



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE (VOCATIONAL)

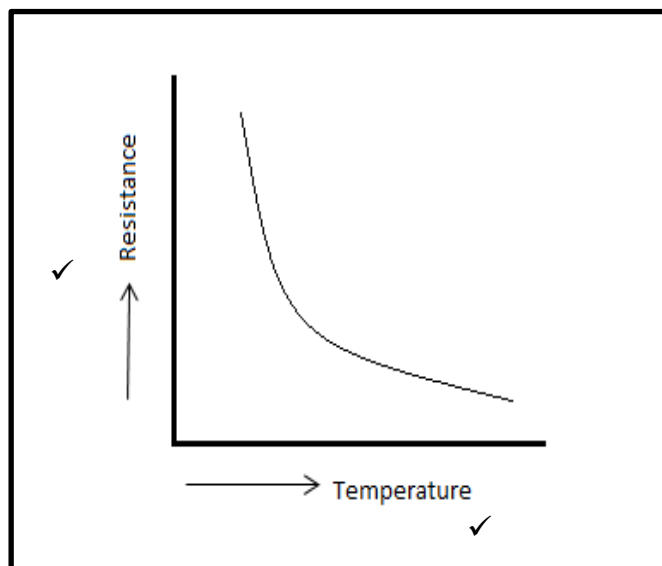
**ELECTRICAL PRINCIPLES AND PRACTICE
NQF LEVEL 3**

26 February 2020

This marking guideline consists of 7 pages.

QUESTION 1

- | | | | | |
|-----|-------|----|---------|-----|
| 1.1 | 1.1.1 | 2 | | |
| | 1.1.2 | 8 | | |
| | 1.1.3 | 18 | | |
| | 1.1.4 | 4 | | |
| | 1.1.5 | 4 | | |
| | | | (5 × 1) | (5) |
-
- | | | | | |
|-----|-------|---|---------|-----|
| 1.2 | 1.2.1 | atomic number | | |
| | 1.2.2 | electromotive force/EMF | | |
| | 1.2.3 | doubled/2 x (two times) | | |
| | 1.2.4 | electrical charges/electrostatic forces | | |
| | 1.2.5 | free electron | | |
| | | | (5 × 1) | (5) |
-
- | | | | | |
|-----|---|----|--|-----|
| 1.3 | $R = \frac{\rho l}{A}$ | | | |
| | $= \frac{17,3 \times 10^{-9} \times 1\,000}{35 \times 10^{-6}}$ | ✓✓ | | |
| | $= 0,494\,\Omega$ | ✓ | | (3) |
-
- | | | | | |
|-----|--|--|--|-----|
| 1.4 | The resistance of insulating materials decreases as the temperature increases. | | | (2) |
|-----|--|--|--|-----|

OR**[15]**

QUESTION 2

2.1 Magnetomotive force is the strength of a magnetic field in a coil of wire. (2)

2.2 $B = \frac{\Phi}{A}$

$$\Phi = B \times A$$

$$\Phi = 180 \times 400 \times 10^{-6} \checkmark \checkmark$$

$$\Phi = 0,072 \text{ Wb} \checkmark \quad \text{or} \quad 72 \text{ mWb} \quad (3)$$

2.3 Lenz's law states that the direction of an induced emf is always such that it tends to set up a current opposite the motion of flux responsible for inducing that emf. (2)

2.4 The principle of electromagnetic induction states that when a conductor cuts magnetic flux, an emf is induced in the conductor. (2)

2.5 2.5.1 $E = Blv$

$$= 0,008 \times 0,25 \times 50 \checkmark$$

$$= 0,1 \text{ V} \checkmark$$

2.5.2 $E = Blv \sin \theta$

$$= 0,008 \times 0,25 \times 50 \times \sin 45^\circ \checkmark$$

$$= 0,07 \text{ V} \checkmark$$

(2 × 2) (4)

2.6 When the switch is pressed, current passes through the coil ✓ and energises the electromagnet, ✓ resulting in the iron armature being attracted to the electromagnet. ✓ Attached to the armature is a striker which hits the gong, creating a sound. ✓ (4)

2.7 Place a woodscrew next to the conductor carrying the current. ✓ The direction in which the screw is turned is the same as the direction of flux, ✓ while the direction the screw travels through the wood represents the direction of the current. ✓ (3)

[20]

QUESTION 3

3.1 3.1.1

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

$$= \frac{12}{2} \checkmark$$

$$= 6 \Omega \checkmark$$

$$\frac{1}{R_P} = \frac{1}{R_{2\Omega}} + \frac{1}{R_{3\Omega}}$$

$$= \frac{1}{2} + \frac{1}{3} \checkmark$$

$$= \frac{5}{6}$$

$$R_P = \frac{6}{5}$$

$$= 1,2 \Omega \checkmark$$

$$R_T = R_P + R_X$$

$$6 = 1,2 + R_X$$

$$R_X = 4,8 \Omega \checkmark$$

(5)

3.1.2

$$V_P = I_T R_P$$

$$= 2 \times 1,2 \checkmark$$

$$= 2,4 \text{ V} \checkmark$$

$$I_{2\Omega} = \frac{V_P}{R_{2\Omega}}$$

$$= \frac{2,4}{2} \checkmark$$

$$= 1,2 \text{ A} \checkmark$$

(4)

OR

$$R_P = \frac{R_{2\Omega} \times R_3}{R_{2\Omega} + R_3}$$

$$= \frac{2 \times 3}{2 + 3}$$

$$= \frac{6}{5}$$

$$R_P = 1,2 \Omega$$

OR

$$I_{2\Omega} = \frac{R_{3\Omega}}{R_P} \times I_T$$

$$= \frac{3\Omega}{5\Omega} \times 2 \text{ A} \checkmark$$

$$= 0,6 \times 2$$

$$= 1,2 \text{ A} \checkmark$$

3.2 The total resistance will increase and the total current will decrease.

OR

The resistance in the parallel network increases, hence the total resistance increases and, therefore, the circuit current decreases. (2)

3.3
$$L = \frac{N\phi}{I}$$

$$= \frac{500 \times 60 \times 10^{-6}}{4} \checkmark$$

$$= 0,0075 \text{ H OR } 7,5 \text{ mH} \checkmark \quad (2)$$

3.4 3.4.1
$$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

$$= \frac{1}{0,1} + \frac{1}{0,2} + \frac{1}{0,4} \checkmark$$

$$= \frac{7}{0,4}$$

$$C_T = \frac{0,4}{7} \checkmark$$

$$C_T = 0,057 \mu\text{F} \checkmark \quad (3)$$

3.4.2
$$C_T = C_1 + C_2 + C_3$$

$$= 0,1 + 0,2 + 0,4 \checkmark$$

$$= 0,7 \mu\text{F} \checkmark \quad (2)$$

3.4.3 The total capacitance increases when capacitors are connected in parallel

OR

The total capacitance decreases when capacitors are connected in series (1)

3.5 Cells are grouped in series, ✓ parallel ✓ and in series-parallel. ✓ (Any 2 × 1) (2)

- 3.6
- A – Protective casing
 - B – Terminals (positive and negative)
 - C - Cell divider
 - D – Electrodes (positive and negative)
 - E - Electrolyte (mixture of sulphuric acid and distilled water)

(5 × 1) (5)

- 3.7 $P = VI\cos\theta$
 $= 220 \times 3 \times 0,75\checkmark$
 $= 495 \text{ W}\checkmark$ (2)
- 3.8 3.8.1 Line voltage refers to the amount of voltage measured between any two line conductors in a balanced three-phase system.
- 3.8.2 Phase voltage refers to the voltage measured across any one component, such as the source winding or load impedance. (2 × 1) (2)
- [30]**

QUESTION 4

- 4.1 The force produced by voltage or current causes the pointer of a deflecting device to move from position zero. (2)
- 4.2
- Low sensitivity
 - Scale not uniform
 - Costs more than moving-iron instruments
 - Only used as voltmeters and ammeters (Any 3 × 1) (3)
- 4.3
- Connect the test leads into the sockets – the red to the $V\Omega$ terminal and the black lead to the COM terminal.
 - De-energise the circuit completely.
 - Remove the component to be measured from the circuit if possible.
 - Select the highest range on the ohm scale.
 - Connect the meter in parallel with the component. (5)
- 4.4 4.4.1 $R_{se} = \frac{V_T}{I_T} - R_m$ **OR** $R_T = \frac{V_T}{I_T}$
 $= \frac{150}{0,025} - 10\checkmark$ $= \frac{150}{0,025} = 6\,000\,\Omega$
 $= 5\,990\,\Omega\checkmark$ $R_{se} = R_T - R_m = 6\,000 - 10 = 5\,990\,\Omega$ (2)
- 4.4.2 (a) $I_{SH} = I_T - I_m$
 $= 20 - 0,025$
 $I_{SH} = 19,975 \text{ A}\checkmark$
- (b) $R_{SH} = \frac{R_m I_m}{I_{SH}}$
 $= \frac{10 \times 0,025}{19,975}\checkmark$
 $R_{SH} = 0,012\,\Omega\checkmark$ (3)

[15]

QUESTION 5

- 5.1 5.1.1 DC generator (1)
- 5.1.2 It converts mechanical energy into electrical energy. (2)
- 5.2 In a wave winding, the two ends of each coil are connected to the commutator segments placed between adjacent poles of the same polarity or the two ends of each coil are bent in opposite directions. (2)
- 5.3 5.3.1 A frame is the outer case or covering of a machine protecting the inner parts thereof. (1)
- 5.3.2 A stator is the stationary part of a machine creating a magnetic field. (1)
- 5.3.3 The armature core houses the armature conductors and rotates in the magnetic field to make the conductors cut the magnetic flux. (2)
- 5.4 5.4.1 • Varied speed
 • High starting torque (2)
- 5.4.2 • Elevators
 • Conveyor belts (2)
- 5.5 A self-excited generator is a generator in which the field excitation is provided by the armature. (2)
- 5.6 $V = E + I_a R_a$
- $E = V - I_a R_a$
- $= 220 - (40 \times 0,185)✓$
- $= 212,6 \text{ V}✓$ (2)
- 5.7 $V = E - I_a (R_a + R_{se})$
- $E = V + I_a (R_a + R_{se})$
- $= 330 + 30(0,05 + 0,15)✓$
- $= 336 \text{ V}✓$ (3)

TOTAL:**(3)**
[20]
100