



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

ELECTRICAL TRADE THEORY N3

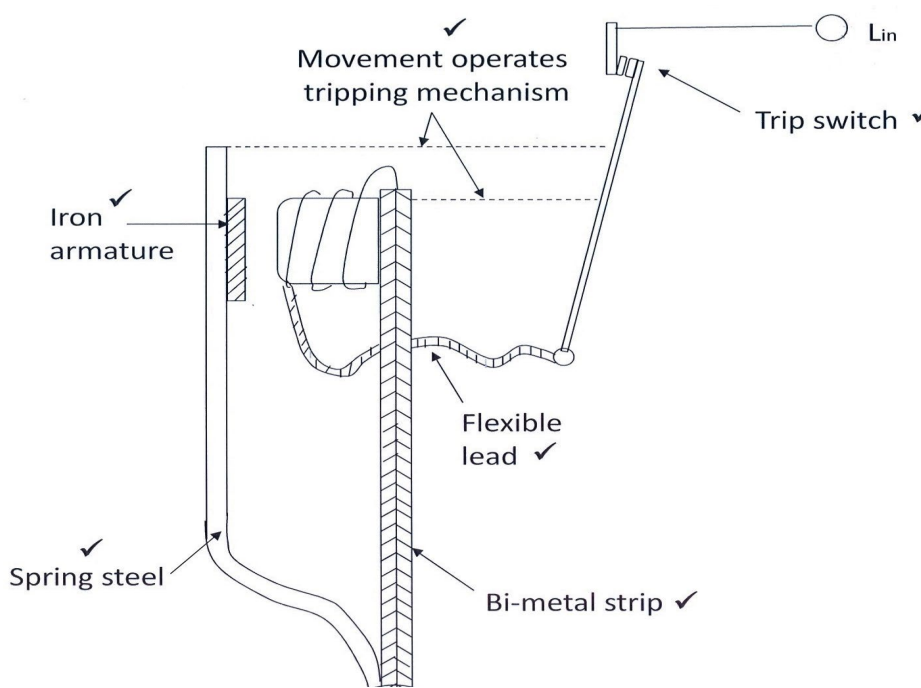
5 APRIL 2018

This marking guideline consists of 8 pages.

QUESTION 1: DOMESTIC APPLIANCES

- 1.1 1.1.1 A: Live can be red or brown
 B: Neutral can be black or blue
 C: Earth can be cream or green/yellow (3)
- 1.1.2 • 4 mm² (1)
- 1.1.3 • 30 A (1)
- 1.1.4 E: Switch disconnect or isolator
 F: Bridge piece (2)
- 1.2 Pressure-reducing valve
 Pressure relief valve
 Safety pressure valve (3)
- [10]**

QUESTION 2: PROTECTION

- 2.1
- 
- (6)
- 2.2 2.2.1 It is the time taken for the bi-metal strips to heat and bend.
- 2.2.2 The magnetic field strength is large enough to attract the armature without the piston. This opens the circuit immediately and current flow stops.

(2 × 2) (4)
[10]

QUESTION 3: ILLUMINATION

- 3.1 3.1.1 DC supply
 3.1.2 Reversing switch
 3.1.3 Current-limiting resistor
 3.1.4 Surge coil
 3.1.5 Starter
(5 × 1) (5)
- 3.2 • To prevent the lamp from darkening at one end due to mercury migration
 • To prevent deterioration of the cathode
(2)
- 3.3 • Lighting streets
 • Highways
 • Airport runways
(3)
[10]

QUESTION 4: ALTERNATING-CURRENT THEORY

- 4.1 $V_{ave} = 0,637 \times V_{max}$
 $= 0,637 \times 200 \checkmark$
 $= 127,4 \text{ V} \checkmark$
(2)
- 4.2 $W = 2\pi f$
 $f = \frac{W}{2\pi}$
 $= \frac{314}{6,2832} \checkmark$
 $= 49.974 \text{ HZ} \checkmark$
(2)
- 4.3 $T = \frac{1}{F}$
 $= \frac{1}{49.974}$
 $= 0,02 \text{ seconds} \checkmark$
(1)
- 4.4 $E_{rms} = 0,707 \times 200$
 $= 141,4 \text{ volts}$
 Crest factor = E_{max}/E_{rms}
 $= 200/141,4$
 $= 1,414$
(2)

4.5 $e = 200 \sin 314,28 t$ volts
 $e = 200 \sin(314,28 \times 8 \times 10^{-3} \times 57,3) \checkmark$
 $= 200 \sin 144,066$
 $= 200 \times 0,587 \checkmark$
 $= 117,4 \text{ V} \checkmark$

(3)
[10]

QUESTION 5: SERIES RLC CIRCUIT

5.1 $XL = 2\pi fl \checkmark$
 $= 2\pi \times 50 \times 0,02 \checkmark$
 $= 6,283 \checkmark$

(3)

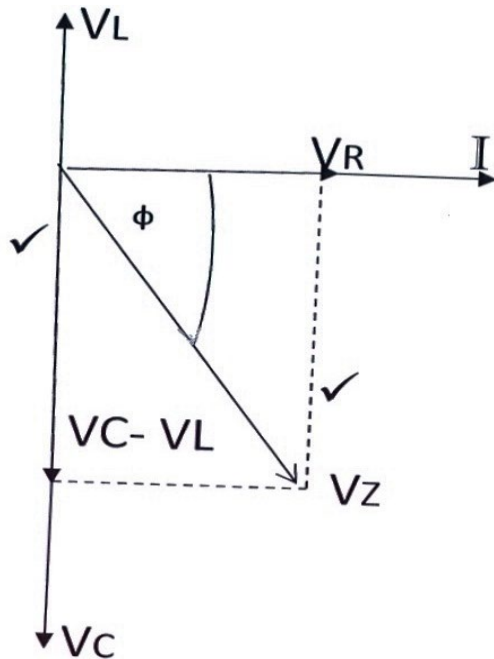
5.2 $XC = \frac{1}{2\pi fc} \checkmark$
 $XC = \frac{1}{2\pi \times 50 \times 1,258 \times 10^{-6}} \checkmark$
 $XC = 2530,29 \text{ ohms} \checkmark$

(3)

5.3 The current is leading because the capacitive reactance is much greater than the inductive reactance.

(2)

5.4

(2)
[10]**QUESTION 6: THREE-PHASE AC SYSTEMS**

- 6.1 6.1.1 $V_L = \sqrt{3} v_{ph}$
- $$v_{ph} = \frac{415}{\sqrt{3}} \checkmark$$
- $$= 239,6 \text{ V} \checkmark \quad (2)$$
- 6.1.2 $V_L = v_{ph}$
- $$v_{ph} = V_L = 415 \text{ V} \checkmark \quad (1)$$
- 6.2 6.2.1 $S = \sqrt{3} V_L I_L$
- $$= \sqrt{3} \times 415 \times 250 \checkmark$$
- $$= 179,7 \text{ kVA} \checkmark \quad (2)$$
- 6.2.2 $P = \sqrt{3} V_L I_L \cos \theta$
- $$= \sqrt{3} \times 415 \times 250 \times 0,86 \checkmark$$
- $$= 154,542 \text{ KW} \checkmark \quad (2)$$

$$6.2.3 \quad P = \sqrt{3} V_L I_L \cos \theta$$

$$I_L = \frac{154.542}{\sqrt{3} \times 415 \times 0.86}$$

$$= 249,99 \text{ A} \checkmark$$

$$I_{ph} = \frac{I_L}{\sqrt{3}}$$

$$I_{ph} = \frac{249,99}{\sqrt{3}} \checkmark$$

$$= 144,33 \text{ A} \checkmark$$

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

7.1 7.1.1 Reduction of eddy current is achieved by laminating the iron core of a transformer.

7.1.2 An alternating current is applied to the primary windings.

(2 × 1) (2)

7.2 7.2.1 Turns ratio = $\frac{V_{phl}}{V_{phz}}$ but $V_{phz} = \frac{V_{L2}}{\sqrt{3}}$

$$= \frac{66\,000}{6\,350} \checkmark \quad = \frac{11\,000}{\sqrt{3}} \checkmark$$

$$= 10,39 : 1 \checkmark \quad = 6\,350 \text{ V} \checkmark$$

(4)

$$7.2.2 \quad I_{L1} = \frac{V_{L2}}{V_{L1}} \times I_{L2}$$

$$= \frac{11 \times 100}{66} \checkmark$$

$$= 16,67 \text{ A} \checkmark$$

(2)

$$7.2.3 \quad S = \sqrt{3} V_L I_{L2}$$

$$= \sqrt{3} \times 66 \times 16,67 \checkmark$$

$$= 1,9 \text{ MVA} \checkmark$$

(2)
[10]

QUESTION 8: DC MACHINES

- 8.1 8.1.1 To provide a smooth turning action of the motor, thus reducing friction and ensuring smooth action
- 8.1.2 To collect current from the armature conductors
- 8.1.3 To reduce armature reaction without brush shifting
- 8.1.4 To indicate a magnetic field that reacts with the armature (4 × 2) (8)
- 8.2 A large DC motor can be started without damaging the motor or motor circuit by inserting series resistors in the circuit✓ and removing them as the speed picks up.✓ (2)
- [10]**

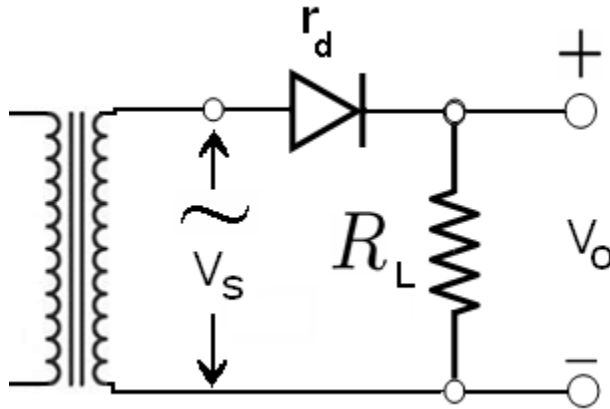
QUESTION 9: AC MACHINES

- 9.1 Speed at which the stator field rotates (1)
- 9.2 • Capacitor-start, split-phase motor
• Resistance-start, split-phase motor
• Capacitor-start, capacitor-run motor
• AC series motor
• Shaded-pole induction motor
• Shaded-pole synchronous motor (Any 3 × 1) (3)
- 9.3 • When the motor is switched on, the external rotor resistance is at a minimum to reduce the starting current.
• As the speed increases, the resistance is completely reduced and the machine runs as a squirrel-cage induction motor. (2 × 2) (4)
- 9.4 • Higher initial cost
• Greater maintenance cost
• Low power factor at high loads
• Very sensitive to supply voltage fluctuations (Any 2 × 1) (2)
- [10]**

QUESTION 10: MEASURING INSTRUMENTS AND ELECTRONICS

- 10.1 • Attraction type
 • Repulsion type
- (2)

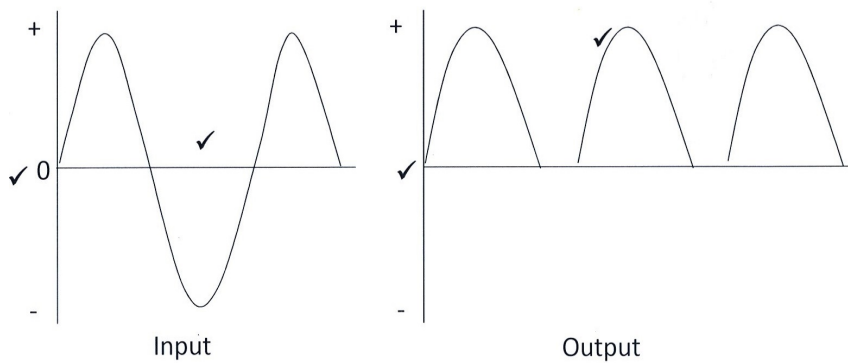
- 10.2 10.2.1



Note:

- 1 Mark – Transformer
1 Mark – Diode Correctly connected
1 Mark – Load (Resistor)

- ### 10.2.2



- 10.3 It allows an electrical current to flow in one direction only. (1)

TOTAL: 100