



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE (VOCATIONAL)

**ELECTRICAL PRINCIPLES AND PRACTICE
NQF LEVEL 2**

XX February 2020

This marking guideline consists of 7 pages.

QUESTION 1

- 1.1
- Unit symbols are written in normal roman type, not italic.
 - There must always be a space between the number and the symbol, e.g. 8 cm.
 - Unit symbols are written in lower case, for example s for seconds and m for meter.
 - Unit symbols are not written in plural.
 - When derived units are formed by multiplication, join unit symbols with a centre dot or a nonbreak space, for example N·m or Nm.
 - When derived units are formed by division, join symbols with a solidus or write them as a negative exponent. For example, write meter per second as m/s, ms⁻¹ or m·s⁻¹. (Any relevant 4 × 1) (4)
- 1.2 $w = Fs$
- $$F = \frac{w}{s}$$
- $$= \frac{50\,000}{100} \checkmark$$
- $$= 500 \text{ N} \checkmark \quad (2)$$
- 1.3 1 mile = 1,6 km
- $$40 \text{ miles} = 40 \times 1,6 \checkmark = 64 \text{ km} \checkmark \quad (2)$$
- 1.4 Pressure is the force per unit area applied in a direction perpendicular to the surface of an object. (2)
- [10]**

QUESTION 2

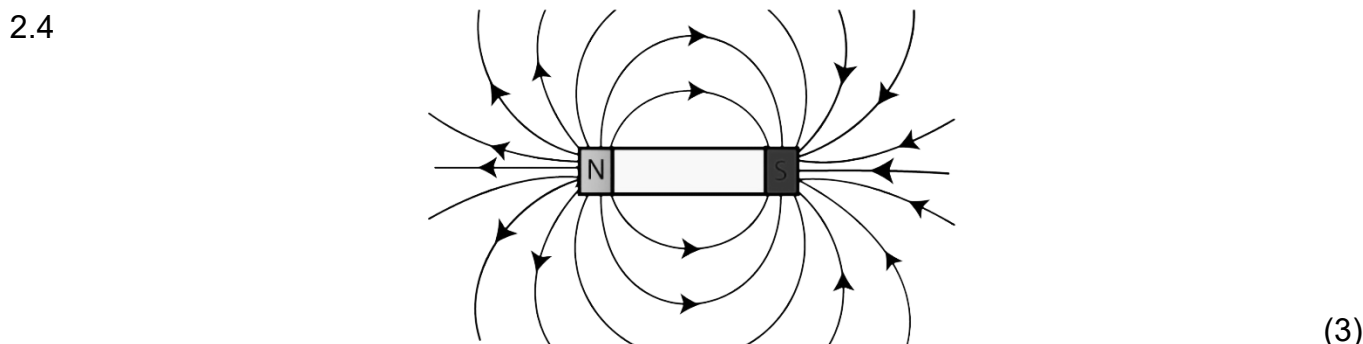
- 2.1 2.1.1 True
- 2.1.2 False
- 2.1.3 True
- 2.1.4 False
- (4 × 1) (4)
- 2.2 2.2.1 $R = \frac{V}{I}$
- $$= \frac{240}{60} \checkmark$$
- $$= 4 \text{ A} \checkmark \quad (2)$$

2.2.2 $P = VI$ **OR** $P = \frac{V^2}{R}$ **OR** $P = I^2 R$
 $= 240 \times 4 \checkmark$ $= \frac{240^2}{60}$ $= 4^2 \times 60$
 $= 960 \text{ W} \checkmark$ $= 960 \text{ W}$ $= 960 \text{ W}$ (2)

2.2.3 $E = Pt$ **OR** $E = I^2 R t$
 $= 960 \times 2 \times 3\,600 \checkmark$ $= 4^2 \times 60 \times 2 \times 3\,600$
 $= 6\,912\,000 \text{ J} \checkmark$ $= 6\,912\,000 \text{ J}$
 $= 6,912 \text{ MJ} \checkmark$ $= 6,912 \text{ MJ}$ (3)

- 2.3 2.3.1
 - Three-phase current is cheaper to generate than single-phase current.
 - A three-phase distribution system can also provide single-phase current.
 - Three-phase motors need less maintenance.
 - A rotating magnetic field is easily produced in a three-phase induction motor.
 - There is less power loss in the value for a given amount of load power.
 - Three-phase motors produce a constant shaft torque, resulting in less variation and vibration.
 - Rectified three-phase does not require as much filtering as rectified single-phase.
 - Three-phase systems need less copper or less conducting material than single-phase systems for a given voltage rating.
 - The power factor of single-phase motors is poor compared to three-phase motors of the same rating. (Any 4 × 1) (4)

- 2.3.2
 - 220 V/230 V/240 V single phase
 - 380 V/400 V three phase (2)



- 2.5 Electromagnetism occurs when an electric field in a conductor produces a magnetic field in a conductor. (2)

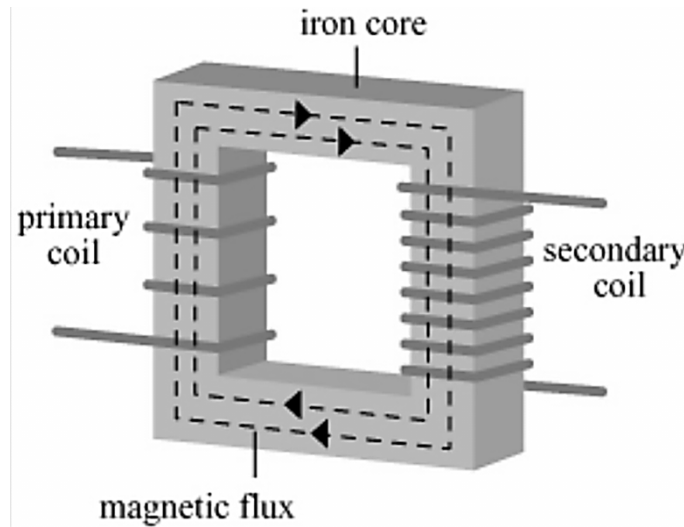
- 2.6 Place your right hand over the coil with your fingers pointing in the direction of the current and with your thumb at 90° to your fingers. Your thumb will point in the direction of the north pole. (3)

[25]

QUESTION 3

- 3.1 3.1.1 $r_T = \frac{r_1}{n}$ **OR** $\frac{1}{r_T} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3}$
- $= \frac{0,1}{3} \checkmark$ $= \frac{1}{0,1} + \frac{1}{0,1} + \frac{1}{0,1}$
- $= 0,033 \Omega \checkmark$ $= \frac{3}{0,1}$
- $r_T = \frac{0,1}{3} = 0,033 \Omega$ (2)
- 3.1.2 $E_T = e_1 = 3 \text{ V} \checkmark$ (1)
- 3.1.3 $I_T = \frac{E_T}{R + r_t}$
- $= \frac{3 \checkmark}{10 + 0,033} \checkmark$
- $= 0,299 \text{ A} \checkmark$ (3)
- 3.2 $R_T = R_1 + R_2 + R_3$
- $= 2 + 5 + 3 \checkmark$
- $= 10 \Omega \checkmark$ (2)
- 3.3 $R_P = \frac{R_3 R_4}{R_3 + R_4}$ **OR** $\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2}$
- $= \frac{3 \times 6}{3 + 6} \checkmark$ $= \frac{1}{3} + \frac{1}{6}$
- $= 2 \Omega \checkmark$ $= \frac{3}{6}$
- $R_T = R_1 + R_2 + R_P$ $R_P = \frac{6}{3} = 2 \Omega$
- $= 2 + 5 + 2 = 9 \Omega \checkmark$ (3)
- 3.4 The total current will be 0 A ✓ and the voltage across the 5 Ω will be 0 V. ✓ (2)
- 3.5 Load balancing is the process whereby the load in a three-phase, four-wire system is split as evenly as possible to prevent overloads in any part of the circuit (2)

3.6



(1 for sketch + 3 for labels) (4)

3.7 3.7.1 $\frac{N_1}{N_2} = \frac{I_2}{I_1}$

$$I_2 = \frac{N_1 \times I_1}{N_2}$$

$$= \frac{10 \times 3}{1} \checkmark$$

$$= 30 \text{ A} \checkmark$$

3.7.2 $\frac{N_1}{N_2} = \frac{10}{1}$

$$\frac{N_1}{100} = \frac{10}{1}$$

$$N_1 = \frac{100 \times 10}{1} \checkmark$$

$$= 1\,000 \text{ turns} \checkmark$$

(2 × 2) (4)

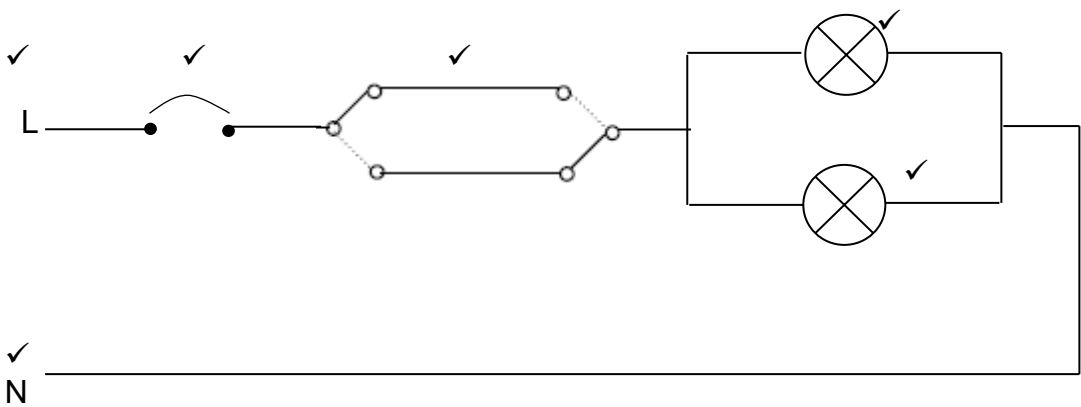
3.8 Step-down transformer ✓ – The number of turns on the primary is more than the number of turns on the secondary. ✓ (Any relevant 2 × 1) (2)

[25]

QUESTION 4

- 4.1 When current flows through the coil, ✓ the magnetic field set up by it interacts with the field produced by the permanent magnet. ✓ This causes the coil to pivot. ✓ (3)
- 4.2
- Small DC generator to produce two different voltage levels
 - Calibrated meter to measure resistances
 - Cranking system (Any relevant 3 × 1) (3)
- 4.3
- Measures current in various subcircuits
 - Checks the starting current on an AC machine
 - Measures balanced and unbalanced loads
 - Traces faults in three-phase AC induction motors (4)
- 4.4 To eliminate parallax error, the user must look directly at the pointer on the scale when taking measurements. (2)
- 4.5 An instrument transformer is used to enable a small measuring instrument to measure high voltage and high current. (2)
- 4.6 A wattmeter is used to measure power. (1)
- [15]**

QUESTION 5

- 5.1
- 
- (6)

- 5.2 5.2.1 Single-phase stove circuit (1)
- 5.2.2
- A = Live conductor: ✓ 6/8 mm² ✓
 - B = Neutral conductor: ✓ 6/8 mm² ✓
 - C = Earth conductor: ✓ 6/8 mm² ✓
 - D = Circuit breaker: ✓ 35 A ✓ (4 × 2) (8)
- [15]**

QUESTION 6

- | | | |
|-----|--|-------------|
| 6.1 | <ul style="list-style-type: none">• PVC-insulated steel-wire armoured cable• Paper-insulated armoured cable | (2) |
| 6.2 | <ul style="list-style-type: none">• Pin insulator• Strain insulator• Suspension insulator | (3) |
| 6.3 | <ul style="list-style-type: none">• Metal• Soft and flexible• Ductile and malleable• Weatherproof• Easily soldered | (5) |
| | | [10] |

TOTAL: 100