higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N2

14 November 2022

This marking guideline consists of 8 pages.

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QUESTION 1

1.1 $$R_{p1} = \left(\frac{1}{R_4} + \frac{1}{R_5} + \frac{1}{R_6}\right)^{-1}$$

$$R_{p1} = \left(\frac{1}{4} + \frac{1}{5} + \frac{1}{20}\right)^{-1} \quad \checkmark$$

$$R_{p1} = \left(\frac{1}{0{,}5}\right)^{-1}$$

$$R_{p1} = 2\ \Omega \quad \checkmark$$

$$R_{s1} = R_3 + R_{p1} \quad \checkmark$$

$$R_{s1} = 18 + 2 = 20\ \Omega \quad \checkmark$$

$$R_{s2} = R_1 + R_2$$

$$R_{s2} = 10 + 20 = 30\ \Omega \quad \checkmark$$

$$R_T = \frac{R_{s1} \times R_{s2}}{R_{s1} + R_{s2}} \quad \checkmark$$

$$R_T = \frac{20 \times 30}{20 + 30} \quad \checkmark$$

$$R_T = 12\ \Omega \quad \checkmark$$ (8)

1.2 $$I_T = \frac{V_T}{R_T}$$

$$I_T = \frac{90}{12} \quad \checkmark$$

$$I_T = 7{,}5\ A \checkmark$$ (2)

1.3 $$I_1 = \frac{V}{R}$$

$$I_1 = \frac{90}{30} \checkmark$$

$$I_1 = 3\ A \checkmark$$

$$I_2 = \frac{V}{R}$$

$$I_2 = \frac{90}{20} \checkmark$$

$$I_2 = 4{,}5\ A \quad \checkmark$$ (4)

1.4 $$V_{R5} = I_2 \times R_{//}$$

$$V_{R5} = 4{,}5 \times 2 \checkmark$$

$$V_{R5} = 9\ V \checkmark$$ (3)

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1.5 $P_{R6} = \frac{V_2^2}{R_6}$ ✓

$P_{R6} = \frac{9^2}{20}$ ✓

$P_{R6} = 4{,}05\ W$ ✓ (3)

[20]

QUESTION 2

2.1
- The size or area of the plates
- The distance between the plates
- The type of material between the plates (3)

2.2 2.2.1 $X_L = 2\pi fL$

$L = \frac{X_L}{2\pi f}$

$L = \frac{39{,}25}{2\pi(50)}$ ✓

$L = 124{,}937\ mH$ ✓ (2)

2.2.2 $X_C = \frac{1}{2\pi fC}$

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

$C = \frac{1}{2\pi(50)(31{,}8)}$ ✓

$C = 100\ \mu f$ ✓ (2)

2.2.3 $Z = \sqrt{R^2 + (X_L \times X_c)^2}$ ✓

$Z = \sqrt{8^2 + (39{,}25 - 31{,}8)^2}$ ✓

$Z = 10{,}932\ \Omega$ ✓ (3)

2.2.4 $I_T = \frac{V}{Z}$

$I_T = \frac{250}{10{,}932}$ ✓

$I_T = 22{,}869\ A$ ✓ (2)

2.2.5 $V_C = I \times X_c$

$V_C = 22{,}869 \times 31{,}8$ ✓

$V_C = 727{,}234\ V$ ✓

$V_L = I \times X_L$

$V_L = 22{,}869 \times 39{,}25$ ✓

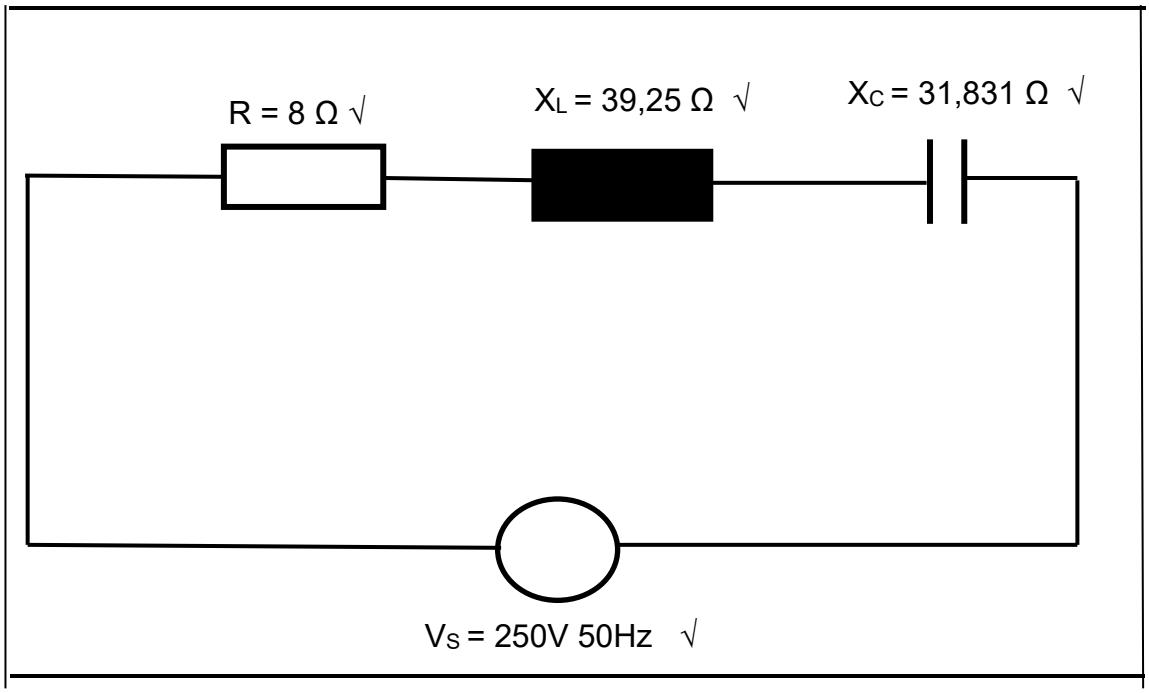
$V_L = 897{,}608\ V$ ✓ (4)

2.2.6 $Cos\,\theta = \frac{R}{Z}$

$\theta = Cos^{-1}\left(\frac{8}{10{,}932}\right)$ ✓

$\theta = 42.862°$ ✓ (2)

2.2.7



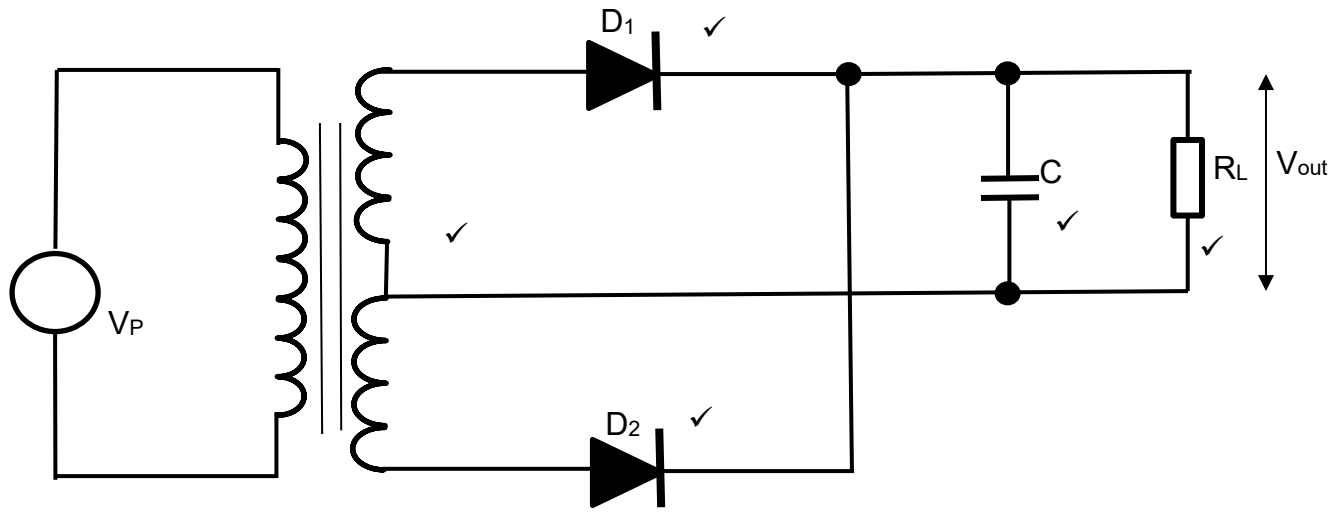
(2)
[20]

QUESTION 3

3.1
- NO bias✓ means that there is no potential applied to the appliance and no electrical current flows.✓
- Forward bias✓ means that when potential is applied, current flows freely. The electron flow is determined by the resistance of the conductor.✓
- Reverse bias✓ is the opposite of the forward bias. The potential is applied in such a way that it opposes the flow of electrons.✓ (3 × 2) (6)

3.2 Peak-to-peak refers to the value measured between the positive ✓ and the negative peak ✓values. (2)

3.3



V Output without smoothing capacitor

✓ both axis and labelling

✓ correct graph

t

Output with smoothing capacitor

V

✓ both axis and labelling

✓ correct graph

t

(9)

3.4
- Pulse frequency
- Capacitor size
- Size of the load

(3)
[20]

QUESTION 4

4.1 4.1.1 True
4.1.2 True

(2 × 1) (2)

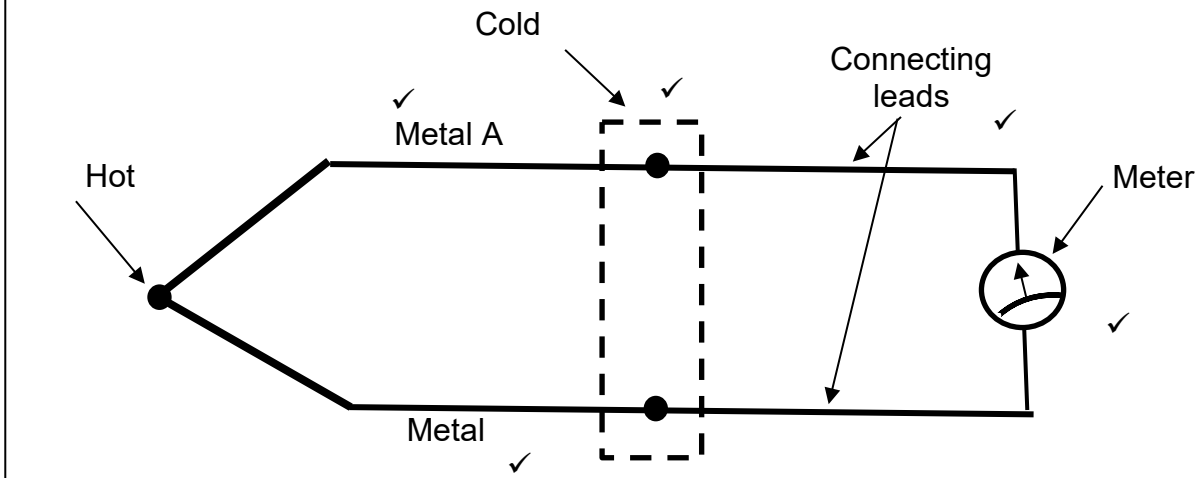
4.2 4.2.1 The cut-off region is when both the base-emitter and collector junctions ✓ are reverse biased. ✓

4.2.2 A saturated region occurs when both base-emitter and base-collector junctions ✓ are forward biased ✓.

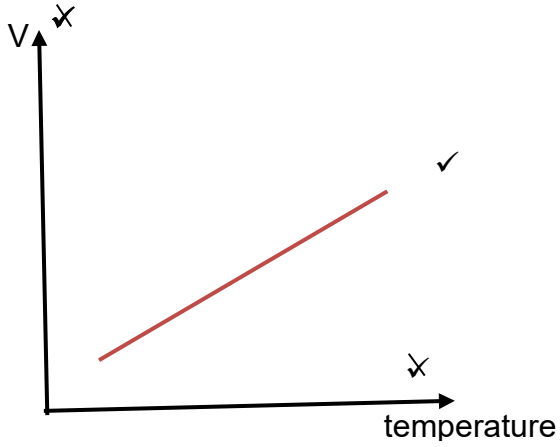
(2 × 2) (4)

4.3
- A small base-emitter current can switch the transistor ON or OFF.
- There is no wear and tear on switchgear caused by arcing.
- Control over a long distance.
- Much faster switching times. (4)

4.4



Characteristic curve



Drawing with no labels (2) (8)

4.5 $I_E = I_B + I_C$
$I_C = I_E - I_B$
$I_C = 50 \times 10^{-3} - 100 \times 10^{-6}$ ✓
$I_C = 49{,}9 \times 10^{-3} A$ or $I_C = 49{,}9\ mA$✓ (2)
[20]

QUESTION 5

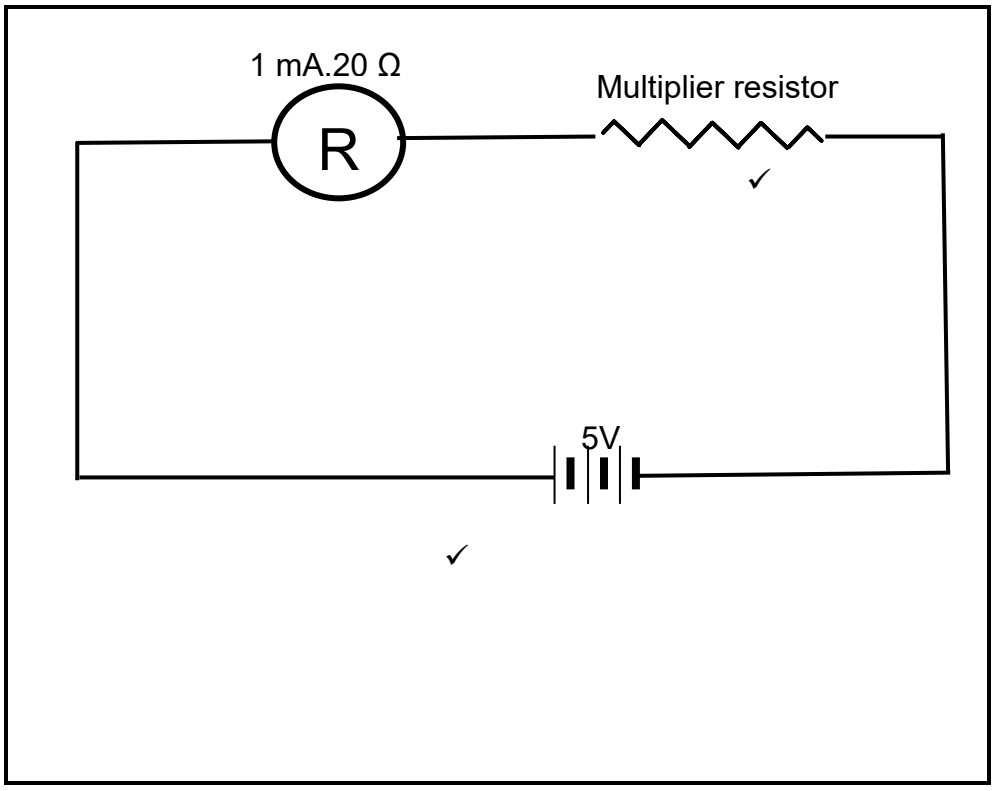
5.1 5.1.1 $V = I \times R$
$V = (1 \times 10^{-3}) \times 20$ ✓
$V = 0{,}02\ V$ *or* $20\ mV$ ✓

$V = 5 - 0{,}02$ ✓
$= 4{,}98\ V$ ✓

$R = \frac{V}{I}$
$R = \frac{4{,}98}{1 \times 10^{-3}}$ ✓

$R = 4\,980\ \Omega$ ✓ (6)

5.1.2



(2)

5.2 $P_o = I_o^2 \times R_o$

$P_o = 1^2 \times 8$ ✓

$\underline{P_o = 8\ W}$ ✓

$$P_i = \frac{V_i^2}{R_i}$$

$$P_i = \frac{(300 \times 10^{-3})^2}{100 \times 10^3}$$ ✓

$$P_i = \frac{90 \times 10^{-3}}{100 \times 10^3}$$

$\underline{P_i = 900 \times 10^{-9}\ W}$ ✓

$$N = 10log\frac{P_o}{P_i}$$

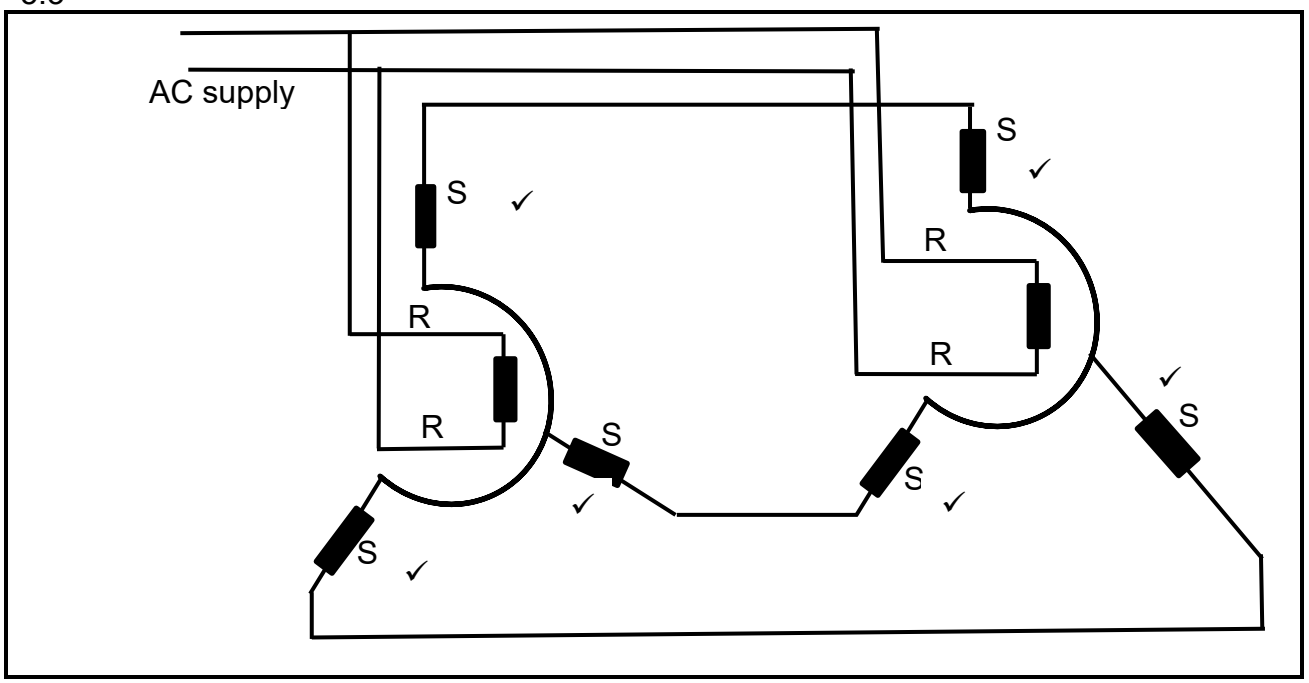
$$N = 10log\frac{8}{900 \times 10^{-9}}$$ ✓

$N = 10\log(8{,}8889 \times 10^6)$

$N = 10 \times 6{,}9488$

$\underline{N = 69{,}488\ dB}$ ✓ (6)

5.3



(6)
[20]

TOTAL: 100

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