higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

ELECTRICAL TRADE THEORY N3

28 November 2023

This marking guideline consists of 8 pages.

Copyright reserved

QUESTION 1

1.1
- They are self-starting
- They are more efficient
- They operate at a better power factor

(3 × 1) (3)

1.2

Delta:

$P_T = 3 \times Power\ per\ phase$

$P_T = 3 \times V_{ph}I_{ph}\ cos\theta$ ✓

$(Note: V_{ph} = V_L$ **and** $I_{ph} = \frac{I_L}{\sqrt{3}})$ ✓

$P_T = 3 \times V_L \times \frac{I_L}{\sqrt{3}}\ cos\theta$ ✓

$But: \frac{3}{\sqrt{3}} = \sqrt{3}$

$\therefore P = \sqrt{3}\, V_L I_L\ cos\theta$ ✓

Star:

$P_T = 3 \times Power\ per\ phase$

$P_T = 3 \times V_{ph}I_{ph}\ cos\theta$

$(Note: I_{ph} = I_L$ **and** $V_{ph} = \frac{V_L}{\sqrt{3}})$ ✓

$P_T = 3 \times \frac{V_L}{\sqrt{3}} \times I_L\ cos\theta$

$But: \frac{3}{\sqrt{3}} = \sqrt{3}$

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

(5)

1.3 1.3.1

$$i_1 = \frac{0 + 28}{2} = 14$$

$$i_2 = \frac{28+33}{2} = 30{,}5\ ✓$$

$$i_3 = \frac{33 + 35}{2} = 34 ✓$$

$$i_4 = \frac{35 + 28}{2} = 31{,}5 ✓$$

$$i_5 = \frac{28 + 9{,}5}{2} = 18{,}75 ✓$$

$$i_6 = \frac{9{,}5+0}{2} = 4{,}75$$

$$I_{ave} = \frac{i_1 + i_2 + +i_3 + i_4 + i_5 + i_6}{n}$$

$$I_{ave} = \frac{14 + 30{,}5 + +34 + 31{,}5 + 18{,}75 + 4{,}75}{6} ✓$$

$\therefore I_{ave} = 22{,}25\ A$ ✓

(6)

1.3.2 $$I_{rms=}\sqrt{\frac{{i_1}^2+{i_2}^2+{i_3}^2+{i_4}^2+{i_5}^2+{i_6}^2}{n}}$$

$$I_{rms=}\sqrt{\frac{14^2+30{,}5^2+34^2+31{,}5^2+18{,}75^2+4{,}75^2}{6}}\checkmark$$

$\therefore I_{rms=}\ 24{,}66\ A\ \checkmark$ (2)

1.3.3 $$K_f=\frac{I_{rms}}{I_{ave}}$$

$$K_f=\frac{24{,}66}{22{,}25}\checkmark$$

$\therefore K_f=\ 1{,}11\ \checkmark$ (2)
[18]

QUESTION 2

2.1
- Semi-automatic top loading
- Fully automatic top loading
- Front loading (washer and dryer combo)
- Front loading (stackable with separate washer and dryer)
- Front loading integrated
- Compact or portable

(Any 3 × 1) (3)

2.2 2.2.1 It is to control the operation of a stove plate✓ by producing three different heat levels. ✓

2.2.2 It is to control the operation of a stove✓ plate by producing more than three heat levels. ✓

(2 × 2) (4)

2.3 Cold water with a high density enters the bottom of the geyser and flows out to the solar collector, which is an insulated box. ✓ The inside of the solar collector as well as the pipework is painted black to allow these components to absorb heat energy.✓ Solar radiation energy penetrates the solar glass and falls onto the absorber. ✓The water in the pipework inside the solar collector heats up and its density decreases. ✓ This water then flows up into the storage tank. ✓ (5)
[12]

QUESTION 3

3.1 3.1.1 False

3.1.2 True

3.1.3 True

3.1.4 False

(4 × 1) (4)

3.2 3.2.1 It is to prevent the tungsten from evaporating✓ and also to prevent the glass bulb from blackening. ✓

3.2.3 An electric current is passed through the tungsten filament, ✓ heating the filament until it glows. ✓

(2 × 2) (4)
[8]

QUESTION 4

4.1 4.1.1 Multiple input
4.1.2 Multiple output

(2 × 1) (2)

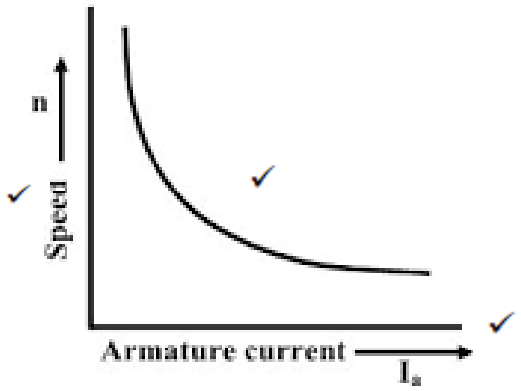
4.2
- Ladder diagrams
- Sequential function charts
- Function block diagrams
- Structured text
- Instruction lists

(Any 3 × 1) (3)
[5]

QUESTION 5

5.1 To determine the open-circuit characteristics✓ or magnetic characteristics. ✓ (2)

5.2



(3)

5.3 W = 37,5 × 9,81 ✓

= 367,875 N ✓

$Radius = \frac{1}{2}$ × d

= $\frac{350}{2}$ ✓

= 0,175 m ✓

$Output\ power = \frac{2\pi\ N\ (W-S)r}{60}$

= $\frac{2\ \pi\ 980\ (367.875-102)0.175}{60}$ ✓

= 4774,966 W ✓

Input power = V × I_L

= 230 × 25 ✓

= 5750 W ✓

Efficiency of motor = $\frac{output}{input}$ × 100 %

= $\frac{4774,966}{5750}$ × 100% ✓

= 83,043 % ✓

(10)
[15]

QUESTION 6

6.1 6.1.1 Ns = $\frac{60\ X\ f}{p}$

= $\frac{60\ X\ 50}{2}$ ✓

= 1500 r/min ✓

6.1.2 Percentage slip = $\frac{Ns-N}{Ns}$ × 100

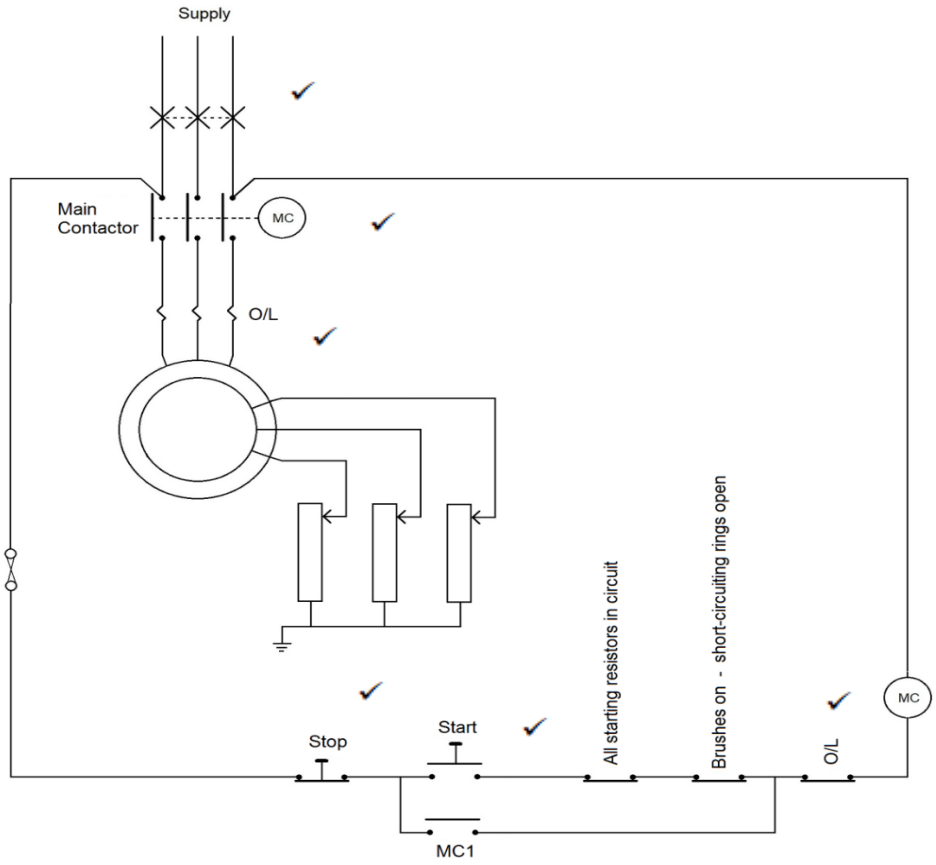
= $\frac{1500-1250}{1500}$ × 100 ✓

= 0,167 × 100

= 16,7 % ✓

(2 × 2) (4)

6.2



(6)
[10]

QUESTION 7

7.1 Natural air cooling is suitable for cooling small transformers only✓, and the air around it carries heat away from the windings and core; ✓ whilst in forced air cooling, fans are used to blow air in either across the transformer windings✓ and core in a dry-type cooling system or across the cooling fins of an oil-cooled transformer. ✓ (4)

7.2 The breather is attached to the conservator tank.✓ Air from which moisture must be removed is drawn into the conservator.✓ Silica gel is placed in the breather to absorb the moisture from the air entering the transformer.✓ (3)

7.3 7.3.1
- Hysteresis losses
- Eddy current losses (2)

7.3.2 Losses that occur in the insulating materials of a transformer (1)
[10]

QUESTION 8

8.1
- The operation of all balanced three-phase loads will be unaffected.✓
- All single-phase loads and three-phase unbalanced loads connected to this supply will experience potential difference variations.✓ (2)

8.2 8.2.1 It is the voltage that, during an insulation fault, ✓ appears between simultaneously accessible parts. ✓ (2)

8.2.2 System earthing is the earthing of a point or points in a system or in an installation or in equipment, which is necessary for purposes other than safety.✓ It relates to earthing of current-carrying conductors such as the supplier's neutral conductor. ✓ (2)

8.3
- For safety reasons and the prevention of electric shock
- To reduce the potential of the neutral conductor to that of the earth (0V)
- To ensure that the neutral conductor will serve as an effective return path for current as well as any leakage current
- To reduce touch voltage
- To provide an earth path for any earth leakage
- To stabilise the phase to earth voltages
- To maintain the neutral of the low-voltage systems as close as possible to earth potential
- To ensure that the relevant protective devices operate correctly

(Any 4 × 1) (4)
[10]

QUESTION 9

9.1
- Energy charge
- Maximum demand charge

(2 × 1) (2)

9.2
- Power factor correction
- Time switches
- Maximum demand monitors

(3 × 1) (3)

9.3
- Ripple relays
- Radio-controlled relays

(2 × 1) (2)
[7]

QUESTION 10

10.1	10.1.1	D		
	10.1.2	C		
	10.1.3	A		
			(3 × 1)	(3)
10.2	•	Batteries		
	•	Solar cells		
	•	Thermocouples		
	•	DC generators		
			(Any 2 × 1)	(2)
				[5]
			TOTAL:	**100**

Copyright reserved