higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE (VOCATIONAL)

ELECTRICAL PRINCIPLES AND PRACTICE
NQF LEVEL 3

4 NOVEMBER 2022

This marking guideline consists of 8 pages.

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QUESTION 1

1.1 1.1.1 Potential difference or terminal voltage
1.1.2 Electromotive force
(2 × 1) (2)

1.2 1.2.1 Protons:✓ positive charge✓
Neutrons:✓ no charge (neutral)✓ (4)

1.2.2 Electron (1)

1.2.3 Free electron (1)

1.3 1.3.1 When it has lost electrons
1.3.2 When it has gained electrons
(2 × 1) (2)

1.4 $R = \frac{\rho l}{A}$

$= \frac{0{,}017 \times 10^{-6} \times 6000}{10 \times 10^{-6}}$ ✓ ✓

$= 10{,}2\ \Omega$ ✓ (3)

1.5 The resistance of carbon decreases with an increase in temperature OR The resistance of carbon increases with a decrease in temperature.✓✓ (2)
[15]

QUESTION 2

2.1 Extend the thumb, the index finger, and the middle finger of the right hand so that they are all at right angles to each other.✓ If the index finger points in the direction of the magnetic field✓ and the thumb points in the direction of motion,✓ then the middle finger will point in the direction of the induced emf.✓ (4)

2.2 A brush makes an electrical contact between the power supply and the commutator.✓✓ (2)

2.3 2.3.1 $E = Blv$
$= 5 \times 0{,}4 \times 10$ ✓
$= 20\ V$ ✓

2.3.2 $E = Blv\ sin\theta$
$= 5 \times 0{,}4 \times 10 \times sin45^0$ ✓
$= 14{,}142\ V$ ✓
(2 × 2) (4)

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

$= \frac{0,055}{16 \times 10^{-4}}$ ✓

$= 34,375\ T$ ✓ (2)

2.5 Magnetic flux density is a measurement of the strength of a magnetic field at a particular point. ✓✓ (2)

2.6 $F = \frac{2 \times 10^{-7} \times I_1 \times I_2}{d}$

$= \frac{2 \times 10^{-7} \times 3 \times 3}{0,002}$ ✓

$= 0,0009\ N/m \quad or \quad 9 \times 10^{-4}\ N/m$ ✓ (2)

2.7 $F = BIl\ sin\theta$

$= 4 \times 12 \times 0,5 \times sin60^0$✓

$= 20,785\ N$ ✓ (2)

2.8 $mmf = NI$

$= 300 \times 5$ ✓

$= 1500\ A$ ✓ (2)

[20]

QUESTION 3

3.1 Terminal voltage is the voltage measured across the terminals of the load when the circuit is switched on. ✓✓ (2)

3.2
- Self-inductance is when an emf is induced in the same circuit as that in which the current is changing.✓✓
- Mutual inductance is when an emf is induced in a circuit by a change of flux due to current changing in an adjacent circuit.✓✓ (4)

3.3
- Alarm clocks
- Watches
- Hearing aids
- Back-up power circuitry (Any 2 × 1) (2)

3.4 $/E/= L\frac{di}{dt}$

$3{,}2 = L \times 16$ ✓

$L = \frac{3{,}2}{16} = 0{,}2\ H$ ✓ (2)

3.5 3.5.1 $R_P = \frac{R_1 \times R_2}{R_1 + R_2}$ OR $\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2}$

$= \frac{2 \times 6}{2 + 6}$ ✓ $= \frac{1}{2} + \frac{1}{6}$

$= 1{,}5\ \Omega$ ✓ $= \frac{4}{6}$

$R_P = \frac{6}{4} = 1{,}5\ \Omega$

$R_S = R_P + R_3$

$= 1{,}5 + 4$

$= 5{,}5\ \Omega$ ✓

$R_T = \frac{R_S \times R_4}{R_S + R_4}$ OR $\frac{1}{R_T} = \frac{1}{R_S} + \frac{1}{R_4}$

$= \frac{5{,}5 \times 8}{5{,}5 + 8}$ ✓ $= \frac{1}{5{,}5} + \frac{1}{8}$

$= 3{,}26\ \Omega$ ✓ $= 0{,}307$

$R_T = \frac{1}{0{,}307} = 3{,}26\ \Omega$ (5)

3.5.2 $I_S = \frac{V_T}{R_S}$

$= \frac{12}{5{,}5}$ ✓

$= 2{,}182\ A$ ✓

$V_{4\Omega} = I_S R_3$

$= 2{,}182 \times 4$ ✓

$= 8{,}728\ V$ ✓ (4)

3.5.3 $R_T = \frac{R_3 \times R_4}{R_3 + R_4}$ OR $\frac{1}{R_T} = \frac{1}{R_3} + \frac{1}{R_4}$

$= \frac{4 \times 8}{4 + 8}$ ✓ $= \frac{1}{4} + \frac{1}{8}$

$= 2{,}667\ \Omega$ ✓ $= \frac{3}{8}$

$R_T = \frac{8}{3} = 2{,}667\ \Omega$

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

$= \frac{12}{2{,}667}$ ✓

$= 4{,}499\ A\ OR\ 4{,}5\ A$ ✓ (4)

3.6 3.6.1 $V_{P1} = V_{L1} = 6{,}6\ kV\ or\ 6600\ V$ (1)

3.6.2 $Transformer\ ratio = \frac{V_{P1}}{V_{P2}}$

$= \frac{6600}{220}$ ✓

$= 30:1$ ✓ (2)

3.6.3 $V_{L2} = \sqrt{3}\ V_{P2}$

$= \sqrt{3} \times 220$ ✓

$= 381{,}051\ V$ ✓ (2)

3.7 A Buchholz relay is used to detect an abnormal condition in a tank and sends an alarm or trip signal.✓✓ (2)
[30]

QUESTION 4

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

$= 2 - 0{,}01$

$I_{SH} = 1{,}99\ A$ ✓

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

$= \frac{8 \times 0{,}01}{1{,}99}$ ✓

$R_{SH} = 0{,}04\ \Omega$ ✓ (3)

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

$= \frac{125}{0{,}01} - 8$ ✓ $= \frac{125}{0{,}01} = 12\ 500\ \Omega$

$= 12\ 492\ \Omega$ ✓ $R_{se} = R_T - R_m = 12500 - 8 = 12\ 492\ \Omega$ (2)

4.2 4.2.1 Insulation resistance tester or megger (1)

4.2.2 It used to measure the insulation resistance of an installation or appliance.✓✓ (2)

4.2.3
- Take the battery out if you are not going to use the instrument for a longer period.
- Coil up the leads neatly.
- Store the meter in its protective case.
- Store the meter away from direct sunlight.
- Store the meter where it is not exposed to water or moisture.
- Always read and follow the manufacturer's instructions when storing this instrument. (Any 5 × 1) (5)

4.3
- Ammeter or multimeter
- Tong tester or clamp meter (2)

[15]

QUESTION 5

5.1 5.1.1 Wave winding

5.1.2 Lap winding (2 × 1) (2)

5.2 5.2.1 DC-motor (1)

5.2.2 It converts electrical energy into mechanical energy. (2)

5.3 $I_{SH} = \frac{V}{R_{SH}}$

$= \frac{250}{100}$ ✓

$= 2{,}5\ A$ ✓

$E = V - I_a R_a$

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

$= \frac{250 - 220}{0{,}3}$ ✓

$= 100\ A$ ✓

$I_T = I_{SH} + I_a$

$= 2{,}5 + 100$

$= 102{,}5\ A$ ✓ (5)

5.4 $E = V + I(R_a + R_{se})$

$= 250 + 70(0{,}25 + 0{,}04)$ ✓✓

$= 270{,}3\ V$ ✓ (3)

5.5 Used for driving:

- Fans
- Grinders
- Washing machines
- Woodworking tools (Any 3 × 1) (3)

5.6
- Hysteresis core loss
- Eddy current loss (2)

5.7
- Speed can be varied
- High starting torque (2)

[20]

TOTAL: 100

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