



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

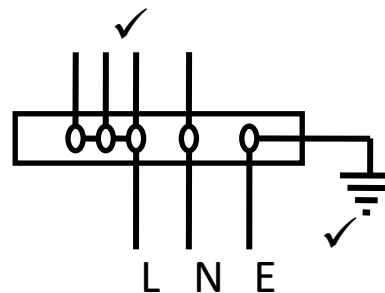
ELECTRICAL TRADE THEORY N3

2 AUGUST 2019

This marking guideline consists of 8 pages.

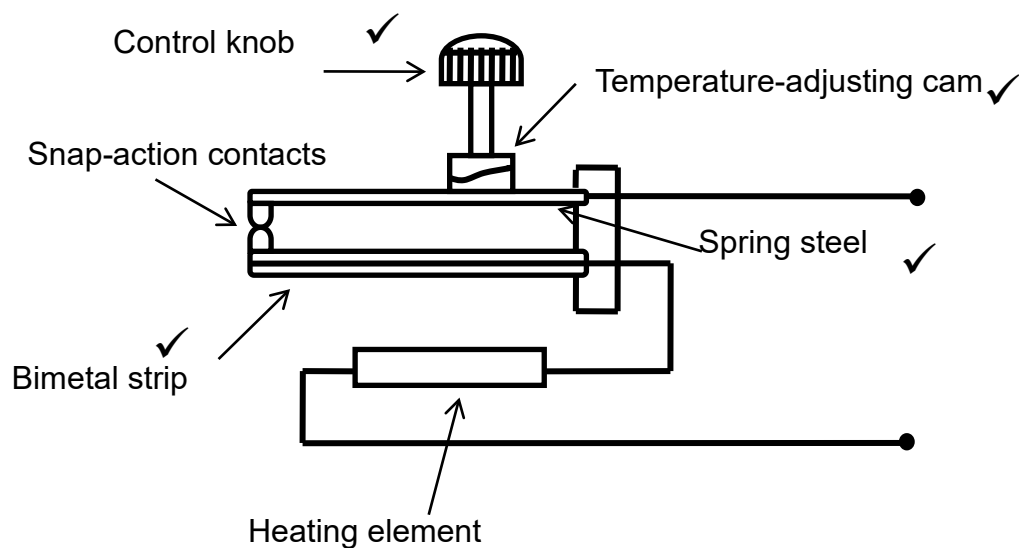
QUESTION 1: DOMESTIC APPLIANCES

1.1



(2)

1.2



(Any 4 × 1) (4)

1.3 Heat causes the bimetal strip to bend✓. The temperature-adjusting cam increases the distance and the bimetal strip flexes, opening the contacts.✓ (2)

1.4 There could be:

- An insulation fault in the flexible cord from the plug to the iron
- An insulation fault between the element and the casing of the iron
- An internal insulation fault between earth and the current-carrying parts in the switching circuit of the iron

(Any 2 × 1) (2)

[10]

QUESTION 2: PROTECTION

- | | | | | |
|-----|-------|--------------------------------------|---------|-----|
| 2.1 | 2.1.1 | Oil-filled cylinder | | |
| | 2.1.2 | Solenoid (coil) | | |
| | 2.1.3 | Iron armature | | |
| | 2.1.4 | Trip switch | | |
| | 2.1.5 | Movement operates tripping mechanism | | |
| | 2.1.6 | Spring | | |
| | 2.1.7 | Iron piston | (7 × 1) | (7) |
-
- | | | | | |
|-----|---|--|--|-------------|
| 2.2 | The piston is attracted into the coil centre because of the magnetic field setup by the current overload.✓ Now the armature is attracted and the mechanical link opens the contacts.✓ This opens the circuit and the current flow stops.✓ | | | (3) |
| | | | | [10] |

QUESTION 3: ILLUMINATION

- | | | | |
|-----|--|--|-----|
| 3.1 | • It provides the voltage surge for starting. | | |
| | • It limits the current to the operating value of the lamps. | | (2) |
-
- | | | | |
|-----|---|--|-----|
| 3.2 | • It reduces the electrical shock hazard. | | |
| | • The fixed base pin acts as a switch breaking the circuit to the ballast when the lamp is removed. | | (2) |
-
- | | | | |
|-----|-------|-----------------------------------|-----------------|
| 3.3 | 3.3.1 | • Street lighting | |
| | | • Flood lighting | |
| | | • Lighting of industrial premises | (Any 2 × 1) (2) |
-
- | | | | |
|--|-------|------------------------------|-----------------|
| | 3.3.2 | • Streetlighting | |
| | | • Security Lighting | |
| | | • Highways / Airport runways | (Any 2 × 1) (2) |
-
- | | | | |
|--|-------|--|-------------|
| | 3.3.3 | • Electrical appliances, such as stoves, fridges and heaters | |
| | | • Control panels where space is limited | (2) |
| | | | [10] |

QUESTION 4: ALTERNATING-CURRENT THEORY

4.1 $I_{rms} = 0,707 \times I_M \checkmark$
 $= 0,707 \times 250 \checkmark$
 $= 176,75A \checkmark$ (3)

4.2 $i = 250 \sin 314t \checkmark$
 $= 250 \sin(314 \times 8 \times 10^{-3} \times 57,3^\circ)$
 $= 250 \times 0,588 \checkmark$
 $= 147,2A \checkmark$ (3)

4.3 $i = 250 \sin 314t$
 $130 = 250 \sin(314t \times 57,3^\circ)$
 $\sin(314t \times 57,3) = \frac{130}{250} \checkmark$
 $t = \frac{\sin^{-1} 0,52}{314 \times 57,3} \checkmark$
 $= 1,74 \text{ milliseconds} \checkmark$ OR $t = 0,00174 \text{ sec}$ (3)

4.4 The value of the sine wave at a specific moment. $\checkmark$ (1)
[10]

QUESTION 5: SERIES RLC CIRCUITS

5.1 5.1.1 $Z_T = \sqrt{R^2 + (x_L - x_C)^2} \checkmark$
 $= \sqrt{5^2 + (9 - 6)^2} \checkmark$
 $= \sqrt{25 + 9} \checkmark$
 $= \sqrt{34} \checkmark$
 $= 5,83\Omega \checkmark$ (3)

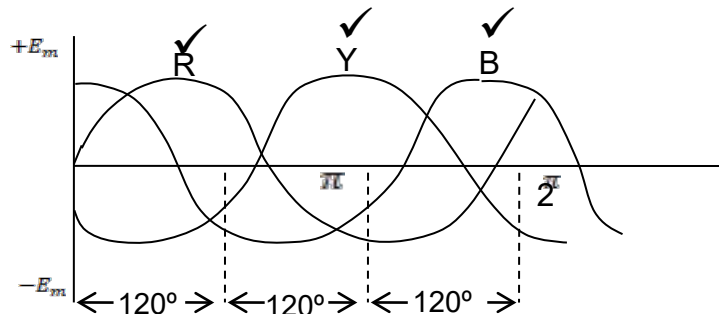
5.1.2 $V_T = Z_T \times I_T \checkmark$
 $= 5,83 \times 2 \checkmark$
 $= 11,66 \text{ V} \checkmark$ (3)

5.1.2 $\tan \emptyset = \frac{x_L - x_C}{R} \checkmark$
 $= \tan^{-1} \frac{9 - 6}{5} \checkmark$
 $= \tan^{-1} \frac{3}{5} \checkmark$
 $\emptyset = 30,96^\circ \checkmark$ (3)

5.2 Lagging as x_L is greater than $x_C \checkmark$ (1)
[10]

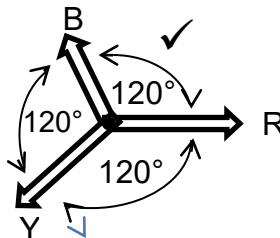
QUESTION 6: THREE-PHASE AC SYSTEMS

6.1

**WAVEFORM**

(3)

6.2



(1)

6.3

6.3.1

$$\begin{aligned}
 P &= \sqrt{3} V_L I_L \cos \phi \checkmark \\
 &= \sqrt{3} \times 380 \times 20 \times 0,9 \checkmark \\
 &= 11847,23 \text{ W} \checkmark \\
 &= 11,85 \text{ kW}
 \end{aligned}$$

OR

$$\begin{aligned}
 P &= 3 \times V_{ph} \times I_{ph} \times \cos \phi \\
 &= 3 \times 380 \times 11,55 \times 0,9 \\
 &= 11\,850,3 \text{ W} \\
 &= 11,85 \text{ kW}
 \end{aligned}$$

(3)

6.3.2

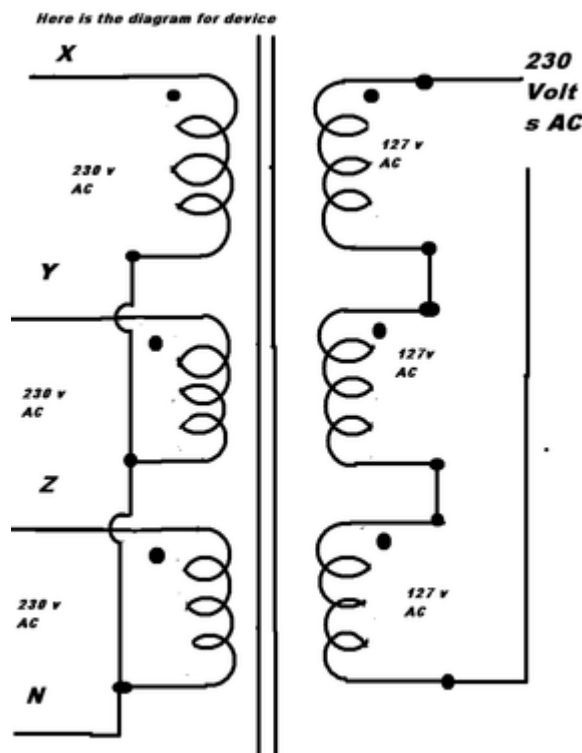
$$\begin{aligned}
 I_{ph} &= \frac{I_L}{\sqrt{3}} \checkmark \\
 &= \frac{20}{\sqrt{3}} \checkmark \\
 &= 11,55 \text{ A} \checkmark
 \end{aligned}$$

(3)

[10]

QUESTION 7: TRANSFORMERS

7.1



Note: 4 Marks Star Primary
3 Marks Delta Secondary

(7)

7.2

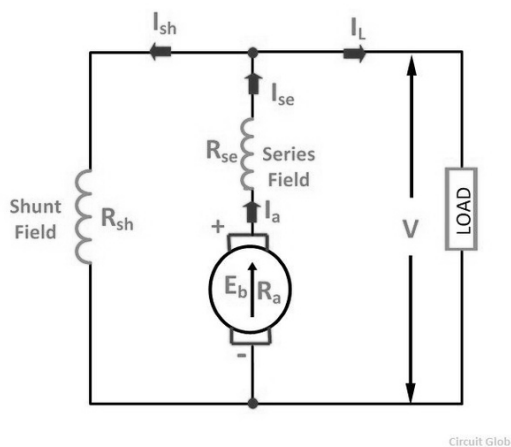
$$\begin{aligned}
 V_{L2} &= \sqrt{3} V_{ph2} \checkmark \\
 V_{ph2} &= \frac{V_{L2}}{\sqrt{3}} \\
 &= \frac{11000}{\sqrt{3}} \checkmark \\
 &= 6359,85V \checkmark
 \end{aligned}$$

(3)

[10]**QUESTION 8: DC MACHINES**

- | | | | |
|-----|-------|---|-----|
| 8.1 | 8.1.1 | It provides continuity for the electric current to reach the armature windings. | (1) |
| | 8.1.2 | It produces a magnetic field that reacts with the armatures magnetic field. | (1) |
| | 8.1.3 | It helps to reduce armature reaction without the need of brush shifting. | (1) |

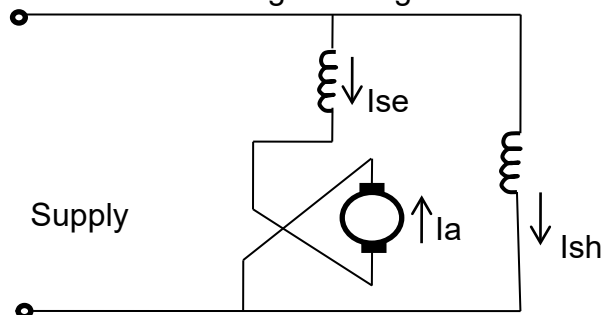
8.2



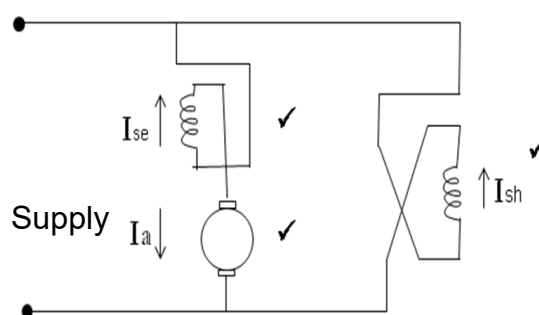
Note:

4 Marks for original Drawing

3 Marks for drawing showing reverse

**REVERSE ARMATURE**

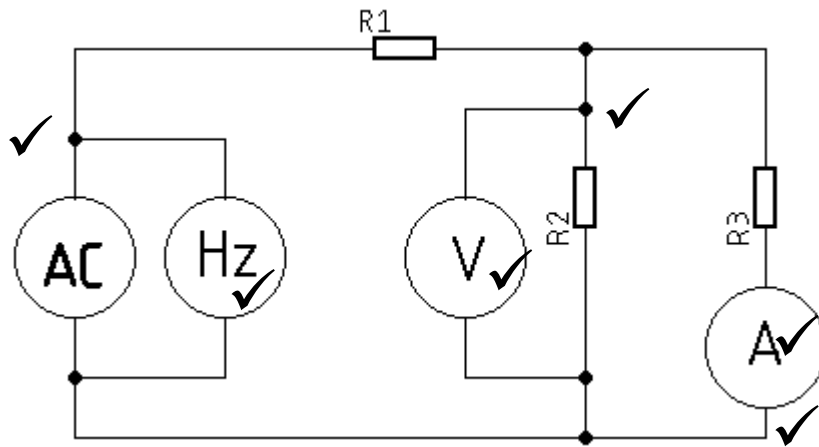
OR

**FIELD WINDING**(7)
[10]**QUESTION 9: AC MACHINES**

9.1	9.1.1	True		
	9.1.2	False		
	9.1.3	False		
	9.1.4	True		
	9.1.5	False		
			(5 × 1)	(5)
9.2	9.2.1	Three-phase induction motor		(1)
	9.2.2	The motor draws less current✓ when the stator windings are connected in star which has a lower supply voltage.✓		(2)
	9.2.3	It should open circuit✓ if the voltage falls either to zero or below the holding voltage✓		(2)
				[10]

QUESTION 10: MEASURING INSTRUMENTS AND ELECTRONICS

10.1



Note:

1 Mark per Instrument – Correct Label

1 Mark Per Instrument – Correct connection

(6)

- 10.2 10.2.1 Collector
 10.2.2 Emitter
 10.2.3 Base

(3 × 1)

(3)

- 10.3 Common emitter

(1)

[10]**TOTAL:****100**