



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N2

18 November 2024

This marking guideline consists of 7 pages.

QUESTION 1: GENERAL

- 1.1 M
- 1.2 E
- 1.3 A
- 1.4 K
- 1.5 C
- 1.6 H
- 1.7 B
- 1.8 D
- 1.9 J
- 1.10 F

(10 × 1) [10]

QUESTION 2: DIRECT-CURRENT THEORY

2.1

$$R_{p1} = \frac{R_1 \times R_2}{R_1 + R_2}$$

$$R_p = \frac{10 \times 20}{10 + 20} \checkmark$$

$$R_{p1} = 6.667 \, \Omega \checkmark$$

$$\frac{1}{R_{p2}} = \frac{1}{R_3} + \frac{1}{R_4} + \frac{1}{R_5}$$

$$\frac{1}{R_{p2}} = \frac{1}{15} + \frac{1}{15} + \frac{1}{25} \checkmark$$

$$R_{p2} = \frac{1}{0.1734}$$

$$R_{p2} = 5.767 \, \Omega \checkmark$$

$$R_{s1} = R_{p2} + R_{p1}$$

$$R_{s1} = 5.767 + 6.667 \checkmark$$

$$R_{s1} = 12.434 \, \Omega \checkmark$$

$$R_{p3} = \frac{R_6 \times R_{s1}}{R_6 + R_{s1}}$$

$$R_{p3} = \frac{30 \times 12.434}{30 + 12.434} \checkmark$$

$$R_{p3} = 8.791 \, \Omega \checkmark$$

$$R_t = R_7 + R_{p3}$$

$$R_s = 30 + 8.791 \checkmark$$

$$R_{s2} = 38.791 \, \Omega \checkmark$$

(10)

$$2.2 \quad I_T = \frac{V_T}{R_T}$$

$$I_T = \frac{50}{38.791} \checkmark$$

$$I_T = 1.289 \text{ A} \checkmark \quad (2)$$

$$2.3 \quad V_{R7} = I_T \times R_7$$

$$V_{R7} = 1.289 \times 30 \checkmark$$

$$V_{R7} = 38,67 \text{ V} \checkmark \quad (2)$$

$$2.4 \quad I_1 = \frac{V_{Rp}}{R_6} \quad \text{OR} \quad I_1 = \left(\frac{R_{S1}}{R_{S1} + R_6} \right) I_T$$

$$I_1 = \frac{11.332}{30} \checkmark \quad I_1 = \left(\frac{12.434}{12.434 + 30} \right) 1,289$$

$$I_1 = 0.378 \text{ A} \checkmark \quad I_1 = 0.378 \text{ A}$$

$$I_2 = \frac{V_{Rp}}{R_{S1}} \quad \text{OR} \quad I_2 = I_T - I_1 \quad \text{OR} \quad I_2 = \left(\frac{R_6}{R_{S1} + R_6} \right) I_T$$

$$I_2 = \frac{11.332}{12.434} \checkmark \quad I_2 = 1,289 - 0.378 \quad I_2 = \left(\frac{12.434}{12.434 + 30} \right) 1,289$$

$$I_2 = 0.911 \text{ A} \checkmark \quad I_2 = 0.911 \text{ A} \quad I_2 = 0.911 \text{ A} \quad (4)$$

$$2.5 \quad P_T = V \times I \quad \text{OR} \quad P_T = I_T^2 \times R_T \quad \text{OR} \quad P_T = \frac{V^2}{R_T}$$

$$P_T = 50 \times 1.289 \checkmark \quad P_T = 1.289^2 \times 38.67 \quad P_T = \frac{50^2}{38.67}$$

$$P_T = 64.45 \text{ W} \checkmark \quad P_T = 64.251 \text{ W} \quad P_T = 64.65 \text{ W} \quad (2)$$

[20]

QUESTION 3: ALTERNATING CURRENT THEORY

$$3.1 \quad \begin{array}{ll} 3.1.1 & \pi/4 \\ 3.1.2 & 180^\circ \\ 3.1.3 & 225^\circ \\ 3.1.4 & 5\pi/3 \\ 3.1.5 & 330^\circ \end{array} \quad \text{OR} \quad \begin{array}{l} 0,785 \\ \\ \\ 5,236 \end{array}$$

(5 × 1) (5)

$$3.2 \quad 3.2.1 \quad R = \frac{V_R}{I_T}$$

$$R = \frac{120 \checkmark}{4} \checkmark$$

$$R = 30 \Omega \checkmark$$

3.2.2

$$X_L = \frac{V_L}{I_T}$$

$$X_L = \frac{220}{4} \checkmark$$

$$X_L = 55 \Omega \checkmark$$

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

$$L = \frac{55}{2\pi(50)} \checkmark$$

$$L = 0.175 H \checkmark$$

(4)

3.2.3

$$X_c = \frac{V_c}{I_T}$$

$$X_c = \frac{160}{4} \checkmark$$

$$X_c = 40 \Omega \checkmark$$

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

$$C = \frac{1}{2\pi(50)(40)} \checkmark$$

$$C = 79.577 \times 10^{-6} f \checkmark$$

(4)

3.2.4

$$Z = \sqrt{R^2 + (X_L - X_c)^2} \checkmark$$

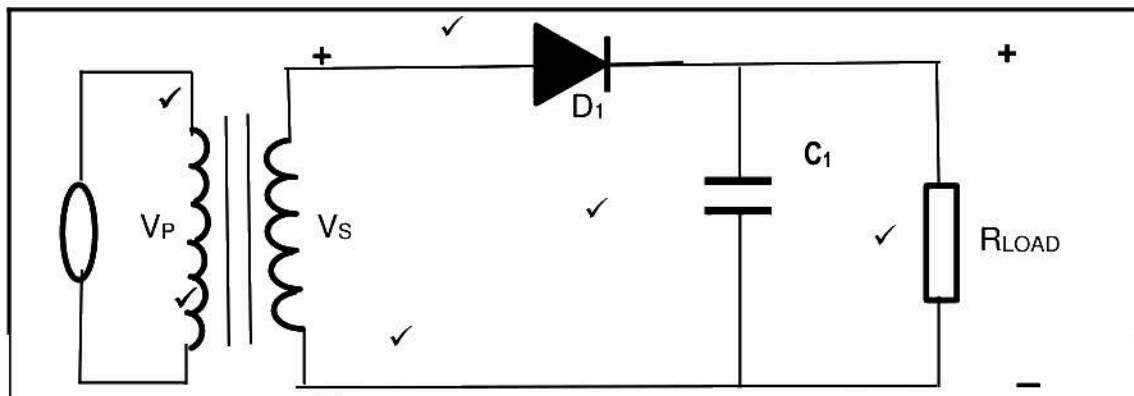
$$Z = \sqrt{(30)^2 + (55 - 40)^2} \checkmark \checkmark$$

$$Z = 33.541 \Omega \checkmark$$

(4)
[20]

QUESTION 4: SEMICONDUCTOR DIODES

4.1



- 4.2
- During the positive half-cycle, D1 is forward biased ✓
 - and during the negative half-wave, D1 is reverse-biased. ✓
 - The presence of the smoothing capacitor alters the condition under which the rectifier diode conducts. When the diode is forward-biased, the capacitor C_1 charges up to the peak value of the input wave (V_m). ✓
 - During the reverse bias (negative half-cycle), ✓
 - the diode is reverse-biased ✓
 - and the supply is effectively disconnected from the load leaving the capacitor as the only source of voltage. The capacitor now discharges into the load and a ripple appears in the voltage across the load. ✓

(marker to use discretion)

(6)

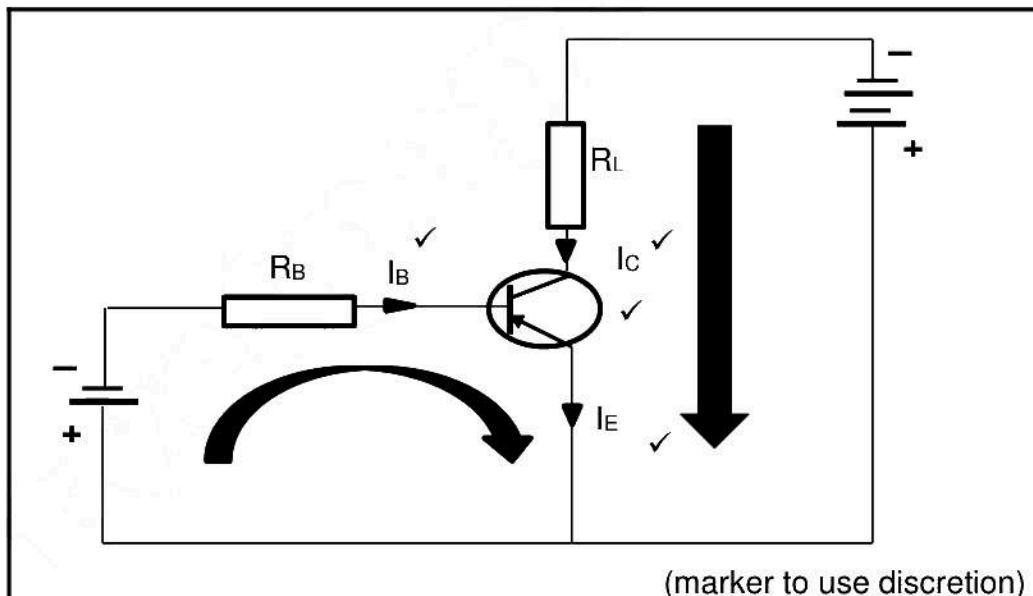
- 4.3
- Optical encoders
 - Security systems
 - High-voltage isolators
 - Level indicators
 - Alphanumeric displays

(5)

[17]

QUESTION 5: TRANSISTORS AND DECIBEL

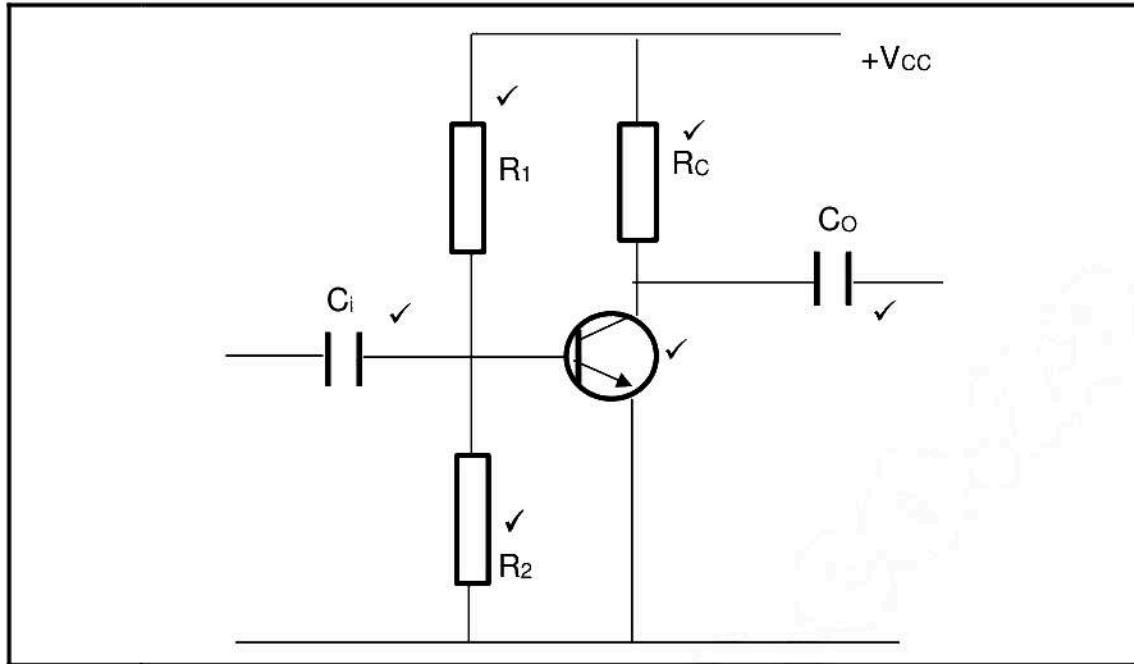
5.1



(marker to use discretion)

(4)

5.2



(6)

5.3

- 5.3.1 No phase shift between input and out
- 5.3.2 180° phase shift between input and output
- 5.3.3 0° phase shift between input and output

(3 × 1) (3)

5.4

$$A_v = 20 \log V_o / V_i$$

$$A_v = 20 \log 6 / 120 \times 10^{-3} \checkmark$$

$$= 33.979 \text{ dB} \checkmark$$

(2)
[15]

QUESTION 6: MEASURING INSTRUMENTS, TRANSDUCERS AND SYNCHROS

6.1

6.1.1

$$R_{SH} = \frac{I_M \times R_M}{I - I_M}$$

$$R_{SH} = \frac{10 \times 10^{-3}(5) \checkmark}{2 - 10 \times 10^{-3} \checkmark}$$

$$R_{SH} = 25 \text{ m}\Omega \checkmark \checkmark$$

(4)

6.1.2

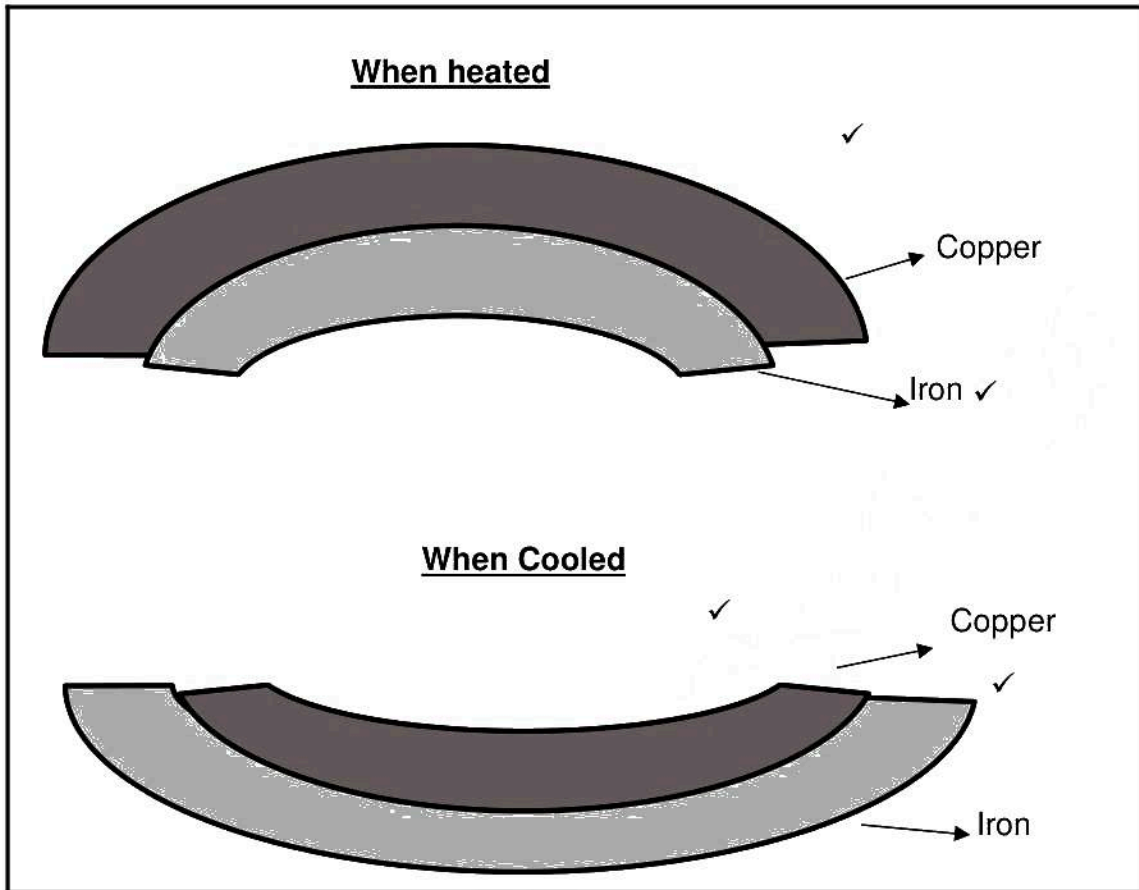
$$= \frac{V}{I_M} - R_M$$

$$R_{se} = \frac{12 \checkmark}{10 \times 10^{-3}} - 5 \checkmark$$

$$R_{se} = 1.195 \text{ k}\Omega \checkmark \checkmark$$

(4)

6.2



(4)

6.3

A synchro system synchronises two or more devices so that they operate at the same time over long distances by means of an electrical signal.

(2)

6.4

- Rapid and accurate transmission of information between equipment and stations.
- Changes in the speed and depth of torpedoes.
- Remote control of model cars or model aeroplanes.
- Remote positioning of communication systems.
- Controlling the course, speed and a range of targets or missiles.
- Angular displacement or position of a ship's rudder.

(Any 4 × 1)

(4)

[18]

TOTAL:

100