higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE (VOCATIONAL)

ELECTRICAL PRINCIPLES AND PRACTICE
NQF LEVEL 3

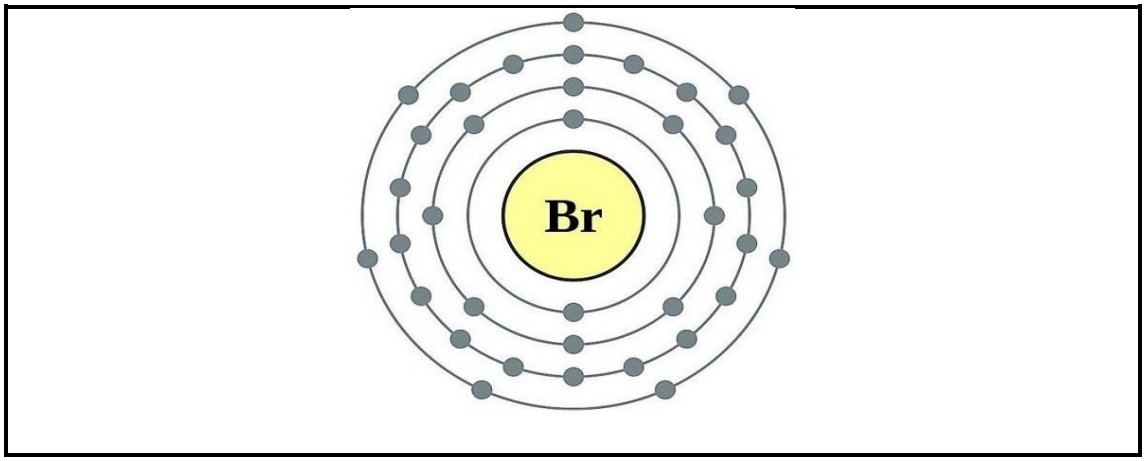
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This marking guideline consists of 8 pages.

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QUESTION 1

1.1



(1 mark per shell = 4 × 1) (4)

1.2
- Temperature
- Resistivity
- Cross-sectional area (3)

1.3 $R_t = R_0[1 + \propto_0 (t - \theta)]$

$150 = 125[1 + 0{,}004(t - 20)]$ ✓✓

$1{,}2 = 1 + 0{,}004(t - 20)$

$0{,}004(t - 20) = 0{,}2$

$t - 20 = 50$ ✓

$t = 70\,°C$ ✓ (4)

1.4 1.4.1
- Potential difference is the difference in the electrical potential between two points in a circuit.
- Potential difference is the voltage measured over a closed circuit.

(Any 1 × 2) (2)

1.4.2
- Electromotive force is the greatest potential difference that can be produced by a source of electric current in a circuit.
- Electromotive force is the voltage measured between the terminals of a battery in an open circuit. (Any 1 × 2) (2)

[15]

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QUESTION 2

2.1 2.1.1 $E = Blv$

$= 0{,}5 \times 0{,}15 \times 3$✓

$= 0{,}225\ V$✓

2.1.2 $F = BIl$

$= 0{,}5 \times 20 \times 0{,}15$✓

$= 1{,}5\ N$✓

(2 × 2) (4)

2.2 2.2.1
- A relay is used to control the opening and closing of the circuit contacts of an electronic circuit.
- A relay is used where it is necessary to control a circuit with a low-power signal. (Any 1 × 2) (2)

2.2.2
- Lighting control systems
- Industrial process control
- Traffic control
- Motor drives control
- Computer interface
- Protection systems of electrical power systems (Any 4 × 1) (4)

2.3
- Current flowing in the coil
- Number of turns in the wire (2)

2.4 $B = \frac{\emptyset}{A}$

$= \frac{0{,}003}{500 \times 10^{-6}}$ ✓

$= 6\ T$ ✓ (2)

2.5 $F = \frac{2 \times 10^{-7} \times I_1 \times I_2}{d}$

$= \frac{2 \times 10^{-7} \times 60 \times 60}{0{,}002}$ ✓

$= 0{,}36\ N$ ✓ (2)

2.6 2.6.1 Parallel
2.6.2 Cross-sectional area
2.6.3 1 m
2.6.4 2×10^{-7}

(4 × 1) (4)
[20]

QUESTION 3

3.1
- Polycarbonate
- Paper
- Mica
- Ceramic
- Variable air
- Polyester
- Polystyrene

(Any 4 × 1) (4)

3.2 3.2.1 Current-divider rule

$$I_2 = \frac{R_1}{R_1 + R_2} I_T$$

$$0{,}5 = \frac{4}{4+6} \times I_T \checkmark$$

$$0{,}5 = 0{,}4 I_T \checkmark$$

$$I_T = 1{,}25\ A \checkmark$$

Alternative response

$$V_P = R_2 I_2$$

$$= 6 \times 0{,}5$$

$$= 3\ V$$

$$I_1 = \frac{V_P}{R_1}$$

$$= \frac{3}{4}$$

$$= 0{,}75\ A$$

$$I_T = I_1 + I_2$$

$$= 0{,}75 + 0{,}5$$

$$= 1{,}25\ A$$

(3)

3.2.2 $V_{R3} = I_T R_3$

$= 1{,}25 \times 2$ ✓

$= 2{,}5\ V$ ✓

$V_{RX} = V_T - V_P - V_{R3}$

$= 12 - 3 - 2{,}5$ ✓

$= 6{,}5\ V$ ✓

Alternative response

$R_P = \frac{V_P}{I_T}$

$= \frac{3}{1{,}25} = 2{,}4\ \Omega$

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

$= \frac{12}{1{,}25} = 9{,}6\ \Omega$

$R_X = \frac{V_{RX}}{I_T}$

$= \frac{6{,}5}{1{,}25}$ ✓

$= 5{,}2\ \Omega$ ✓

$R_X = R_T - R_P - R_3$

$= 9{,}6 - 2{,}4 - 2$

$= 5{,}2\ \Omega$

(6)

3.2.3 $R_T = R_3 + R_X$

$= 2 + 5{,}2$

$= 7{,}2\ \Omega$ ✓

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

$= \frac{12}{7{,}2}$ ✓

$= 1{,}667\ \Omega$ ✓

(3)

3.3
- Delta connection
- Star connection

(2)

3.4 $\frac{1}{L_T} = \frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3}$

$\frac{1}{L_T} = \frac{1}{2} + \frac{1}{4} + \frac{1}{8}$ ✓

$\frac{1}{L_T} = \frac{7}{8}$

$L_T = \frac{8}{7}$ ✓

$= 1{,}143\ \text{mH}$ ✓ (3)

3.5
- They use less copper.
- They take up less space.
- They are more efficient than regular transformers. (3)

3.6
- Series grouping of cells
- Parallel grouping of cells
- Series-parallel grouping of cells (Any 2 × 1) (2)

3.7
- Natural air cooling
- Forced air cooling (2)

3.8 $\frac{N_1}{N_2} = \frac{I_2}{I_1}$

$I_2 = \frac{N_1 I_1}{N_2}$

$= \frac{1 \times 12}{5}$ ✓

$= 2{,}4\ A$ ✓ (2)

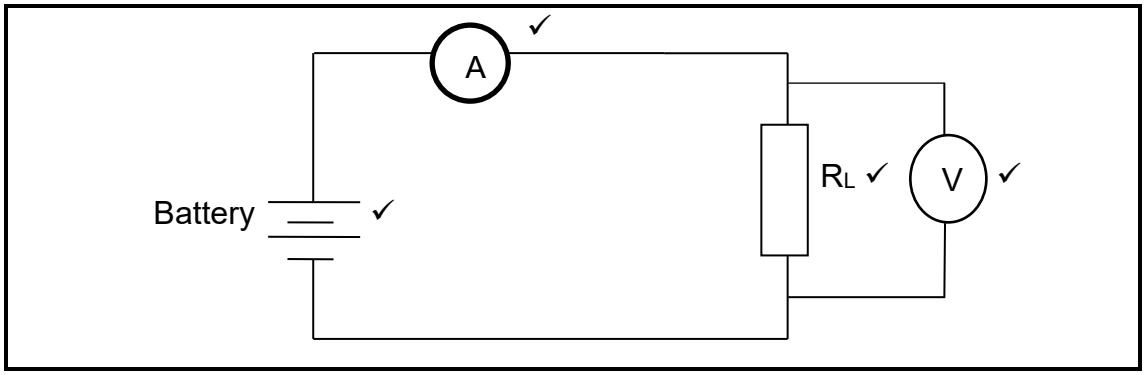
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QUESTION 4

4.1 4.1.1 B
4.1.2 C
4.1.3 A
4.1.4 E

(4 × 1) (4)

4.2



(4)

4.3
- An analogue meter uses a pointer to indicate the measured quantity.
- A digital meter gives a reading by displaying digits. (2)

4.4 It is used to measure:
- Current
- Resistance
- Voltage (3)

4.5 $R_{se} = \frac{V}{I_m} - R_m$

$= \frac{300}{0{,}02} - 145$ ✓

$= 14\,855\ \Omega$ ✓ (2)

[15]

QUESTION 5

5.1 5.1.1 True
5.1.2 True
5.1.3 False

(3 × 1) (3)

5.2 5.2.1 $V = E + I_a R_a$

$= 120 + 20 \times 0{,}4$ ✓

$= 128\ V$ ✓

5.2.2 $V = E - I_a R_a$

$= 120 - 40 \times 0{,}4$ ✓

$= 104\ V$ ✓

(2 × 2) (4)

5.3
- High inertial load
- Pumps
- Compressors
- Conveyor belts (4)

5.4 5.4.1 A direct-on-line starter connects the motor directly across the main supply.

5.4.2 In the star-delta starting method, the stator winding is connected in star while starting and in delta while running at normal speed.

(2 × 2) (4)

5.5
- Series field coil
- Shunt field coil (2)

5.6
- Very simple and low cost
- Reliable and quiet
- Speed can be controlled by series resistor (3)

[20]

TOTAL: 100

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