higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N2

20 November 2023

This marking guideline consists of 8 pages.

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QUESTION 1

1.1 C
1.2 B
1.3 B
1.4 C
1.5 D
1.6 B
1.7 C
1.8 D
1.9 D
1.10 B

(10 × 1) **[10]**

QUESTION 2

2.1 $R_{S1} = R_4 + R_5$
$R_{S1} = 4 + 2 = 6\ \Omega$ ✓

$$R_{P1} = \frac{R_{S1} \times R_6}{R_{S1} + R_6}$$ ✓

$$R_{P1} = \frac{6 \times 5}{6 + 5}$$ ✓

$R_{P1} = 2{,}727\ \Omega$✓

$R_{S2} = R_{P1} + R_3 + R_7$

$R_{S2} = 2{,}727 + 6 + 5 = 13{,}727\ \Omega$✓

$$R_{P2} = \frac{R_{S2} \times R_2}{R_{S2} + R_2}$$ ✓

$$R_{P2} = \frac{13{,}727 \times 10}{13{,}727 + 10} = 5{,}786\ \Omega$$✓

$R_T = R_1 + R_{P2}$

$R_T = 7 + 5{,}786 = 12{,}786\ \Omega$✓ (8)

2.2 $$I_T = \frac{V_T}{R_T}$$
$$I_T = \frac{24}{12{,}786}$$ ✓
$I_T = 1{,}877A$ ✓ (2)

2.3 $V_{R2} = I_T \times R_{P2}$
$V_{R2} = 1{,}877 \times 5{,}786$✓✓
$V_{R2} = 10{,}860\ V$✓ (3)

2.4
$$I_1 = \frac{V_{R2}}{R_2}$$
$$I_1 = \frac{10{,}860}{10} \checkmark$$
$$I_1 = 1{,}086\ A \checkmark$$
$$I_2 = \frac{V_{R2}}{R_{S2}}$$
$$I_2 = \frac{10{,}860}{13{,}727} \checkmark$$
$$I_2 = 0{,}791\ A \checkmark$$
(4)

2.5
$$P = \frac{V_T^2}{R_T}$$
$$P = \frac{(24)^2}{12{,}786} \checkmark\checkmark$$
$$P = 45{,}049\ W \checkmark$$

OR
$$P = V \times I_T$$
$$P = (24)(1{,}877)$$
$$P = 45{,}084\ \text{W}$$

OR
$$P = I_T^2 R$$
$$P = (1{,}877)^2(12{,}786)$$
$$P = 45{,}033\ \text{W}$$

(3)
[20]

QUESTION 3

3.1 3.1.1
$$f_r = \frac{1}{2\pi\sqrt{LC}}$$
$$f_r = \frac{1}{2\pi\sqrt{128 \times 10^{-3} \times 58 \times 10^{-6}}} \checkmark$$
$$f_r = 58{,}412\ Hz \checkmark$$
(2)

3.1.2
$$X_L = 2\pi f L$$
$$X_L = 2\pi(58{,}412)(128 \times 10^{-3}) \checkmark$$
$$X_L = 46{,}978\ \Omega \checkmark$$
(2)

3.1.3
$$X_C = \frac{1}{2\pi f C}$$
$$X_C = \frac{1}{2\pi(58{,}412)(58 \times 10^{-6})} \checkmark$$
$$X_C = 46{,}978\ \Omega \checkmark$$
(2)

3.1.4
$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$
$$Z = \sqrt{(15)^2 + (46{,}978 - 46{,}978)^2} \checkmark$$
$$Z = \sqrt{225 + 0}$$
$$Z = 15\ \Omega \checkmark$$

OR Z=R (resonance)
Z=15 Ω
(2)

3.1.5 $I_T = \frac{V}{Z}$

$I = \frac{100}{15}$ ✓

$I = 6.667A$ ✓ (2)

3.1.6 $V_R = I \times R$

$V_R = 6{,}667 \times 15$ ✓

$V_R = 100\ V$ ✓

$V_L = I \times X_L$

$V_L = 6{,}667 \times 46{,}978$ ✓

$V_L = 313{,}202\ V$ ✓

$V_C = I \times X_C$

$V_C = 6{,}667 \times 46{,}978$ ✓

$V_C = 313{,}202\ V$ ✓ (6)

3.1.7

$Cos\theta = \left(\frac{R}{Z}\right)$

$\theta = Cos^{-1}\left(\frac{15}{15}\right)$ ✓

$\theta = 0°$ ✓

OR

$\tan\theta = \left(\frac{X_L - X_C}{R}\right)$

$\tan\theta = \left(\frac{0}{15}\right)$

$\theta = 0°$

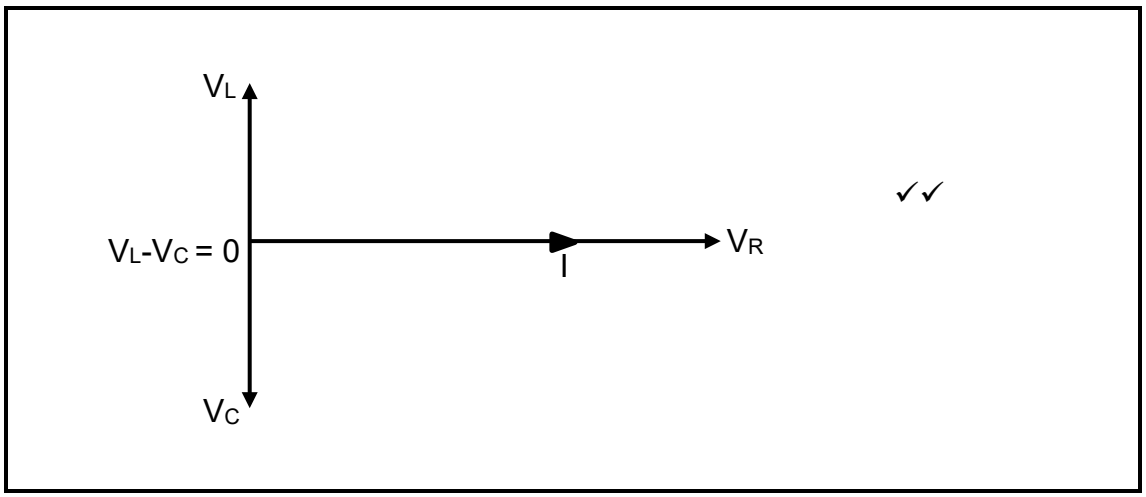
OR

$\sin\theta = \left(\frac{X_L - X_C}{Z}\right)$

$\tan\theta = \left(\frac{0}{15}\right)$

$\tan\theta = 0°$ (2)

3.2



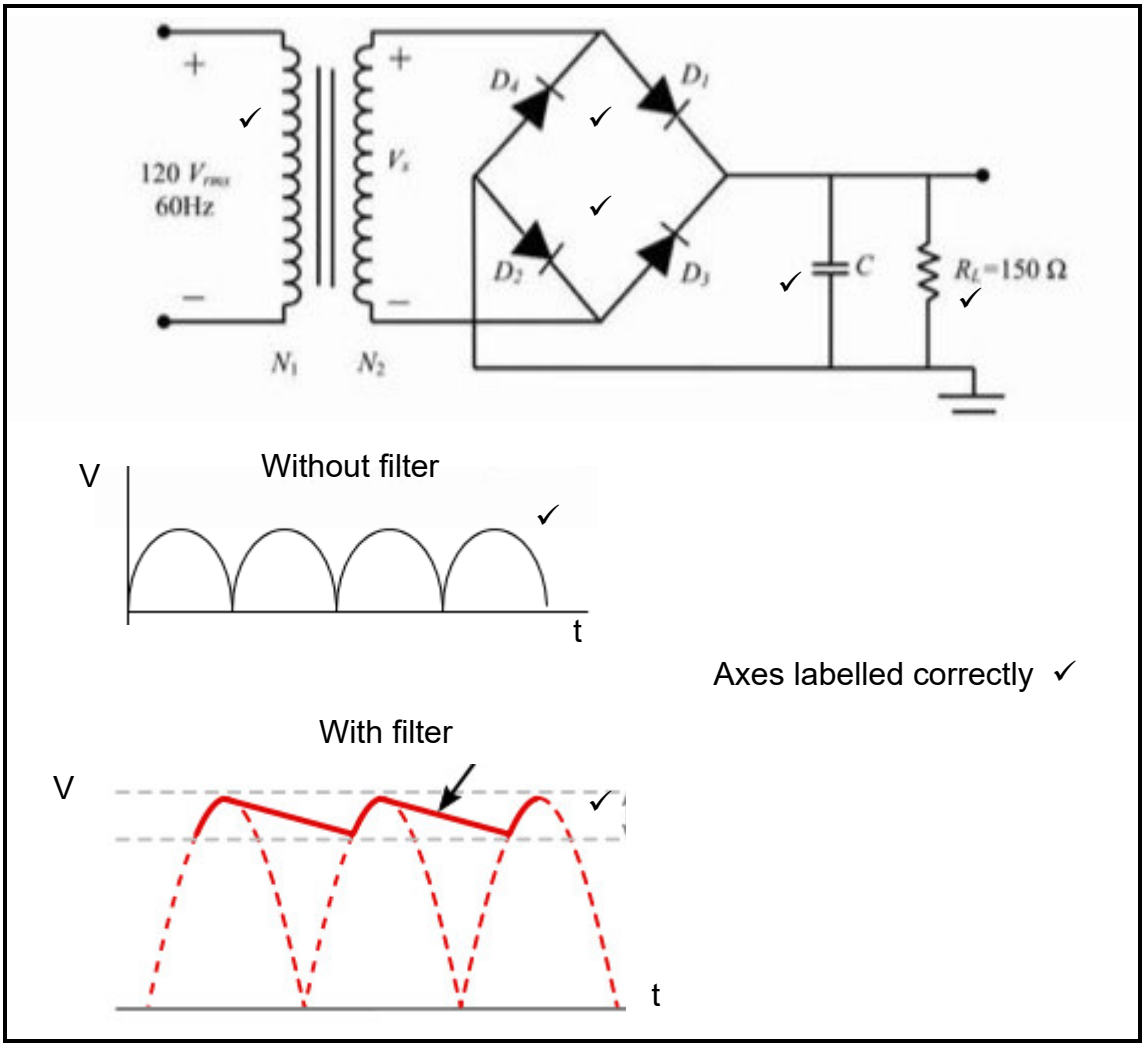
✓✓

(2)

[20]

QUESTION 4

4.1



(8)

4.2
- Avalanche breakdown
- Zener breakdown

(2)

4.3 4.3.1

$$A_P = 10log\frac{P_{out}}{P_{in}}$$

$$12 = 10log\frac{100 \times 10^{-3}}{P_{in}}$$

$$Antilog\left(\frac{12}{10}\right) = \frac{100 \times 10^{-3}}{P_{in}} \checkmark$$

$$P_{in} = \frac{100 \times 10^{-3}}{15{,}849} \checkmark$$

$$P_{in} = 0{,}006309\ W$$

$$P_{in} = 6{,}309 \times 10^{-3}\ W \checkmark$$

(3)

4.3.2 $A_{P2} = 10log\frac{P_{out}}{P_{in}}$

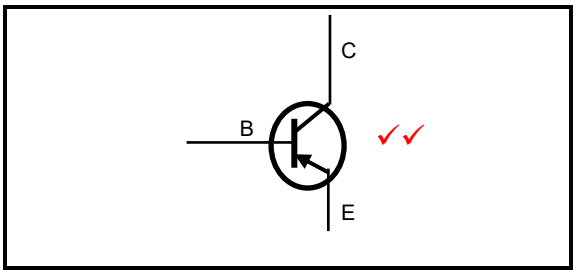
$A_{P2} = 10\log\left(\frac{450 \times 10^{-3}}{100 \times 10^{-3}}\right)$ ✓✓

$A_{P2} = 6{,}532$ dB✓ (3)

4.3.3 $A_{overall} = 12 + 6{,}532$ ✓
$A_{overall} = 18{,}532\ dB$ ✓ (2)
[18]

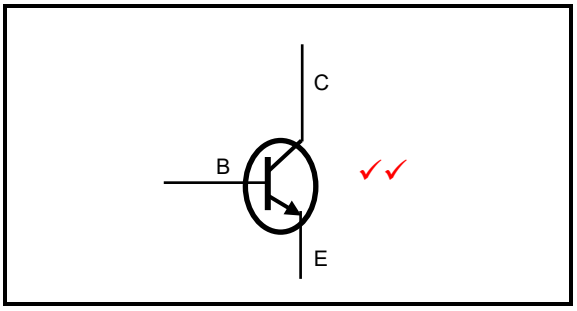
QUESTION 5

5.1 5.1.1



✓✓

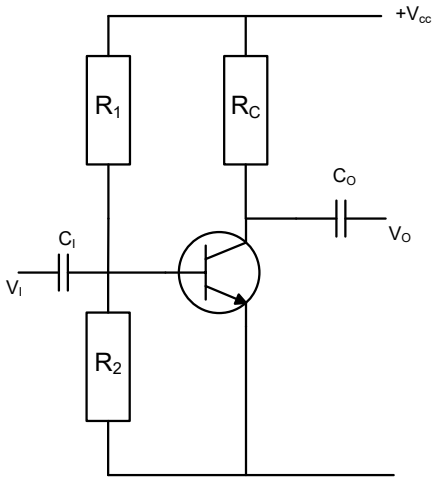
5.1.2



✓✓

(2 × 2) (4)

5.2



Transistor shown correctly. ✓

Base biasing shown correctly. ✓

R_C shown correctly. ✓

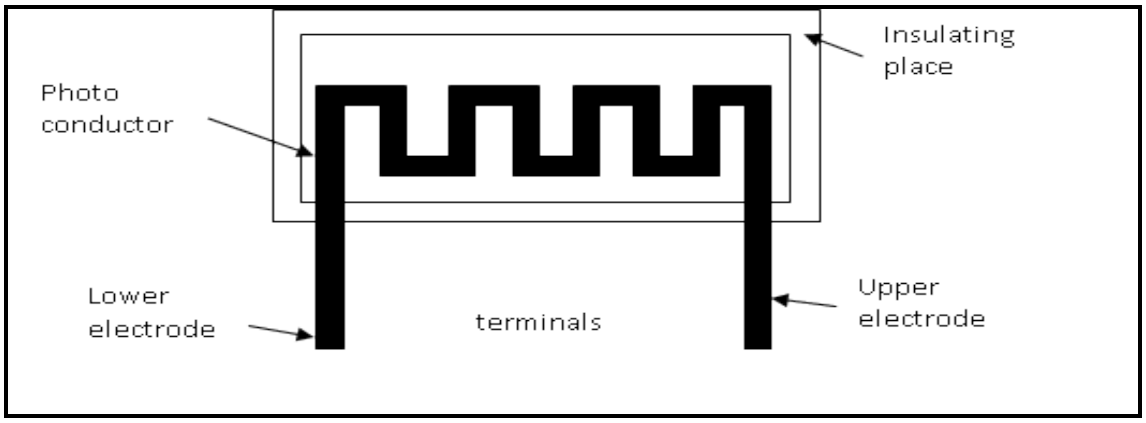
Capacitors C_I and C_O shown correctly. ✓

V_{cc} shown correctly. ✓

(5)

5.3
- Camera light meters
- Clock radios
- Security alarms
- Street light (4)

5.4



(5)

Correct drawing (2)
Any 3 correct labels (3) **[18]**

QUESTION 6

6.1 6.1.1 $I_{sh} = I_T - I_m$
$= 7 - 12{,}5 \times 10^{-3}$
$= 6{,}988$ A ✓

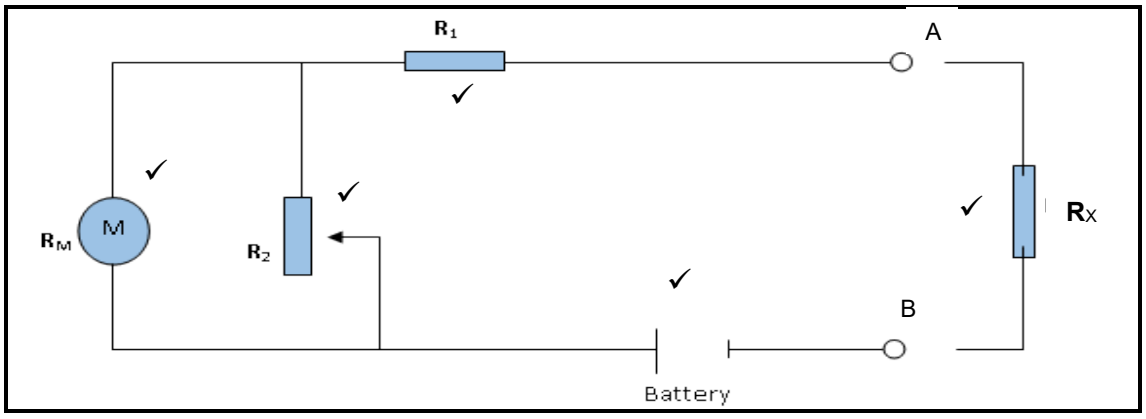
$R_{sh} = \frac{I_m R_m}{I_{sh}}$
$= \frac{(12.5\times10^{-3})(175)}{6{,}998}$ ✓
$= 0{,}313\ \Omega$ ✓ (3)

6.1.2 $R_s = \frac{V}{I_m} - R_m$
$= \frac{45}{12{,}5\times10^{-3}} - 175$ ✓
$= 3425\ \Omega$ ✓

(2)

+

6.2



(5)

Marker must use discretion.
Any applicable circuit.
Series or parallel type.

6.3

- They are reliable, adaptable and compact.
- The transmitter and receiver can be far apart.
- Transmit information quickly and accurately.
- Consume very little electrical power.
- Contact between the transmitter and receiver can be by means of electrical wires, radio frequencies, radar, infrared and telemetering. (Any 4 × 1) (4)

[14]

TOTAL: 100

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