \times 206 \Rightarrow 1854 = 25750I_1 + 6798I_2$ _(3) ✓

$(2) \times 33 \Rightarrow 297 = 10923I_1 - 6798I_2$ __(4) ✓

$(3) + (4)$

$1854 = 25750I_1 + 6798I_2$ _(3)

$297 = 10923I_1 - 6798I_2$ __(4)

$2151 = 36673I_1$ ✓

$I_1 = 0,587A$ ✓

I_1 = 0,05865 A or 58mA (correction)

Replace I_1 in (1)

$9 = 125(0,587) + 33I_2$

$9 = 125(0,587) + 33I_2$

$-64,375 = 33I_2$ ✓

$I_2 = -1,951A$ ✓

I_2 = 0,05056 A or 50mA (correction)

$(I_1 - I_2) = 0,587 - (-1,951)$✓

$(I_1 - I_2) = 2,538A$ ✓

$I_1 - I_2$ = 8mA (correction) (8)

[12]

QUESTION 6

6.1

$$X_L = 2\pi fL$$
$$X_L = 2\pi \times 60 \times 25 \checkmark$$
$$\underline{X_L = 9424,778\Omega} \checkmark$$

X_L = 9,426 ohms acceptable (use pi=3,142)

$$I = \frac{V}{X_L}$$
$$I = \frac{110}{9424,778} \checkmark$$
$$\underline{I = 11,671mA} \checkmark$$

(4)

6.2

$$X_C = \frac{1}{2\pi fC}$$
$$X_C = \frac{1}{2\pi \times 60 \times 0,5 \times 10^{-6}} \checkmark$$
$$\underline{X_C = 6305,165\Omega} \checkmark$$

Xc = 5304,47 ohms

$$I = \frac{V}{X_L}$$
$$I = \frac{110}{6305,165} \checkmark$$
$$\underline{I = 17,446mA} \checkmark$$

I = 20,74 mA

(4)

6.3

$$I_R = \frac{V}{R}$$
$$I_R = \frac{110}{2200} \checkmark$$
$$\underline{I_R = 50mA} \checkmark$$

(2)

6.4

$$I_T = \sqrt{I_R^2 + (I_C - I_L)^2} \checkmark$$
$$I_T = \sqrt{(50 \times 10^{-3})^2 + (17,446 \times 10^{-3} - 11,671 \times 10^{-3})^2} \checkmark$$
$$\underline{I_T = 50,332mA} \checkmark$$

(3)

6.5

$$\Theta = \cos^{-1}\frac{I_R}{I_T}$$

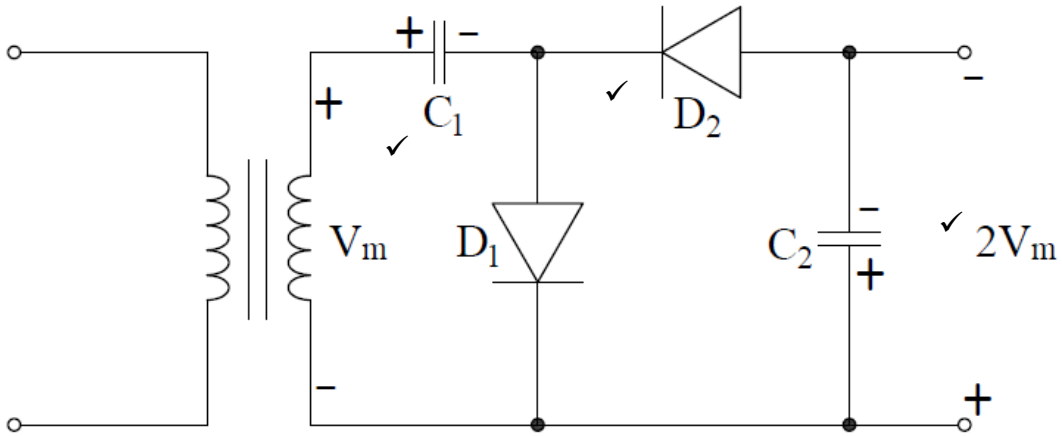
$$\Theta = \cos^{-1}\frac{50\times10^{-3}}{50,332\times10^{-3}} \checkmark$$

$$\underline{\Theta = 6,585^\circ} \checkmark$$

(2)
[15]

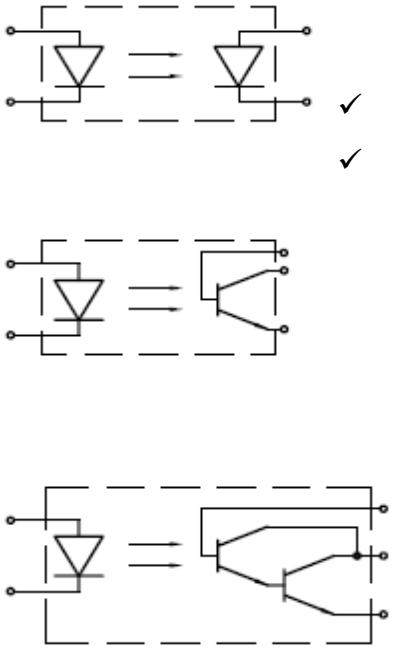
QUESTION 7

7.1



(3)

7.2



(2)
[5]

QUESTION 8

8.1
- 0° phase shift.
- Low current gain.
- High voltage gain.
- Low input impedance.
- High output impedance.

(Any 4 × 1) (4)

8.2 8.2.1

$$I_C = \frac{V_{CC}}{R_C}$$

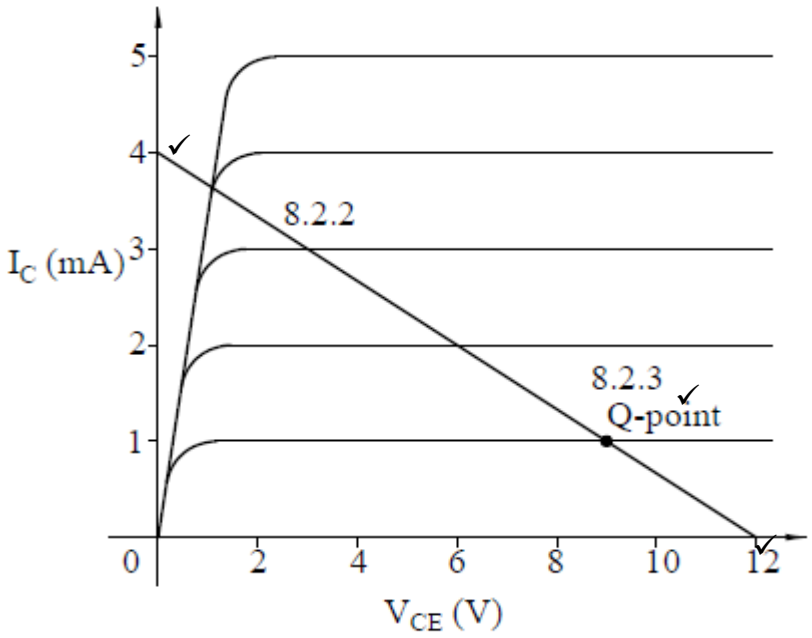
$$I_C = \frac{12}{3000} \checkmark$$

$$\underline{I_C = 4mA} \checkmark$$

(2)

8.2.2

8.2.3

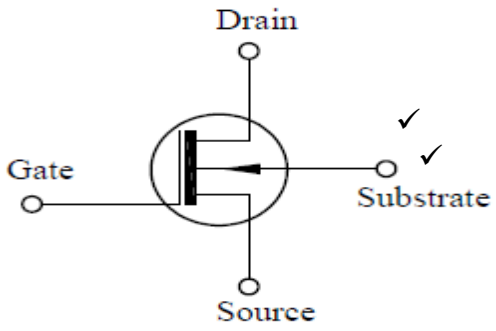


(2)
(1)

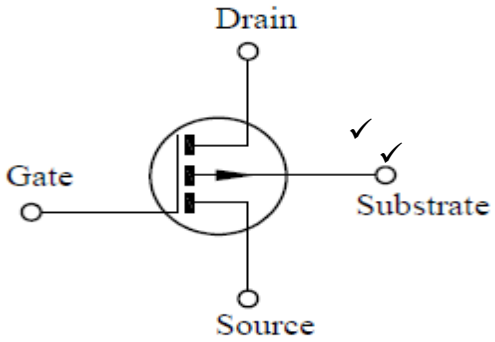
8.3
- Improves stability
- Reduces gain
- Increases bandwidth
- Reduces distortion
- Reduces noise
- Increases input impedance
- Decreases output impedance

(Any 4 × 1) (4)

8.4 8.4.1



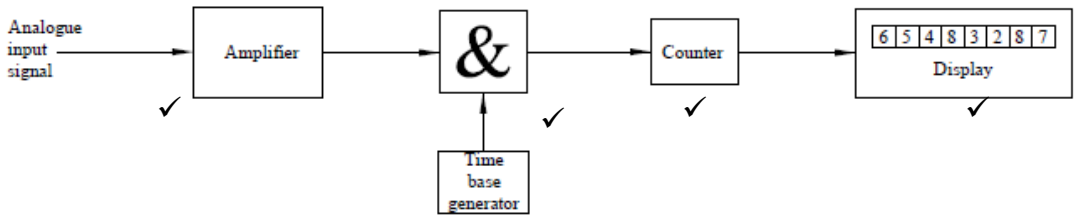
8.4.2



(2 × 2) (4)
[17]

QUESTION 9

9.1



(4)

9.2.

- V_i is an analogue value to be measured.
- The counter is set to zero.
- The unknown voltage (V_i) is compared to an internal generated voltage (V_2).
- $V_i > V_2$ the comparator's output is high and the AND gate allows pulses of the pulse generator through.
- These pulses are counted by the counter.
- $V_i = V_2$ the comparator's output becomes low.
- No more pulses through the gate.
- Last number through the counter is shown on the display. (Any 5 × 1) (5)

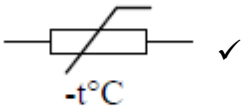
5 points that flow logically to explain the operation **[9]**

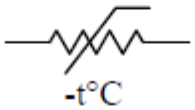
QUESTION 10

10.1
- Pressure / force
- Displacement
- Position (3)

10.2
- Positioning the magnetic core through an external force changes the induced voltage in the two secondary windings of the transformer.
- The magnitude of the difference is an indication of the magnitude and direction of the force. (2)

10.3





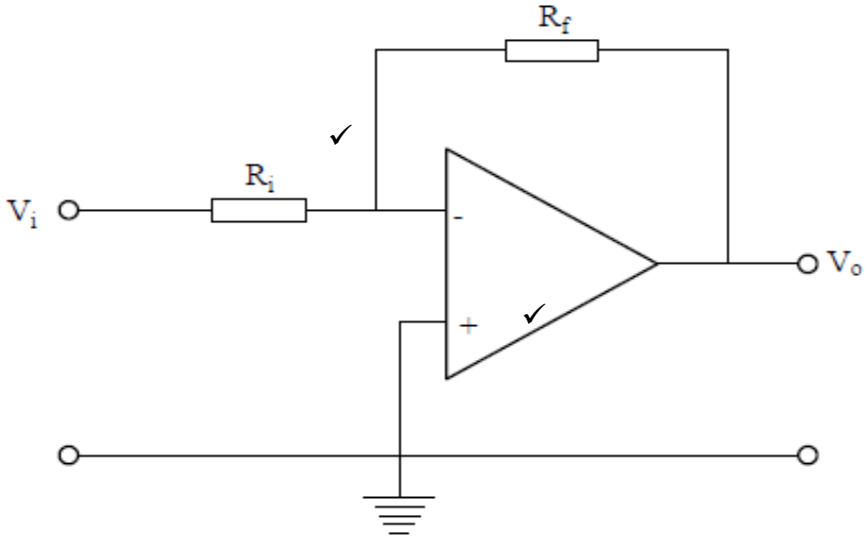
(1)

10.4
- Solar cells
- Light intensity meters (2)

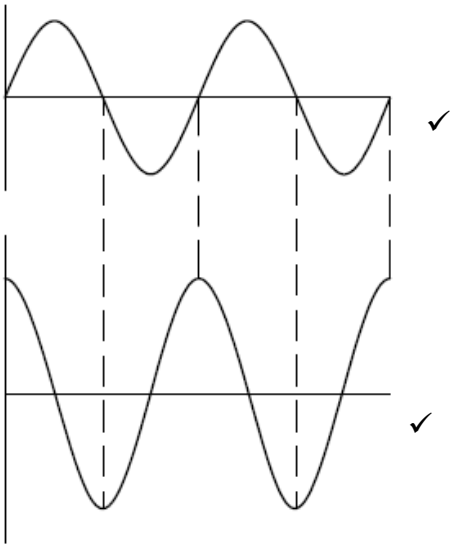
[8]

QUESTION 11

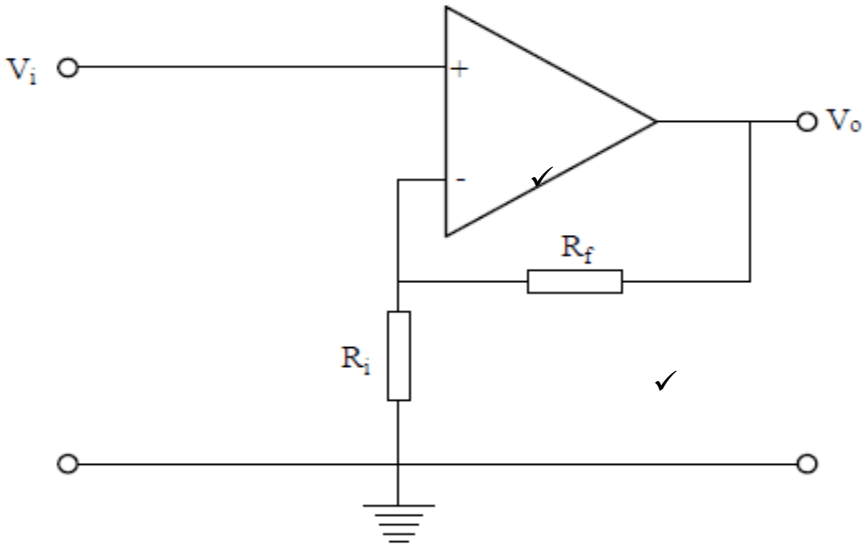
11.1



11.2



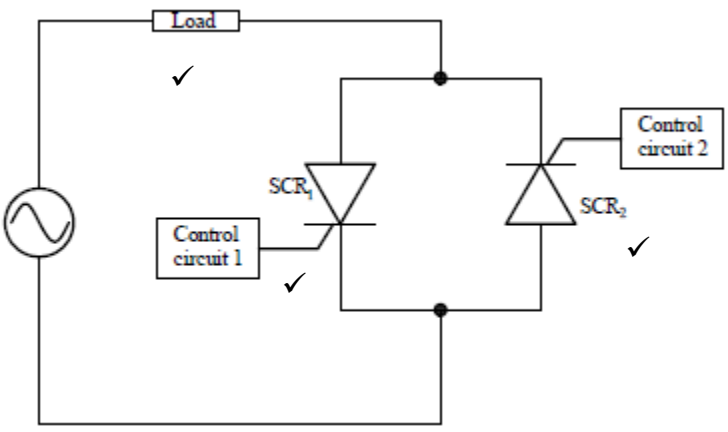
11.3



(3 × 2) **[6]**

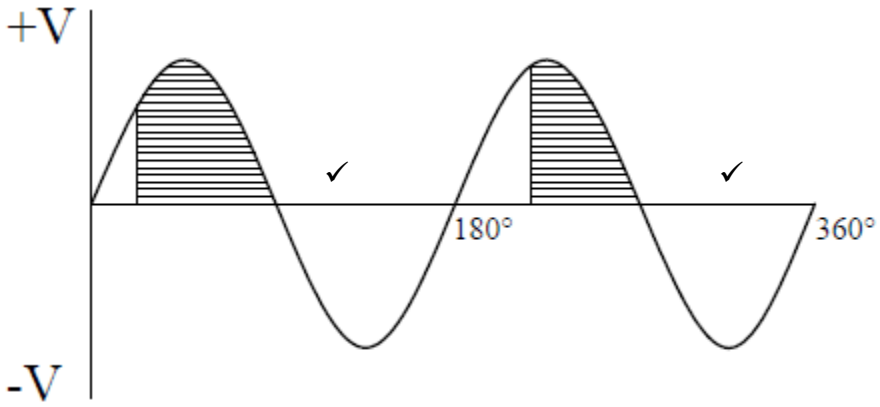
QUESTION 12

12.1



(3)

12.2



(2)

12.3 Forced commutation is when the current in an SCR is forced to flow in the✓ opposite direction and line commutation is whenever the sine wave signal crosses zero from positive to negative.✓ (2)

12.4
- LC filters
- Zener diodes
- TranZorps
- Varistors

(Any 1 × 1) (1)
[8]

TOTAL SECTION B: 80
GRAND TOTAL: 100

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