



**higher education  
& training**

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

# **MARKING GUIDELINE**

**NATIONAL CERTIFICATE**

**ELECTRICAL TRADE THEORY N2**

**5 August 2021**

**This marking guideline consists of 8 pages.**

**QUESTION 1: ALTERNATING CURRENT THEORY**

- 1.1.1 RMS value: value of an alternating quantity producing the same heat energy as direct quantity when applied to same resistance.
- 1.1.2 Instantaneous value of alternating quantities: are smaller values occurring at specific instant before or after the maximum value of a wave.

(2 x 2) (4)

1.2 1.2.1  $E_{RMS} = 0,707E_M$   
 $= 0,707 \times 200 \checkmark$   
 $= 141,4 \text{ V} \checkmark$

1.2.2  $E_{AVE} = 0,637E_M$   
 $= 0,637 \times 200 \checkmark$   
 $= 127,4 \text{ V} \checkmark$

1.2.3  $2\pi ft = 314,28t$   
 $f = \frac{314,28t}{2\pi} \checkmark$   
 $= 50\text{Hz} \checkmark$

1.2.4  $\text{form factor} = \frac{\text{RMS value}}{\text{Ave value}}$

$$\text{form factor} = \frac{141,4}{127,4} \checkmark$$

$$\text{form factor} = 1,11 \checkmark$$

(4 x 2) (8)  
[12]**QUESTION 2: CONDUCTORS, INSULATORS AND CABLES**

- 2.1 2.1.1 True  
 2.1.2 False  
 2.1.3 False

(3 x 1) (3)

- 2.2 2.2.1 Thermal insulation  
 Electrical insulator in electronic appliance  
 Insulation between commutator segment of DC machine

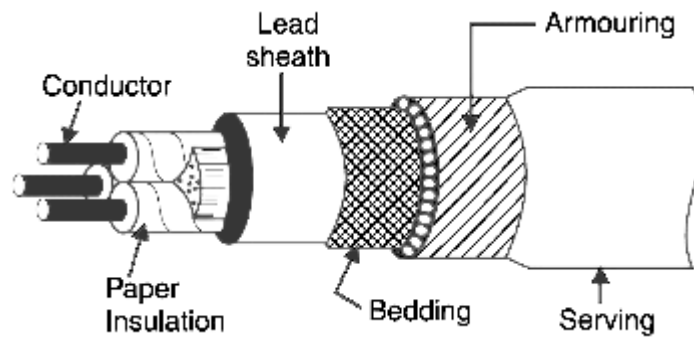
(Any one)

- 2.2.2 Used to manufacture various components including telephone casing, kitchenware, circuit-breaker casing, children's toys

- 2.2.3 Used in overhead line insulators

(3 x 1) (3)

2.3



(ONE mark for each correct labelling)

(6)  
[12]**QUESTION 3: SWITCHGEAR, CONTACTORS AND RELAYS**

- |     |   |  |      |
|-----|---|--|------|
| 3.1 | A disconnecter is an off-load isolator✓ whilst a switch disconnecter is an on-load isolator.✓ |  | (2)  |
| 3.2 | 3.2.1   | Circuit breaker  |      |
|     | 3.2.2   | Earth-leakage unit   |      |
|     | 3.2.3   | Surge arrestor   |      |
|     |   | (3 × 1)  | (3)  |
| 3.3 | Coil  |  | (1)  |
| 3.4 | 3.4.1   | Maximum current that will be able to flow through a circuit breaker before it opens the circuit.   |      |
|     | 3.4.2   | Maximum fault current that a circuit breaker is capable of interrupting or capable of withstanding |      |
|     |   | (2 × 2)  | (4)  |
|     |   |  | [10] |

**QUESTION 4: BATTERIES**

- |     |   |                              |     |
|-----|---|------------------------------|-----|
| 4.1 | • | Size of plates               |     |
|     | • | Rate of discharge            |     |
|     | • | Number of plates             |     |
|     | • | Quantity of active materials |     |
|     | • | Temperature                  |     |
|     |   | (5 × 1)                      | (5) |
| 4.2 | • | Motor cycles                 |     |
|     | • | Marine equipment             |     |
|     | • | Wheelchairs                  |     |
|     | • | Camcorders                   |     |
|     | • | Telecommunication industry   |     |
|     |   | (2 × 1)                      | (2) |

- 4.3      4.3.1      Positive electrode  
             4.3.2      Negative electrode  
             4.3.3      Medium transport of lithium ions from the cathode to the anode or vice versa

(3 × 1)

(3)

**[10]****QUESTION 5: DC MACHINES**

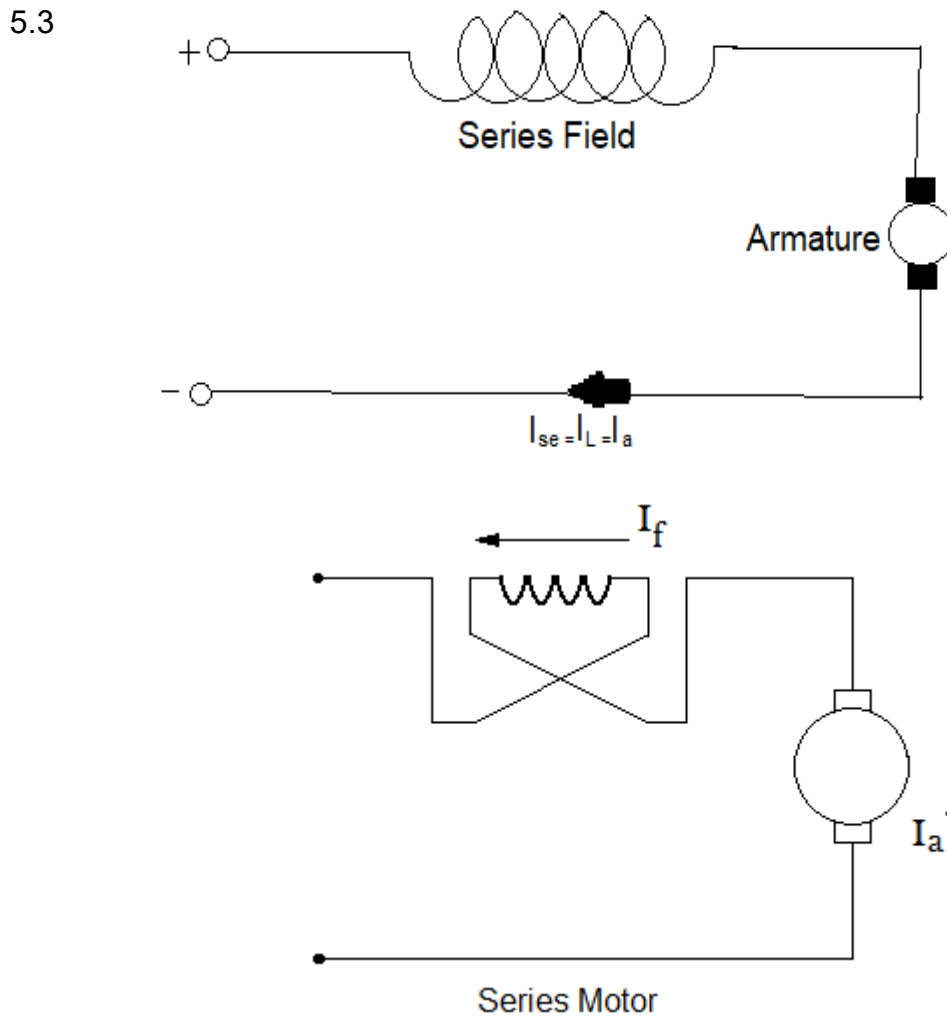
- 5.1      Distortion of the main magnetic field entering and leaving the armature caused by the magnetic field of the armature.

(2)

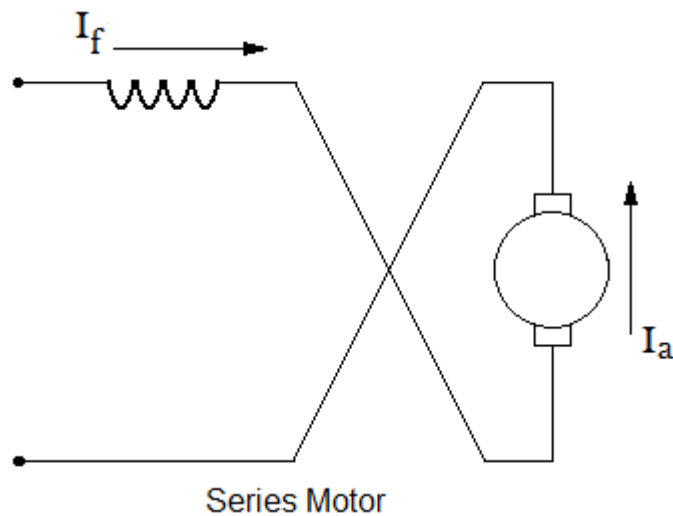
- 5.2      •      Shifting brushes  
             •      Increasing brush contact resistance  
             •      Increasing field flux  
             •      Interpoles

(Any 2 × 1)

(2)



Or



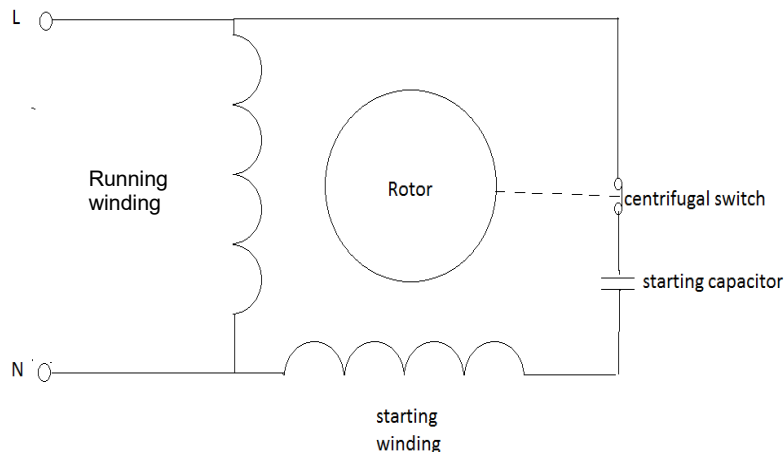
Supply	ONE mark for each sketch
Reversing of field winding	ONE mark for each sketch
Direction of current	ONE mark for each sketch

(3 × 2)

(6)  
[10]**QUESTION 6: AC MACHINES**

- 6.1
- Simple construction
  - Self-starting
  - Higher starting torque for same output
  - More efficient
  - Available in various sizes
  - Cheaper for same output
  - Small physical size for same output
- (Any 2 × 1) (2)
- 6.2
- Consists of steel laminations, with aluminium or copper conductors embedded in its surface
  - The conductor bars are inserted from one end of the rotor and as one bar in each slot.
  - The rotor bars are then short-circuited at the ends with end rings.
- (3)

6.3



½ mark for each correct label

(3)  
[8]**QUESTION 7: TRANSFORMERS**

7.1      7.1.1       $V_{L2} = \sqrt{3} V_{P2}$

$V_{L2} = \sqrt{3} \times 220$

$V_{L2} = 381,051 \text{ V} \quad \checkmark$  (1)

7.1.2       $I_{P1} = \frac{I_{L1}}{\sqrt{3}}$

$= \frac{120}{\sqrt{3}} \quad \checkmark$

$= 69,282 \text{ A} \quad \checkmark$  (2)

7.1.3       $S = \sqrt{3} V_{L1} I_{L1}$       OR       $S = 3 V_{P1} I_{P1}$

$S = \sqrt{3} \times 1100 \times 120 \quad \checkmark$        $S = 3 \times 1100 \times 69,282$

$= 228,631 \text{ kVA} \quad \checkmark$        $= 228,631 \text{ kVA}$  (2)

7.2      A transformer transfers AC electrical power from one electric circuit to another through the process of electromagnetic induction, converting one voltage to another. (2)

- 7.3
- Star-star connection
  - Delta-star connection
  - Star-Delta connection
  - Delta-delta connection
- (Any 3 × 1) (3)  
[10]

**QUESTION 8: EARTHING**

- 8.1
- Electrically separate high voltage from user (isolating transformer)
  - Earth conductive parts
  - Enclose equipment operating with high voltage (e.g. fencing)
  - Double-insulate electric equipment
  - Install earth leakage protection
  - Bond all to common earth to ensure electrical earth continuity
- (Any relevant 4 × 1) (4)
- 8.2      8.2.1      Connecting earth continuity conductor✓ to cable armouring or steel enclosure✓
- 8.2.2      Fixing (Tightening) cable and electrically connect✓ armouring to equipment.✓ (2 × 2) (4)
- 8.3      Voltage which, during insulation fault, appears between simultaneously accessible conductive parts (2) [10]

**QUESTION 9: MEASURING INSTRUMENT**

- 9.1
- Relatively expensive
  - Can be affected by ambient temperature
  - Voltage limitations
  - Battery operated LCD display
- (Any 3 × 1) (3)
- 9.2      9.2.1      B
- 9.2.2      A
- 9.2.3      C
- (3 × 1) (3) [6]

**QUESTION 10: RENEWABLE ENERGY AND ELECTRICAL RETICULATION**

- 10.1
- Solar
  - Wind
  - Biomass
  - Ocean
  - Water
  - Geothermal
  - Hydrogen
- (Any relevant 4 × 1) (4)

10.2	<ul style="list-style-type: none"><li>• Gas turbine power station</li><li>• Solar power station</li><li>• Wind turbine power station</li><li>• Hydroelectric power station</li><li>• Nuclear power station</li><li>• Coal fired power station</li></ul>	(Any relevant 4 × 1)	(4)
10.3	Infrastructure and conductors ensuring delivery of electrical energy from all points of generation to all points of consumption		(2)
10.4	The electrical power is transmitted in delta (in delta connection neutral point does not exist)		(2)
			<b>[12]</b>
<b>TOTAL:</b>			<b>100</b>