higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T670**(E)**(J27)T

# NATIONAL CERTIFICATE

# FAULT FINDING AND PROTECTIVE DEVICES N5

(8080115)

**27 July 2018 (X-Paper)**
**09:00–12:00**

**This question paper consists of 5 pages and 1 formula sheet.**

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# DEPARTMENT OF HIGHER EDUCATION AND TRAINING
# REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
FAULT FINDING AND PROTECTIVE DEVICES N5
TIME: 3 HOURS
MARKS: 100

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**INSTRUCTIONS AND INFORMATION**

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. Write neatly and legibly.

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## QUESTION 1

Design and draw only the control circuit of the following sequence starters:

Press start button – motor A starts
After 10 seconds – motor B starts
After another 10 seconds – motor A stops
All the coils are 380 V and the two timers are set at 10 seconds.

NOTE: Show ALL the protections and safety equipment. **[10]**

## QUESTION 2

The contactor M in FIGURE 1 below does not pull in.

State FIVE possible faults and how each fault can be repaired.

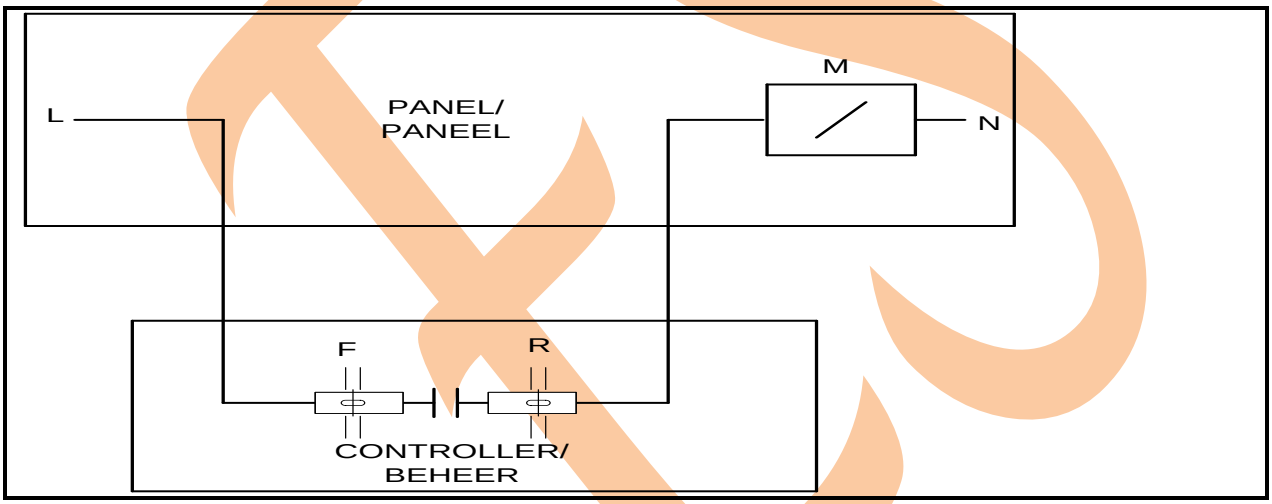



**FIGURE 1** **[10]**

## QUESTION 3

3.1 Briefly describe the following parts of a DC motor:

3.1.1 Armature

3.1.2 Brush holders

3.1.3 Slip-ring

(3 × 2) (6)

3.2 Make a labelled drawing of a direct-current motor to test the polarity of the field by means of a nail. Clearly show the position of the nail with the right and wrong polarity. (4)

**[10]**

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## QUESTION 4

4.1 Name TWO variable losses in DC machines. (2)

4.2 Name THREE types of constant losses in a DC series motor. (3)

4.3 Name THREE main losses in a DC shunt motor under load. (3)

4.4 Name TWO types of brushes that are used in DC machines. (2)
**[10]**

## QUESTION 5

5.1 Dynamic breaking is the method used to slow down AC and DC motors before applying mechanical brakes.

Briefly explain how DC injection is applied in AC motors to slow down the motor. (3)

5.2 Calculate the value of the dynamic breaking resistor needed to cause maximum breaking effort to a 30 kW, 220V DC motor. (5)

5.3 Give TWO examples where inching circuit is used. (2)
**[10]**

## QUESTION 6

6.1 Draw a diagram of a positive series voltage regulator. (5)

6.2 Draw a diagram of a negative series voltage regulator. (5)
**[10]**

## QUESTION 7

7.1 What is an X–Y plotter? (2)

7.2 Name SIX special features of the X–Y plotter. (6)

7.3 Briefly explain the function of the self-balancing potentiometer used in an X–Y plotter. (2)
**[10]**

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## QUESTION 8

8.1 Define the following terms as applied to operational amplifiers:

8.1.1 Open loop

8.1.2 Closed loop

8.1.3 Positive feedback

8.1.4 Negative feedback

(4 × 2) (8)

8.2 Name TWO advantages of an operational amplifier. (2)

**[10]**

## QUESTION 9

9.1 Name TWO types of flip-flops. (2)

9.2 Draw the truth tables of NAND gate and NOR gate functions with TWO inputs of each. (8)

**[10]**

## QUESTION 10

Convert the following numbers to the base shown in brackets:

10.1 $110010, 101_2$ (10)

10.2 $79_{10}$ (2)

10.3 $126_8$ (10)

10.4 $3AB_{16}$ (2)

10.5 $23,375_{10}$ (2)

(5 × 2) **[10]**

**TOTAL: 100**

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## FORMULA SHEET

## FAULT FINDING AND PROTECTIVE DEVICES N5

$$\frac{R_a}{R_2} = \frac{(1 + \alpha\ cu\ ta)}{(1 + \alpha\ cu\ t_2)}$$

| | | |
|---|---|---|
| | *Ra* = | *Resistance of motor windings at ambient temperature before test in ohms* |
| | $\forall cu$ = | *Temperature coefficient of resistance of copper (0,004)* |
| | *ta* = | *Ambient temperature in °C* |
| | $R_2$ = | *Resistance of hot windings after test in ohms* |
| | $t_2$ = | *Temperature of hot windings after test in °C* |
| $P = VI\ Cos\ ø$ | *P* = | *Power in watts in single-phase AC circuit* |
| | *V* = | *Applied voltage in volts* |
| | *I* = | *Current in circuit in amperes* |
| | *Cos ø* = | *Power factor*<br>*Cosine of phase angle between applied voltage and current* |
| *Electron charge* | *E* = | $1,602 \times 10^{-19}$ *coulombs* |
| *Mass of electron* | *Me* = | $9,11 \times 10^{-31}$ *kg* |
| *Mass of proton* | *Mp* = | $1,673 \times 10^{-27}$ |
| *Heat energy due to friction between shaft journal and bearing* | $E\mu$ = | $T\mu \times 2\pi u$ *Joule per second* |
| | *u* = | *Revolutions per second* |
| | $T\mu$ = | *Friction torque in Nm* |
| | $T\mu$ = | $\mu \times P \times R$ |
| | $\mu$ = | *Coefficient of friction* |
| | *P* = | *Normal load on bearing in Newton* |
| | *R* = | $\frac{D}{2}$ *in metres* |
| | *D* = | *Journal diameter in metres* |

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