



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

ELECTRO-TECHNOLOGY N3

15 August 2025

This marking guideline consists of 7 pages.

QUESTION 1

- 1.1 True ✓
- 1.2 True ✓
- 1.3 False ✓
- 1.4 False ✓
- 1.5 True ✓
- 1.6 False ✓
- 1.7 True ✓
- 1.8 True ✓
- 1.9 False ✓
- 1.10 True ✓

(10 × 1) [10]

QUESTION 2

- 2.1 To evenly distribute the main magnetic flux over the air gap between the stator and rotor. ✓ (2)

2.2

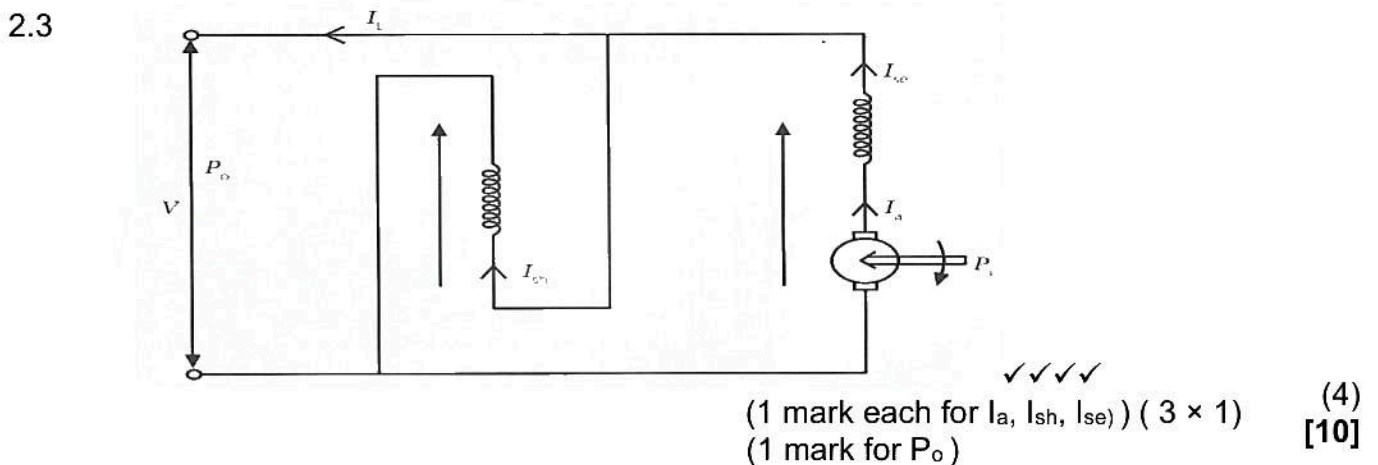
$$T = \frac{0,318 I_a \phi p Z}{c}$$

$$Z = \frac{cT}{0,318 I_a \phi p} = \frac{(2)(95)}{(0,318)(40)(30 \times 10^{-3})(2)} \checkmark$$

$$= 248,952 \checkmark$$

Number of slots = $\frac{\text{Conductors}}{\text{cond/slots}} = \frac{248,952}{8} = 31,119 \checkmark$

≈ 32 slots ✓ (4)



QUESTION 3

- 3.1
- Increasing brush contact resistance.✓
 - Using interpoles.✓
 - Using compensating windings.✓
 - Shifting brushes forward in a generator and backwards in a motor.✓
- (Any 3 × 1) (3)
- 3.2
- 3.2.1 The distance between the center of the poles.✓✓
OR
The periphery of the armature divided by the number of poles. ✓✓ (2)
- 3.2.2 The distance between the coil sides.✓✓
OR
The periphery of the armature spanned by two sides of the coil. ✓✓ (2)
- 3.3
- $$E = \frac{2p\phi ZN}{60c}$$
- $$Z = \frac{60Ec}{2p\phi N}$$
- $$Z = \frac{60(240)(6)}{2(3)(20 \times 10^{-3})(1200)} \quad \checkmark\checkmark$$
- $$= 600 \text{ conductors} \checkmark$$
- (3)
[10]

QUESTION 4

- 4.1
- 4.1.1 Summation of losses or Swinburne method. ✓ (1)
- 4.1.2 Regenerative method or Back-to-back method. ✓ (1)
- 4.2
- 4.2.1 $P_i = VI_L = (210)(35) \checkmark$
 $= 7350 \text{ W or } 7,35 \text{ kW} \checkmark$ (2)
- 4.2.2 $\eta = \frac{P_o}{P_i} \times 100\%$
 $P_o = \eta \times P_i = (0,91)(7350) \checkmark$
 $= 6688,5 \text{ W or } 6,689 \text{ kW} \checkmark$ (2)
- 4.2.3 $W - S = mg = (19,5)(9,81) = 191,295 \text{ N} \checkmark$ (1)
- 4.2.4 $P_o = \frac{2\pi Nr(W - S)}{60}$
 $N = \frac{60P_o}{2\pi r(W - S)} = \frac{60(6688,5)}{2\pi(0,3)(191,295)} \quad \checkmark\checkmark$
 $= 1112,949 \text{ r/min} \checkmark$ (3)

QUESTION 5

$$\begin{aligned}
 5.1 \quad 5.1.1 \quad \omega &= 2\pi f = 640 \\
 f &= \frac{640}{2\pi} \checkmark \\
 &= 101,859 \text{ Hz } \checkmark
 \end{aligned}
 \tag{2}$$

$$\begin{aligned}
 5.1.2 \quad e &= 250 \sin(640t \times 57,3) \\
 &= 250 \sin(640 \times 0,003 \times 57,3) \checkmark \\
 &= 234,899 \text{ V } \checkmark
 \end{aligned}
 \tag{2}$$

$$\begin{aligned}
 5.2 \quad 5.2.1 \quad I_{\text{ave}} &= \frac{i_1 + i_2 + i_3 + i_4 + i_5 + i_6 + i_7 + i_8}{8} \\
 &= \frac{1,3 + 3,8 + 6 + 7,9 + 9 + 10,2 + 9 + 8,6}{8} \checkmark \\
 &= \frac{55,8}{8} \checkmark \\
 &= 6,975 \text{ A } \checkmark
 \end{aligned}
 \tag{3}$$

$$\begin{aligned}
 5.2.2 \quad I_{\text{rms}} &= \sqrt{\frac{i_1^2 + i_2^2 + i_3^2 + i_4^2 + i_5^2 + i_6^2 + i_7^2 + i_8^2}{8}} \\
 &= \sqrt{\frac{1,3^2 + 3,8^2 + 6^2 + 7,9^2 + 9^2 + 10,2^2 + 9^2 + 8,6^2}{8}} \checkmark \\
 &= \sqrt{\frac{454,54}{8}} \checkmark \\
 &= 7,538 \text{ A } \checkmark
 \end{aligned}
 \tag{3}$$

[10]

QUESTION 6

$$6.1 \quad 6.1.1 \quad I_R = \frac{V_T}{R} = \frac{200}{12} = 16,667 \text{ A } \checkmark
 \tag{1}$$

$$\begin{aligned}
 6.1.2 \quad X_L &= 2\pi fL \\
 &= 2\pi(50)(38 \times 10^{-3}) = 11,938 \Omega \checkmark \\
 I_L &= \frac{V_T}{X_L} = \frac{200}{11,938} \checkmark \\
 &= 16,753 \text{ A } \checkmark
 \end{aligned}
 \tag{3}$$

$$\begin{aligned}
 6.1.3 \quad I_T &= \sqrt{I_R^2 + I_L^2} \\
 &= \sqrt{(16,667)^2 + (16,753)^2} \checkmark \\
 &= 23,632 \text{ A } \checkmark
 \end{aligned}
 \tag{2}$$

6.2

$$F_r = \frac{1}{2\pi\sqrt{LC}}$$

$$C = \frac{1}{(2\pi F_r)^2 L} = \frac{1}{(2\pi \times 1 \times 10^3)^2 (150 \times 10^{-3})} \checkmark \checkmark \checkmark$$

$$= 1,689 \times 10^{-7} \text{ F or } 168,869 \text{ nF } \checkmark$$

(4)
[10]

QUESTION 7

7.1

- Three-phase motors can deliver more power to the consumer.✓
- Three-phase systems generate higher torque.✓
- There are two operating voltages, namely phase voltage and line voltage.✓
- Three-phase motors have simple construction and are cheaper.✓
- Three-phase motors are self-starting.✓
- Three-phase systems are more economical.✓
- Single-phase loads can be supplied by a three-phase source.✓
- Domestic and industrial consumers can be supplied from the same system.✓

(Any 4 × 1) (4)

7.2

7.2.1 $V_p = V_L = 650 \text{ V } \checkmark$

(1)

7.2.2 $P = \sqrt{3} V_L I_L \cos \theta$

$$I_L = \frac{P}{\sqrt{3} V_L \cos \theta} = \frac{150 \times 10^3}{\sqrt{3} (650) (0,88)} \checkmark \checkmark$$

$$= 151,403 \text{ A } \checkmark$$

$$I_P = \frac{I_L}{\sqrt{3}} = \frac{151,403}{\sqrt{3}} \checkmark$$

$$= 87,413 \text{ A } \checkmark$$

(5)
[10]

QUESTION 8

8.1

- Air cooling/Natural air cooling/Forced cooling.✓
- Oil cooling/Oil-immersed air cooling/Oil-immersed water cooling.✓

(Any 2 × 1) (2)

8.2

8.2.1 $T.R = \frac{N_1}{N_2} = \frac{1200}{300} \checkmark$

$$= 4 : 1 \checkmark$$

(2)

$$\begin{aligned}
 8.2.2 \quad \frac{V_1}{V_2} &= \frac{N_1}{N_2} \\
 V_2 &= \frac{N_2 \times V_1}{N_1} = \frac{(300)(230)}{1200} \checkmark \\
 &= 57,5 \text{ V } \checkmark
 \end{aligned}
 \tag{2}$$

$$\begin{aligned}
 8.2.3 \quad \frac{N_1}{N_2} &= \frac{I_2}{I_1} & \text{OR} & \quad \frac{V_1}{V_2} = \frac{I_2}{I_1} \\
 I_2 &= \frac{N_1 \times I_1}{N_2} = \frac{(1200)(5)}{300} \checkmark & I_2 &= \frac{V_1 \times I_1}{V_2} = \frac{(230)(5)}{57,5} \checkmark \\
 &= 20 \text{ A } \checkmark & &= 20 \text{ A } \checkmark
 \end{aligned}
 \tag{2}$$

$$\begin{aligned}
 8.2.4 \quad S &= \frac{V_1 I_1}{1000} = \frac{(230)(5)}{1000} \checkmark \\
 &= 1,15 \text{ kVA or } 1150 \text{ VA } \checkmark \\
 \text{OR} \\
 S &= \frac{V_2 I_2}{1000} = \frac{(57,5)(20)}{1000} \checkmark \\
 &= 1,15 \text{ kVA or } 1150 \text{ VA } \checkmark
 \end{aligned}
 \tag{2}$$

[10]

QUESTION 9

- 9.1
- Attractive type ✓
 - Repulsive type ✓
- (2)

- 9.2
- Eddy-current damping. ✓
 - Air damping. ✓
- (2)

9.3

9.3.1

$$\begin{aligned}
 R_t &= \frac{V}{I_m} = \frac{100}{20 \times 10^{-3}} = 5000 \Omega = 5 \text{ k}\Omega \checkmark \\
 R_{se} &= \frac{V}{I_m} - R_m = 5000 - 200 \checkmark \\
 &= 4800 \Omega = 4,8 \text{ k}\Omega \checkmark
 \end{aligned}
 \tag{3}$$

9.3.2

$$\begin{aligned}
 V_m &= I_m R_m \\
 &= (20 \times 10^{-3})(200) = 4 \text{ V } \checkmark \\
 I_{sh} &= I - I_m = 10 - (20 \times 10^{-3}) = 9,98 \text{ A } \checkmark \\
 R_{sh} &= \frac{I_m V_m}{I_{sh}} = \frac{4}{9,98} = 0,401 \Omega \checkmark
 \end{aligned}
 \tag{3}$$

QUESTION 10

- 10.1
- AND gate ✓
 - OR gate ✓
 - NOT gate ✓
 - NAND gate / NOT-AND gate ✓
 - NOR gate / NOT-OR gate ✓
- (5)

- 10.2
- $$\begin{array}{r} 1011 \\ (+) \ 1111 \\ \hline 11010 \end{array} \checkmark \checkmark \checkmark \checkmark \checkmark$$
- (1 mark for each correct digit, from right-hand side) (5)
- [10]**

TOTAL: 100