



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

ELECTRICAL TRADE THEORY N2

6 APRIL 2018

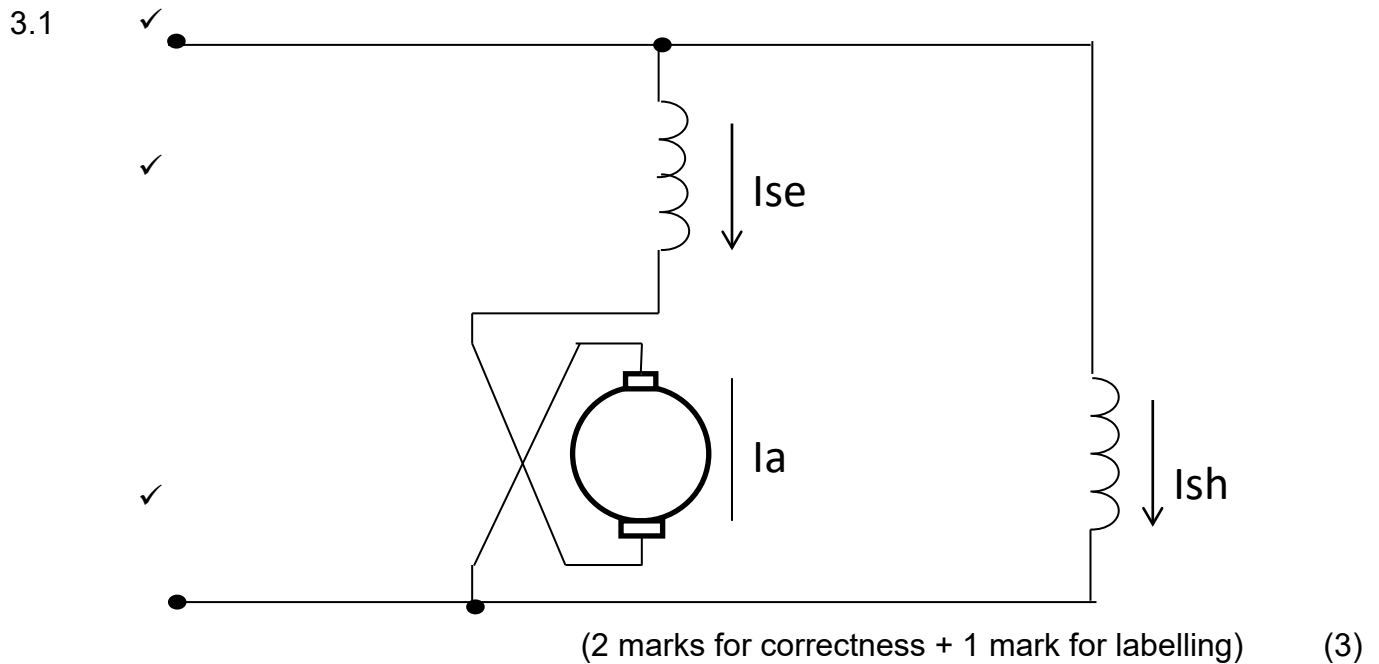
This marking guideline consists of 7 pages.

QUESTION 1: CONDUCTORS AND CABLES

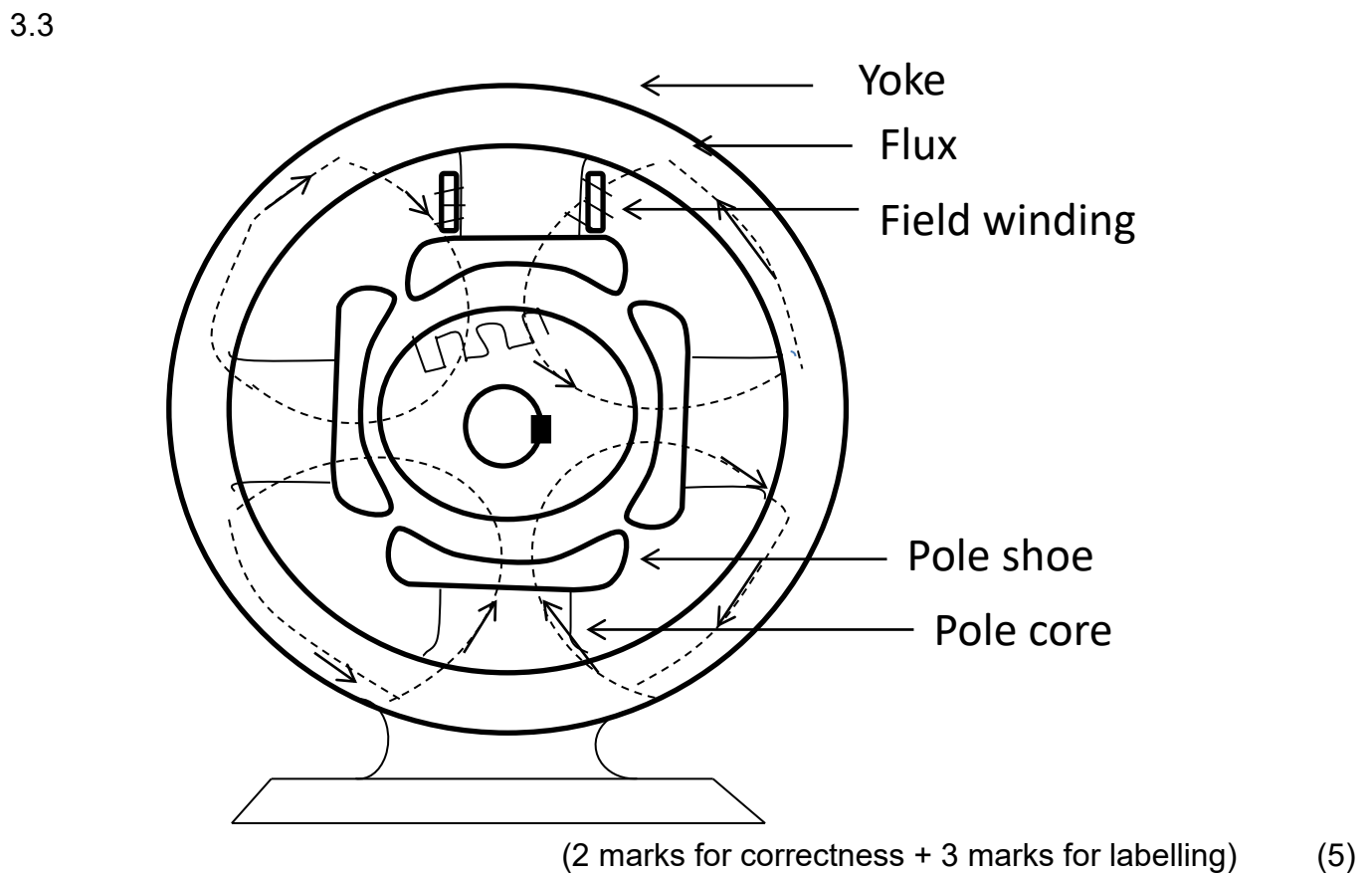
- 1.1
- Armoured cable is cable with steel around it and mechanically protected.
 - Conductors and their insulation are protected by metal wire and waterproof covering. (Any 1) (1)
- 1.2
- Advantages
- Easy to identify and trace a cable
 - Easy to locate a fault
 - Easy to replace a cable
 - Well protected against mechanical damage
 - Well protected against the elements
 - Not visible
- Disadvantages
- More expensive to install than the construction
 - In a small duct heat build-up can result in a lower rating than a cable installed in free air
 - More accessible for cable theft. (Any 3 + 3) (6)
- 1.3
- $$P = V_L \times I_L \times \cos\theta \times 1,732$$
- $$I_L = P / 1,732 \times V_L \times \cos\theta \checkmark$$
- $$= 100\,000 / 380 \times 1,732 \times 0,9 \checkmark$$
- $$= 162,82 \text{ A} \checkmark \quad (3)$$
- 1.4
- It is the maximum voltage drop allowed in a circuit between the supply point and the socket outlet. It is regulated at 5% of the supply voltage. (1)
- [11]**

QUESTION 2: SWITCHGEAR, CONTACTORS AND RELAYS

- 2.1
- Prepare the ends.
 - Join the conductors.
 - Insulate.
 - Reshield.
 - Rejacket. (5)
- 2.2
- Each subcircuit must be labelled at its respective circuit breaker. (1)
- 2.3
- Copper crimping ferrules are used for joining copper conductors.
 - Aluminium crimping ferrules are used for joining aluminium conductors.
 - Bimetal ferrules are used when making transition joints e.g. (joining copper and aluminium conductors).
 - Only suitable corrosion-free fluxes may be used when soldering joints.
 - Any insulation, e.g. insulation tape or shrink sleeve, must be similar (5)
- 2.4
- The switch arm is not in fully closed position (the switch is facing downward). (1)
- [12]**

QUESTION 3: DC MOTORS AND STARTERS

3.2 Separately excited and self-excited (2)



3.4 Low starting torque (1)

3.5 Relatively constant speed for a range of loads (1)

[12]

QUESTION 4: AC MOTORS AND STARTERS

- 4.1 The currents through each of the three stator windings in a three-phase motor differ in phase by a third of a cycle (120°).
A pulsating magnetic field is set up by each of these windings.
Since each magnetic field follows after the next they combine to set up a resultant field which moves around the stator surface at a constant speed. (4)
- 4.2
- Autotransformer starter
 - Star-delta starting
 - Rotor-resistance starting controllers
 - Direct on line
- (4)
- 4.3 The function of a motor starter is to reduce the current drawn by the motor while the rotor accelerates. (1)
- 4.4
- Insulation resistance test between windings (the readings will be high, usually above 500 000 ohms)
 - Insulation resistance to earth test readings are taken in case (the readings will be high, usually above 500 000)
 - Short-circuit and open-circuit tests (the readings will differ from motor to motor but they must be the same in each case for the same motor) a lower reading for one of the coils will indicate a short circuit of some or all of the turns. (3 × 2) (6)
- [15]

QUESTION 5: EARTHING

- 5.1 The metallic frames and or metallic enclosures must be bonded to earth. (2)
- 5.2 Equipment earthing relates to an earthing connection to the metal frames of electrical machines, ✓ the metal housing that contains switching equipment or other electrical apparatus, metal raceways ✓ (e.g. metal conduit, metal trunking ducts or wire armouring around cables) containing electrical conductors, closely adjacent conducting structures and any other extraneous conductive parts judged to be vulnerable to contact by an energised conductor. ✓ (3)
- 5.3 An earth continuity conductor is a conductor, including any clamp or terminal, which connects the consumer's earth terminal to the exposed conductive parts of an installation electrically in order to earth those parts and to carry fault currents. (3)
- 5.4 5.4.1 The metal enclosure of the transformer must be connected with an earth continuity conductor to the earth terminal or directly to the earth electrode/mat.

- 5.4.2 The lightning rods mounted on the highest point above the substation must be connected with an earth continuity conductor to the earth terminal or directly to the earth electrode/mat.

(2 × 2) (4)
[12]

QUESTION 6: PROTECTION

- 6.1 The function of a lightning arrester is to provide a path by which these surges are discharged to earth before a flashover on the line can occur. (3)
- 6.2 The function of a fuse is to detect overcurrent or short-circuit currents and automatically disconnect the faulty equipment or circuit from the supply. (1)
- 6.3 In the event of an overload, the heating element heats the bimetal strip sufficiently to bend far enough to open the snap action. The snap-action contacts open the circuit to the contactor coil and the contactor disconnects the motor from the supply. (4)
- 6.4 6.4.1 The purpose of phase-imbalance protection is to disconnect all phases when the currents differ by a specific amount. (1)
- 6.4.2 Motor-supply lines require phase-imbalance protection. (1)
[10]

QUESTION 7: MEASURING INSTRUMENTS

- 7.1
 - Ripple relay
 - Radio-controlled relay(2)
- 7.2 During maximum demand the supplier's tariff will be higher and the highest current drawn will be continuously for 30 or 60 minutes by the consumer. (2)
- 7.3 A frequency meter is used to measure the number of cycles produced per second by an alternating supply. (2)
[6]

QUESTION 8: TRANSFORMERS

8.1 8.1.1 Voltage across each phase is 380 V (1)

8.1.2 $I_{ph} = 10/1,732 \checkmark$
 $= 5,774 \text{ A} \checkmark$ (2)

8.1.3 $P = 1,732 \times V_L \times I_L \times \cos\theta$
 $= 1,732 \times 380 \times 10 \times 0,9 \checkmark$
 $= 5\,923,614 \text{ W OR } 5,924 \text{ kW} \checkmark$

$\eta = P_2/P_1$
 $P_2 = 94\% \times 5,924 \checkmark$
 $= 5,569 \text{ kW} \checkmark$ (4)

8.2 8.2.1 $\theta = 25$
 $\cos 25 = 0,906 \checkmark$

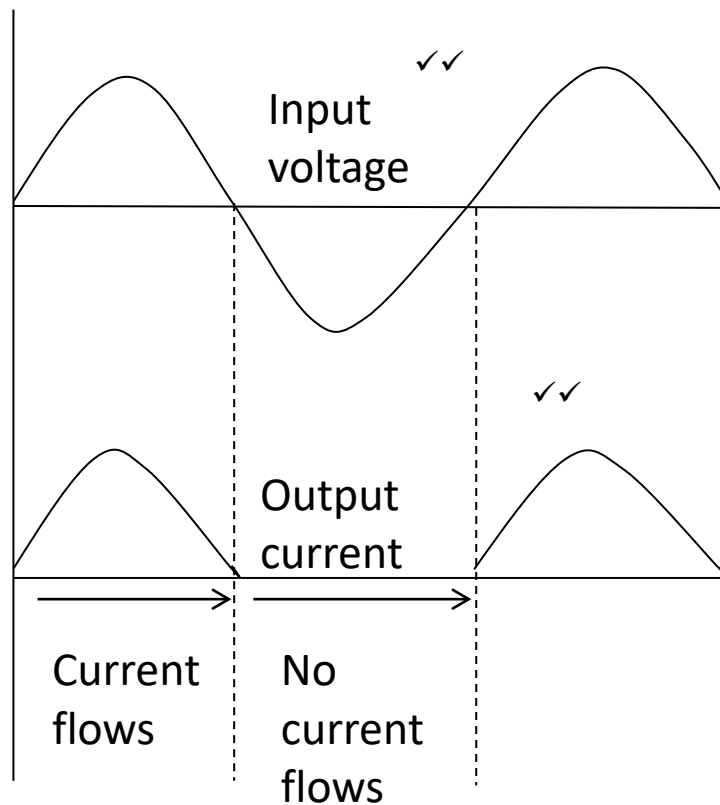
$I_L = 1,732 \times 12$
 $= 20,785 \text{ A} \checkmark$

$P = 1,732 \times V_L \times I_L \times \cos\theta \checkmark$
 $= 1,732 \times 250 \times 20,785 \times 0,906 \checkmark$
 $= 8\,154 \text{ W OR } 8,154 \text{ kW} \checkmark$ (5)

[12]

QUESTION 9: ELECTRONICS

9.1



(2 marks for correctness of input + 2 marks for correctness of output)

(4)

9.2 The intermittent rating refers to the current that a diode can conduct, based on specific time interval variations rather than continuous conduction, without exceeding a safe allowable temperature.

(3)

9.3 A pulse on the gate will switch it on, provided that the anode is more positive than the cathode

(3)

[10]**TOTAL: 100**