higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE (VOCATIONAL)

ELECTRICAL PRINCIPLES AND PRACTICE
NQF LEVEL 3

2 December 2024

This marking guideline consists of 7 pages.

Copyright reserved

QUESTION 1

1.1 Because it has an equal number of protons (positive charges)✓ and electrons (negative charges).✓ (2)

1.2 1.2.1 Germanium
1.2.2 32
1.2.3 32
(3 × 1) (3)

1.3 Number of electrons = $2n^2$ (2)

1.4 $A = \frac{\pi d^2}{4}$

$= \frac{\pi \times (0{,}01)^2}{4}$ ✓

$= 78{,}54 \times 10^{-6} m^2$ ✓

$R = \frac{\rho l}{A}$

$= \frac{0{,}173 \times 10^{-6} \times 2000}{78{,}54 \times 10^{-6}}$ ✓

$= 4{,}405\ \Omega$ ✓ (4)

1.5
- The resistance of carbon increases as the temperature decreases.
- The resistance of carbon decreases as the temperature increases.

(Any 1 × 2) (2)

1.6
- When the resistance increases, the resistivity also increases.
- When the resistance decreases, the resistivity also decreases.
- Resistance is directly proportional to resistivity. (Any 1 × 2) (2)

[15]

QUESTION 2

2.1
- The conductor must be carrying current.
- The conductor must be in the magnetic field. (2)

2.2 2.2.1 Principle of electromagnetic induction (1)

2.2.2 When a conductor cuts across magnetic flux, ✓ an EMF or voltage will be induced across the end of the conductor.✓ (2)

Copyright reserved

2.3 2.3.1 The screw rule is used to determine the direction of the magnetic flux around a conductor. (2)

2.3.2 Lenz's law is used to determine the direction of the induced EMF. (1)

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

$\emptyset = BA$

$= 0{,}5 \times 100 \times 10^{-4}$ ✓

$= 0{,}005\ Wb\ or\ 5\ mWb$ ✓ (2)

2.5 2.5.1 $F = BIl$

$B = \frac{F}{Il}$

$= \frac{8}{4 \times 5}$ ✓

$= 0{,}4\ T$ ✓

2.5.2 $F = BIl\ sin\theta$

$= 0{,}4 \times 4 \times 5 \times\ sin45^0$ ✓

$= 5{,}657\ N$ ✓

2.5.3 $E = Blv\ sin\theta$

$= 0{,}4 \times 5 \times 10 \times sin60^0$ ✓

$= 17{,}321\ V$ ✓

(3 × 2) (6)

2.6
- Railroad crossings
- Telephones
- Fire and burglar alarms
- School bells
- Doorbells
- Alarms in industrial plants

(Any 2 × 1) (2)

2.7 $mmf = NI$

$$N = \frac{mmf}{I}$$

$$= \frac{600}{5} \checkmark$$

$$= 120\ turns \checkmark$$ (2)

[20]

QUESTION 3

3.1 $$I = \frac{E_T}{R_T + r_T}$$

$$= \frac{12}{10 + 0{,}3} \checkmark\checkmark$$

$$= 1{,}165\ A \checkmark$$ (3)

3.2 3.2.1 Polarised
3.2.2 Non-polarised

(2 × 1) (2)

3.3 $E_1 - E_2 = V_1 + V_2 + V_3$

$12 - E_2 = 2 + 3 + 1 \checkmark$

$12 - E_2 = 6 \checkmark$

$E_2 = 6\ V \checkmark$ (3)

3.4 The inductance of a coil is the ability of the coil to induce an EMF in itself or in an adjacent coil. (2)

3.5
- Three-phase AC power-supply system✓
- Single-phase AC power-supply system✓ (2)

3.6 3.6.1 $$R_T = \frac{R}{n}$$

$$= \frac{2}{8} \checkmark$$

$$= 0{,}25\ \Omega \checkmark$$ (2)

3.6.2 $R_T = \frac{R}{n}$

$= \frac{2}{7}$ ✓

$= 0{,}286\ \Omega$ ✓ (2)

3.6.3 $R_T = 0\ \Omega$ (1)

3.7 3.7.1
- The nickel-cadmium cell
- The nickel-iron cell (2)

3.7.2 Lead-acid battery (1)

3.8 3.8.1 $V_P = \frac{V_L}{\sqrt{3}}$

$= \frac{400}{\sqrt{3}}$ ✓

$= 230{,}94\ V$ ✓ (2)

3.8.2 $P = \sqrt{3}\, V_L I_L cos\theta$

$I_L = \frac{P}{\sqrt{3}\, V_L cos\theta}$

$= \frac{20 \times 10^3}{\sqrt{3} \times 400 \times 0{,}85}$ ✓

$= 33{,}962\ A$ ✓

$I_P = I_L = 33{,}962\ A$ ✓ (3)

3.9
- A step-down transformer has more windings on the primary coil than on the secondary coil.

OR

It has fewer windings on the secondary coil than on the primary coil.

- A step-up transformer has fewer windings on the primary coil than on the secondary coil.

OR

It has more windings on the secondary coil than on the primary coil. (2)

3.10
- Copper loss
- Eddy-current loss
- Hysteresis loss (3)

[30]

Copyright reserved

QUESTION 4

4.1 4.1.1 $I_{SH} = I_T - I_m$

$= 1 - 0{,}002$

$I_{SH} = 0{,}998\ A$ ✓

$R_{SH} = \frac{R_m I_m}{I_{SH}}$

$= \frac{10 \times 0{,}002}{0{,}998}$ ✓

$R_{SH} = 0{,}02\ \Omega$ ✓ (3)

4.1.2 $R_{se} = \frac{V_T}{I_T} - R_m$ OR $R_T = \frac{V_T}{I_T}$

$= \frac{12}{0{,}002} - 10$✓ $= \frac{12}{0{,}002} = 6\ 000\ \Omega$

$= 5\ 990\ \Omega$✓ $R_{se} = R_T - R_m = 6000 - 10 = 5\ 990\ \Omega$ (2)

4.2 4.2.1
- Close the switch.
- Connect the test leads to the appropriate sockets.
- Set up the instrument to measure DC voltage.
- Select the highest range first.
- Connect the meter in parallel with the 10-Ω resistor.

(Any other relevant answer) (5)

4.2.2 To protect the meter from damage (1)

4.3 Voltage tester (1)

4.4
- One-wattmeter-method for a balanced load
- Two-wattmeter-method for a balanced or unbalanced load
- Three-wattmeter-method for a three-phase, four-wire system for balanced and unbalanced loads (3)

[15]

QUESTION 5

5.1
- Direct online starter
- Star-delta starter
- Auto-transformer starter (3)

5.2
- Cumulative compound motor: The series winding is connected to aid the shunt winding.
- Differential compound motor: The series winding is connected to oppose the shunt winding. (2)

5.3 5.3.1 DC machine (1)

5.3.2 A = Yoke
B = Field winding
C = Field pole
D = Pole shoe
E = Commutator
F = Armature conductor (6)

5.4 $I_{sh} = \frac{V}{R_{sh}}$

$= \frac{220}{50}$ ✓

$= 4{,}4\ A$ ✓

$I_a = I + I_{sh}$

$= 150 + 4{,}4$

$= 154{,}4\ A$ ✓

$E = V + I_a R_a$

$= 220 + 154{,}4 \times 0{,}01$ ✓

$= 221{,}544\ V$ ✓ (5)

5.5 $E = V - I_a R_a$

$R_a = \frac{V - E}{I_a}$

$= \frac{100 - 70}{2}$ ✓✓

$= 15\ \Omega$ ✓ (3)

[20]

TOTAL: 100

Copyright reserved