higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N2

23 July 2021

This marking guideline consists of 7 pages.

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QUESTION 1

1.1.1 True√

1.2.2 True√

1.3.3 True√

1.4.4 True√

1.5.5 False√

(5 × 1) **[5]**

1.2	
Column A	Column B
1.2.1	D √
1.2.2	C √
1.2.3	E √
1.2.4	B √
1.2.5	A √

QUESTION 2

2.1 2.1.1

$$R_{se} = R_5 + R_6$$
$$= 3 + 12$$
$$= 15\ \Omega \checkmark$$

$$R_P = \frac{1}{R_5} + \frac{1}{R_4} + \frac{1}{R_3}$$

$$R = \frac{1}{15} + \frac{1}{15} + \frac{1}{10}$$

$$= \frac{1}{0{,}233333333}$$

$$R_P = 4{,}286\ \Omega \checkmark$$

$$R_T = R_1 + R_2 + R_P$$
$$= 3 + 4 + 41{,}286$$
$$= 11{,}286\ \Omega \checkmark$$ (6)

2.1.2

$$I_T = {}^{V}/_{R}$$
$$= {}^{24}/_{11{,}286} \checkmark$$
$$= 2{,}127\ A \checkmark$$ (2)

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2.1.3 $V_{R_3} = IR_P$
$= 2{,}127 \times 4{,}286$ √√
$= 9{,}116\ V$ √ (3)

2.1.4 $I_2 = {}^{V}/_{R}$
$= {}^{9{,}114}/_{10}$ √
$= 0{,}911\ A$ √ (2)

2.1.5 $P = I^2R$
$= (2{,}127)^2 \times 4$ √√
$= 18{,}097\ W$ √ (3)

2.2
- Type of material √
- Length of conductor √
- Cross-sectional area of conductor √
- Temperature of conductor √ (4)

[20]

QUESTION 3

3.1 $V = \sqrt{V_R{}^2 + (V_1 - V_C)^2}$
$= \sqrt{(180)^2 + (117{,}6 - 266{,}6)^2)}$ √√
$= 32\ 400$
$= 233{,}669\ V$ √√ (4)

3.2 $Z = \frac{V}{I} = {}^{233{,}669}/_{10}$
$= 23{,}367\ \Omega$ √ (3)

3.3 $R = \frac{V}{I}$
$= \frac{180}{10}$ √
$= 18\ \Omega$ √ (2)

3.4 $X_C = {}^{V}/_{I}$
$= {}^{266{,}6}/_{10}$ √
$= 26{,}66\ \Omega$ √

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

$= \frac{1}{2\pi(50)(26{,}66)}$ √

(4)

$$= \frac{1}{8\,375{,}486014}$$

$$= 0{,}000119396$$

$$= 119{,}396\ \mu f \surd$$

3.5 $X_L = \frac{V}{I}$

$$= \frac{117{,}6}{10} \surd$$

$$= 11{,}76\ \Omega \surd$$

$$X_L = 2\pi f L$$

$$\mathrm{L} = \frac{117{,}6}{2\pi(50)} \surd$$

$$\mathrm{L} = 0{,}374\ \mathrm{H} \surd$$

(4)

3.6 $\cos\theta = \frac{R}{Z}$

$$\cos\theta = \frac{18}{30{,}192} \surd$$

$$\theta = \cos^{-1}\left(\frac{18}{30{,}192}\right) \surd$$

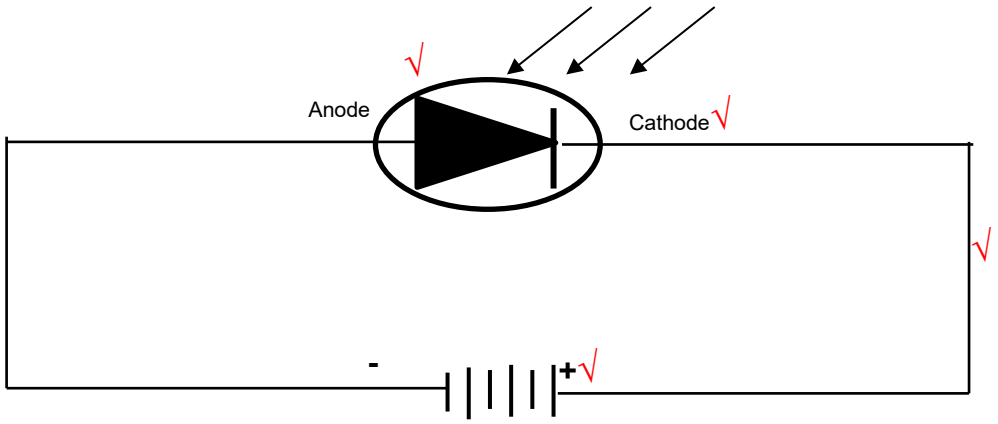
$$= 53{,}403° \surd$$

(3)
[20]

QUESTION 4

4.1 A photodiode operates under the reverse-bias condition. √ When light falls on the reverse-biased PN-junction (photodiode), the leakage current increases. As the light intensity increases√ further, the leakage current increases and the diode becomes more conductive. When the photodiode PN-junction is not exposed to any light, √ a small current, termed the dark current, will flow. √ (4)

4.2

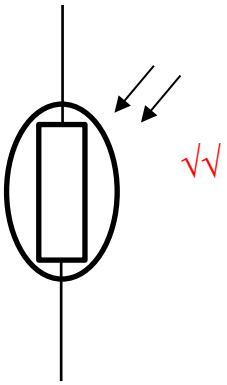


Reverse bias

(3)

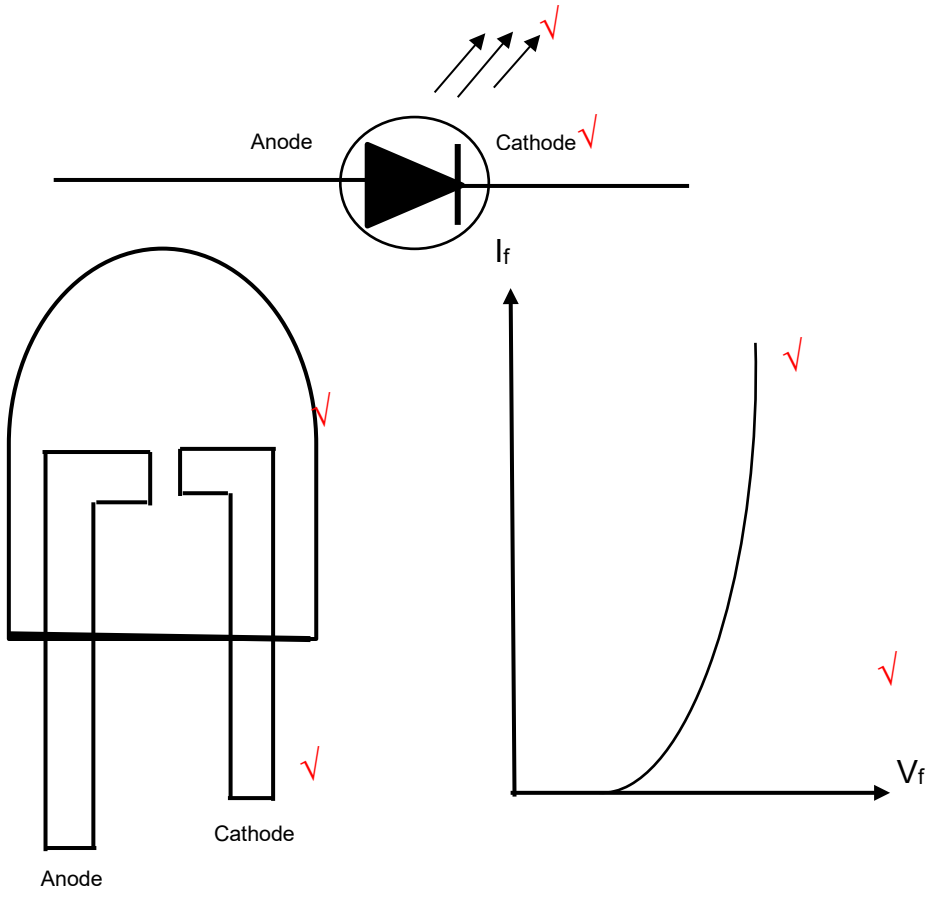
4.3 photoconductive cell or photo resistor√√ (2)

4.4



(2)

4.5

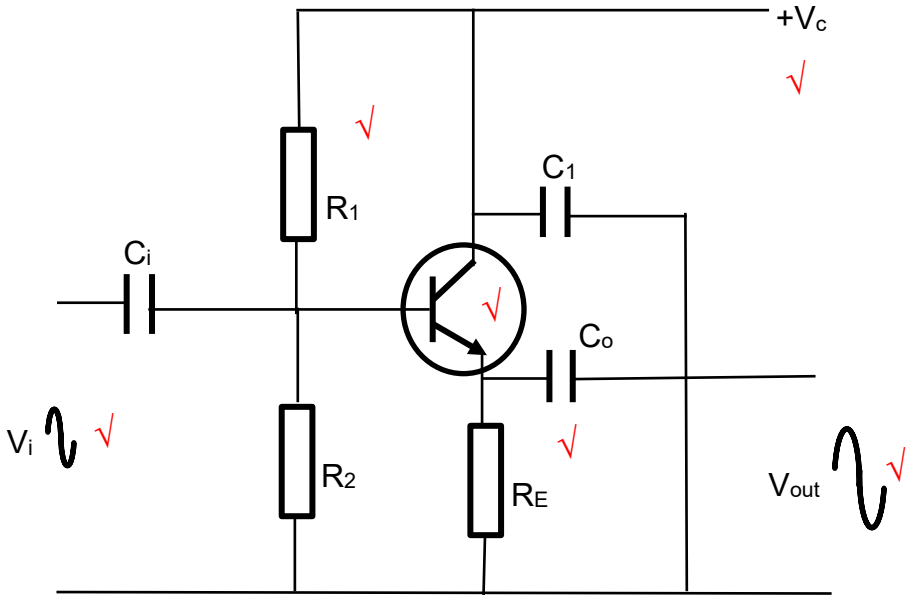


(6)

[18]

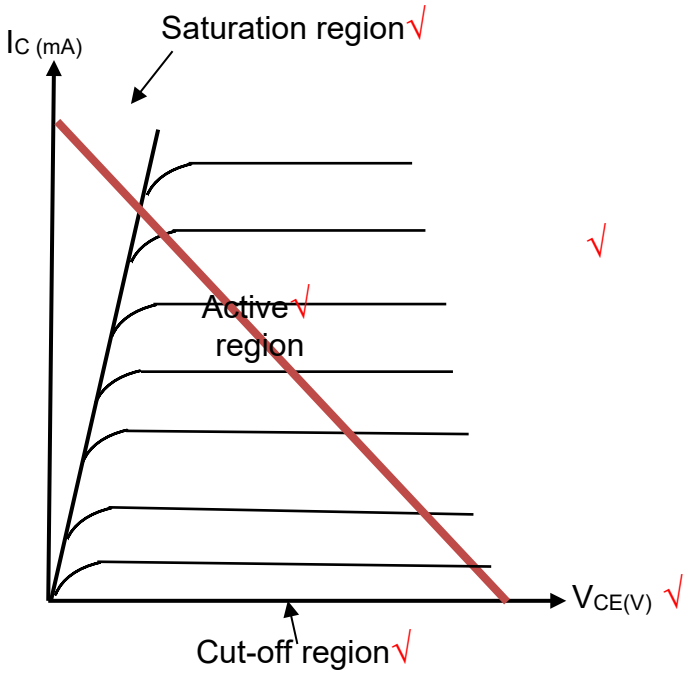
QUESTION 5

5.1



(6)

5.2



(5)

5.3
- The cut-off region occurs when both the base emitter and base junctions are reverse biased. √√
- The active region occurs when the base emitter junction is forward biased and the base collector junction is reverse biased. √√
- The saturation region occurs when both the base emitter and the base emitter and the base collector junctions are forward biased and the transistor is turned on fully. √√

(3 × 2) (6)

[17]

QUESTION 6

6.1 $R_{IN} = 600\ \Omega$ $R_{OUT} = 10\ \Omega$ $I_{IN} = 2 \times 10^{-3}\ A$ $N = 40\ dB$

$$P_{IN} = I^2R$$
$$= (2 \times 10^{-3}) \times 600 \surd$$
$$= 0{,}0024\ W \surd$$

$$40 = 10\log\frac{P_{OUT}}{0{,}0024}$$
$$\frac{40}{10} = \frac{P_{OUT}}{\log 0{,}0024} \surd$$
$$\text{Antilog}\ 4 = \frac{P_{OUT}}{0{,}0024}$$
$$P_{out} = 10\ 000 \times 0{,}0024 \surd$$
$$= 24\ W \surd$$

(7)

$$P = \frac{V^2}{R}$$
$$24 = \frac{V^2}{10}\surd$$
$$\sqrt{V}^2 = \sqrt{24} \times 10$$
$$\text{V} = 15{,}49\ \text{V}\surd$$

6.2 6.2.1

$$I = I_{Sh} + I_M$$
$$I_{Sh} = I - I_M$$
$$I_{Sh} = 45 - (20 \times 10^{-3})\surd$$
$$= 44{,}98\ \text{A}\surd$$

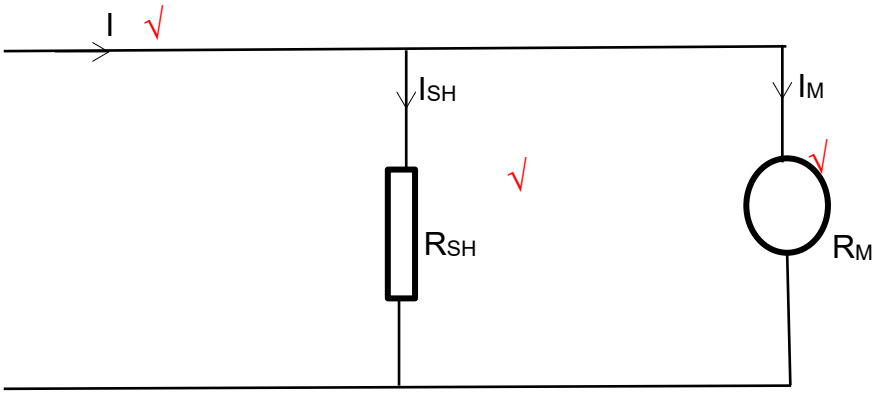
(2)

6.2.2

$$R_{Sh} = \frac{I_M \times R_M}{I_{Sh}}$$
$$R_{Sh} = \frac{(20 \times 10^{-3}) \times 150}{44{,}98}\surd\surd$$
$$R_{Sh} = 0{,}0667\ \Omega\surd$$

(3)

6.3



(3)

[15]

TOTAL: 100