



**higher education  
& training**

Department:  
Higher Education and Training  
**REPUBLIC OF SOUTH AFRICA**

# **MARKING GUIDELINE**

**NATIONAL CERTIFICATE**

**ELECTRICAL TRADE THEORY N2**

**9 April 2020**

**This marking guideline consists of 7 pages.**

**QUESTION 1: CONDUCTORS AND CABLES**

- 1.1
- The conductor and insulation factor (CIF)
  - The conductor cross sectional area (A)
  - The time duration of the fault current (t)
- (3)
- 1.2
- $$P = \sqrt{3} V_L I_L \cos \theta$$
- $$I_L = \frac{P}{\sqrt{3} V_L \cos \theta} \checkmark$$
- $$= \frac{60000}{\sqrt{3} \times 380 \times 0,8} \checkmark$$
- $$= 113,95 \text{ A} \checkmark$$
- (3)
- 1.3
- Motors
  - Contactors
  - Relays
  - Discharge lamps
  - Transformers
  - Timers
- (Any 4 × 1) (4)
- 1.4 kVA or MVA (1)
- [11]**

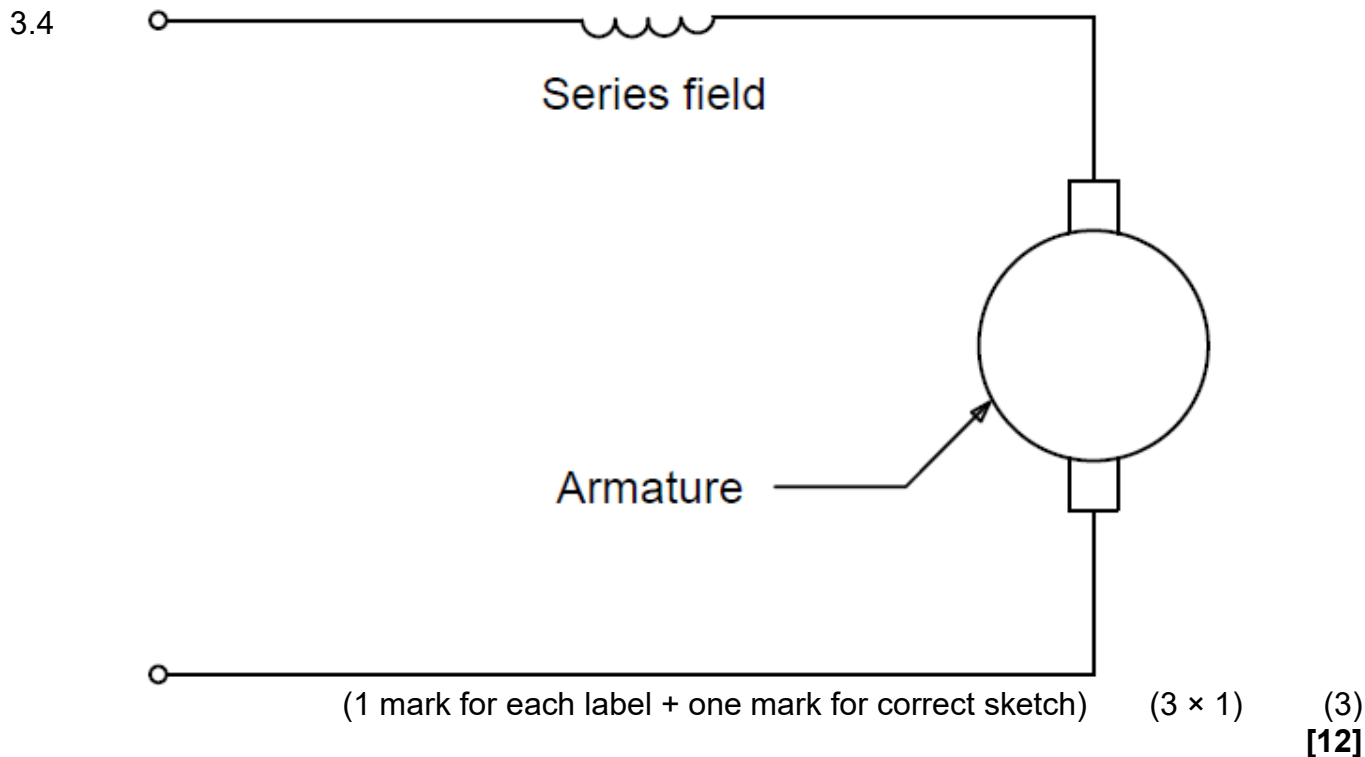
**QUESTION 2: SWITCHGEAR, CONTACTORS AND RELAYS**

- 2.1
- 2.1.1 False
- 2.1.2 True
- 2.1.3 True (3 × 1) (3)
- 2.2
- 2.2.1 Small electromagnetic switch with one or more sets of contacts.
- 2.2.2 Large electromagnetic switch with one or more sets of contacts.
- 2.2.3 To open and close contacts in order to open or close a circuit
- 2.2.4 To open and close contacts in order to open or close a circuit.
- 2.2.5 Operated remotely
- 2.2.6 Operated remotely (6 × 1) (6)

- 2.3
- Resin joint with taped conductors
  - Hot shrink joint
  - Cold shrink joint
  - Hot or cold shrink joint with resin
  - Resin pressure joint
  - Metal joint boxes filled with a sealing compound.
- (Any 3 × 1) (3)  
**[12]**

**QUESTION 3: DC MOTORS AND STARTERS**

- 3.1 3.1.1 Shunt field / Series field  
3.1.2 Series field / Shunt field (2 × 1) (2)
- 3.2 It has a dangerously high speed at no load. (1)
- 3.3 3.3.1 DC motor / DC generator / DC machine (1)
- 3.3.2 A = Field winding  
B = Pole shoe  
C = Armature winding  
D = Brush  
E = Commutator (5 × 1) (5)



**QUESTION 4: AC MOTORS AND STARTERS**

- 4.1 Main winding / running winding  
Starting winding / auxiliary winding (2)
- 4.2 The purpose of a centrifugal switch is to disconnect the starting winding of a motor✓once the rotor has reached a certain speed. ✓ (2)
- 4.3 4.3.1 Stator is a stationary part of the motor.
- 4.3.2 Rotor is a rotating part of the motor. (2 × 1) (2)
- 4.4 There will be no force on the rotor bars if the field and rotor at the same speed.✓ Bars must cut through the magnetic flux.✓  
(Any other relevant answer) (2)
- 4.5 4.5.1 Bars are used
- 4.5.2 Winding wires are used (2 × 1) (2)
- 4.6
- They are self-starting
  - For the same output they have a higher starting torque
  - They are more efficient
  - They are available in many sizes.
  - For the same output they are cheaper
  - For the same output their physical size is smaller.
  - They require less maintenance
  - Very simple construction (Any 5 × 1) (5)
- [15]**

**QUESTION 5: EARTHING**

- 5.1 5.1.1 The metal frame and star point of the winding✓ are earthed.✓ (2)
- 5.1.2 An earth conductor runs above the power cables✓ and is connected to the steel frames (pylons) and a common earth.✓ (2)
- 5.1.3
- Overhead earth wires stretching across the substation
  - Tall metal earth poles to redirect lightning away from equipment
  - Earth rods and mats together with a bare wire grid laid in the ground (3)
- 5.2 Floating earth is a zero-volt connection point that is not connected to the consumer's earth continuity conductor.✓ Noncurrent-carrying conductive parts are connected together.✓ (2)

- 5.3
- To provide a return path for earth leakage current.
  - To have neutral as close as possible to earth potential.
  - To reduce *touch voltage*.
  - To stabilise the phase to earth voltages.
  - To ensure protective circuitry will operate if fault occurs. (Any 3 × 1) (3)
- [12]**

### QUESTION 6: PROTECTION

- 6.1 Time delay is obtained by the amount of time it takes for the heating element to heat up✓ as well as the time it takes for the bi-metal strip to bend. ✓ (2)
- 6.2 When the ambient temperature is very low, ✓ the tripping current as well as the time delay is increased. ✓ When the ambient temperature is very high, ✓ the overcurrent tripping value as well as the time delay is reduced. ✓ (4)
- 6.3 Pressing the test button on an earth leakage causes a 15 to 30 mA difference in the live and neutral current.✓ This will result in an emf being induced in the secondary winding activating the tripping circuit.✓ The tripping coil is energised✓ and the circuit is disconnected from the supply✓. (Any other relevant answer) (4)
- [10]**

### QUESTION 7: MEASURING INSTRUMENTS

- 7.1 Energy meter is used to measure the amount of electrical energy consumed by means of watt-hour meter/kilowatt-hour meter. (1 × 2) (2)
- 7.2 Current coil/fixed coil  
Voltage coil/moving coil (2)
- 7.3 Electrodynamometer type/Dynamometer type  
Induction type (2)
- [6]**

**QUESTION 8: TRANSFORMERS**

8.1      8.1.1       $\frac{V_1}{V_2} = \frac{N_1}{N_2}$

$$V_2 = \frac{N_2 \times V_1}{N_1}$$

$$= \frac{1 \times 220}{25} \checkmark$$

$$= 8,8 \text{ V } \checkmark$$

8.1.2       $\frac{I_2}{I_1} = \frac{N_1}{N_2}$       *OR*       $\frac{I_2}{I_1} = \frac{V_1}{V_2}$

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

$$= \frac{1 \times 10}{25} \checkmark$$

$$= 0,4 \text{ A } \checkmark$$

$$I_1 = \frac{V_2 I_2}{V_1}$$

$$= \frac{8,8 \times 10}{220}$$

$$= 0,4 \text{ A}$$

(2 × 2)      (4)

8.2      8.2.1       $\text{Turns ratio} = \frac{V_1}{V_2}$

$$= \frac{220}{11} \checkmark$$

$$= 20:1 \checkmark$$

(2)

8.2.2       $\frac{V_1}{V_2} = \frac{N_1}{N_2}$

$$N_2 = \frac{V_2 \times N_1}{V_1}$$

$$= \frac{11 \times 2000}{220} \checkmark$$

$$= 100 \text{ V } \checkmark$$

(2)

- 8.3      8.3.1       $V_{P1} = 2200 \text{ V} \checkmark$  (1)
- 8.3.2       $V_{L1} = 220 \text{ V} \checkmark$  (1)
- 8.3.3       $I_{P1} = \frac{I_{L1}}{\sqrt{3}}$
- $= \frac{120}{\sqrt{3}} \checkmark$
- $= 69,282 \text{ A} \checkmark$  (2)
- [12]**

**QUESTION 9: ELECTRONICS**

- 9.1      The Zener diode will not conduct in reverse-bias mode until the breakdown voltage is reversed. ✓ Thereafter the current will have to be limited ✓ because the Zener voltage remains constant at that value. ✓ (3)
- 9.2      In an NPN transistor, current flows from the collector to the emitter. ✓ In a PNP transistor, current flows from the emitter to the collector. ✓ (2)
- 9.3      9.3.1      If the rated voltage is exceeded, the diode will be damaged. (1)
- 9.3.2      A rectifier is used to convert AC to DC. (2)
- 9.3.3      When the positive terminal of a battery is connected to P-type material ✓ and the negative terminal is connected to N-type material. ✓

OR

- When the anode is positive with respect to the cathode. (2)
- [10]**

**TOTAL: 100**