education

Department:
Education
REPUBLIC OF SOUTH AFRICA

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NATIONAL CERTIFICATE

ELECTRICAL TRADE THEORY N3

(11041263)

1 April (X-Paper)
09:00 – 12:00

This question paper consists of 7 pages and a 1-page formula sheet.

DEPARTMENT OF EDUCATION
REPUBLIC OF SOUTH AFRICA

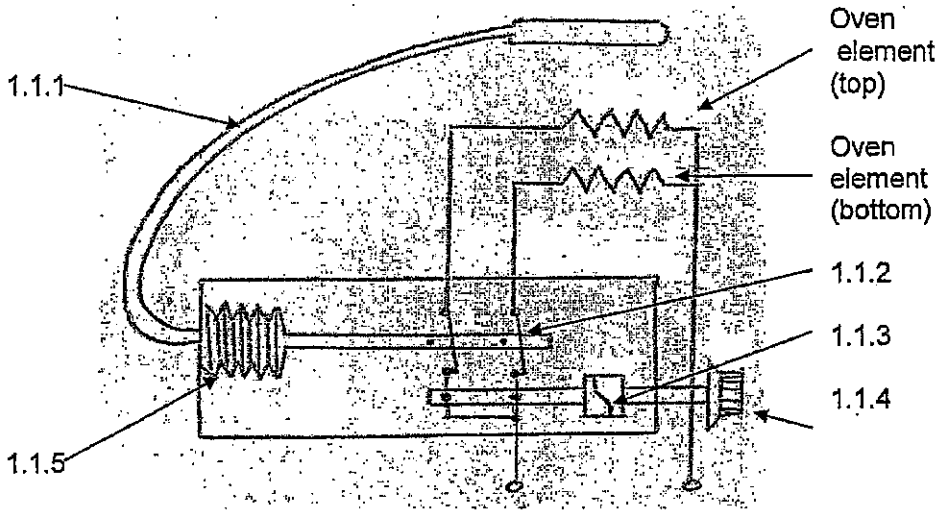
NATIONAL CERTIFICATE
ELECTRICAL TRADE THEORY N3
TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Where applicable, answers must be in accordance with the SABS (SANS) Code of Practice SANS 10142-1:2003 for the Wiring of Premises.
5. Sketches must be neat, labelled and large enough to show the required detail.
6. Formulae used in Electrical Trade Theory N3 can be found at the end of the question paper.
7. Answers must be given to TWO decimal places.
8. Write neatly and legibly.

QUESTION 1: DOMESTIC APPLIANCES

1.1 Name the components, indicated with the arrows, in the sketch of an oven thermostat shown below.



(5)

1.2 Explain the operation of the oven thermostat circuit shown in QUESTION 1.1. (5)
[10]

QUESTION 2: PROTECTION

2.1 Make a neat, labelled sketch of a magnetic type circuit breaker. (5)

2.2 Explain the operation of the magnetic type circuit breaker under the following headings:

2.2.1 Overload (3)
2.2.2 Short circuit (2)
[10]

QUESTION 3: ILLUMINATION

3.1 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (31.1 – 3.1.5) in the ANSWER BOOK.

3.1.1 A fluorescent lamp circuit has started. Removing the glow starter at this point will switch the lamp off. (1)

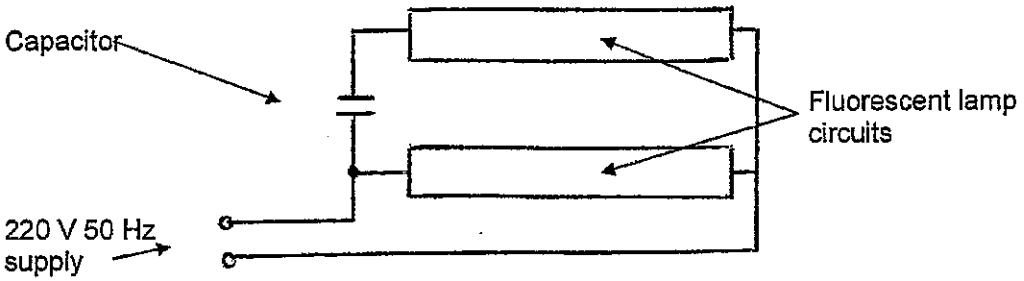
3.1.2 A choke will limit the current in a DC supplied lamp circuit. (1)

3.1.3 A glow starter starts the lamp by opening the circuit. (1)

3.1.4 Cold cathode neon lamps emit a white glow. (1)

3.1.5 Vaporized mercury emits a blue-green light. (1)

3.2 Study the circuit below. Give a reason for the use of this type of circuit and explain how it operates.



(3)
[8]

QUESTION 4: ALTERNATING CURRENT THEORY

A waveform is represented by e = 100sin(628,32t) volts.

NOTE: The angle is in radians.

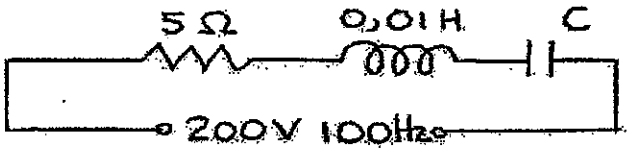
4.1 Calculate the necessary values and draw the waveform to scale. (5)

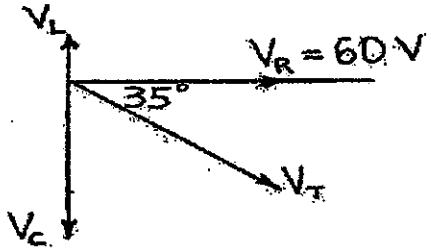
4.2 Calculate the form factor of the waveform above. (5)
[10]

QUESTION 5: SERIES RLC CIRCUITS

5.1 Study the circuit diagram and phasor diagram below.

Calculate the value of C that will give the resultant phasor diagram shown below.





(9)

5.2 Are the magnitudes of the true and apparent power equal in this circuit? (1)
[10]

QUESTION 6: THREE-PHASE AC SYSTEMS

Three identical loads are connected to a 3-phase, 380 V, 4-wire supply. Draw a circuit diagram that:

6.1 Shows the loads connected in star (2)

6.2 Shows the neutral conductor connected to the common point of the star connected loads (1)

6.3 Indicates voltage values between all conductors (do calculations if necessary) (4)

6.4 Calculate the total apparent power consumed if each load draws 10 A (3)
[10]

QUESTION 7: TRANSFORMERS

7.1 Explain the construction of a transformer under the following headings:

7.1.1	Iron core	(1)
7.1.2	Primary and secondary winding insulation	(1)
7.1.3	Primary and secondary winding thickness	(1)
7.1.4	Number of turns	(1)
7.1.5	3-phase transformer	(1)

7.2 A three-phase step-down transformer has a delta connected primary and a star connected secondary. The primary line voltage is 66 kV and the secondary line voltage 11 kV. Ignore losses and calculate the following:

7.2.1	The turns ratio	(3)
7.2.2	The primary line current if the secondary line current is 200 A	(3)
7.2.3	The size of the transformer in MVA	(1)
		[12]

QUESTION 8: DIRECT CURRENT MACHINES

8.1 State the functions of the following components of a DC motor:

8.1.1	The field coil	(2)
8.1.2	The brushes and commutator	(2)
8.1.3	Interpoles	(2)

8.2 Draw a rough graph of the load characteristics of the following DC motors:

8.2.1	A shunt connected motor	(2)
8.2.2	A series connected motor	(2)
		[10]

QUESTION 9: MEASURING INSTRUMENTS AND ELECTRONICS

9.1 State the functions of the following components of measuring instruments:

9.1.1	Hair springs	(1)
9.1.2	Fixed iron	(1)
9.1.3	Permanent magnets	(1)

9.2 Draw the following:

9.2.1	A neat, fully labelled circuit diagram of a full wave rectifier using two diodes and a centre-tap transformer	(3)
9.2.2	The waveform across a load connected to QUESTION 9.2.1 if the supply is sinusoidal	(2)

9.2.3 The waveform across a load connected to QUESTION 9.2.1 if the supply is sinusoidal and a smoothing capacitor connected across the load. (2)

[10]

QUESTION 10: AC MACHINES

Study the diagram of a starter circuit shown below.

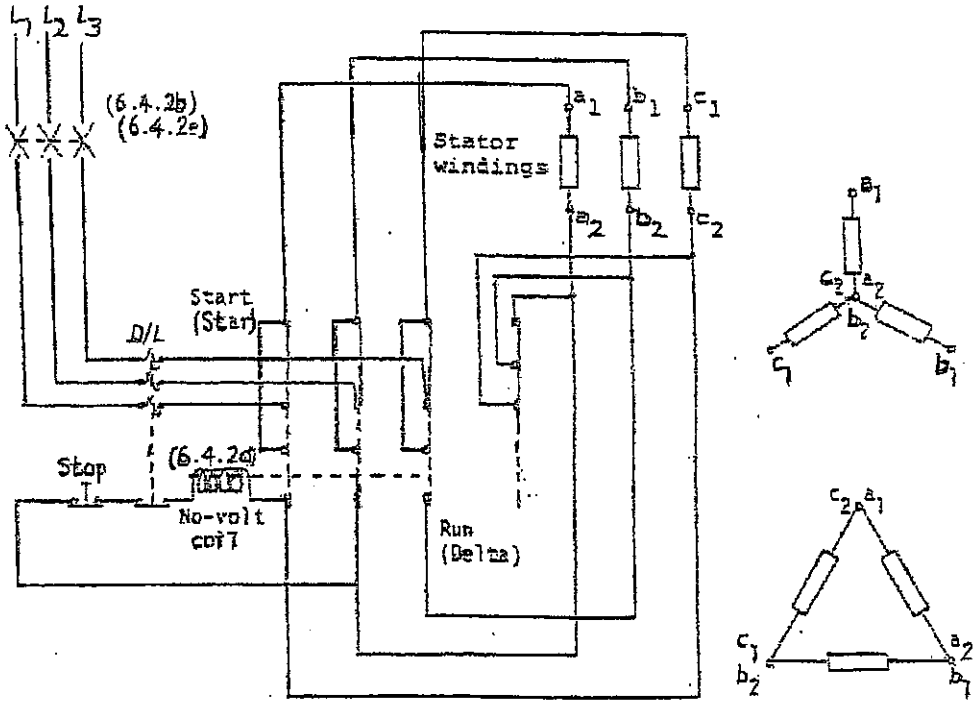
10.1 For which type of motor would this be a suitable starter circuit? (1)

10.2 What principle is being used here to start the motor? (2)

10.3 What is the purpose of the no-volt coil shown in the sketch? (2)

10.4 Explain the sequence of events that happen if the current drawn from the supply exceeds the rating of the overload protection. (3)

10.5 Would this circuit stop the motor if L_3 falls away? Explain your answer. (2)



[10]

TOTAL: 100

ELECTRICAL TRADE THEORY N3

FORMULA SHEET

$$I_T = \frac{V}{Z}$$

$$I_{ACTIVE} = I_T \cos \phi$$

$$I_{REACTIVE} = I_T \sin \phi$$

$$X_L = 2\pi f L$$

$$X_C = \frac{1}{2\pi f C}$$

SERIES

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$\phi = \cos^{-1}\left(\frac{R}{Z}\right)$$

$$V_R = I_T R$$

$$V_{XL} = I_T X_L$$

$$V_{XC} = I_T X_C$$

$$V = \sqrt{V_R{}^2 + (V_{XL} - V_{XC})^2}$$

$$S = VI$$

$$P = I^2 R$$

3-PHASE

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

$$S = \sqrt{3}\, V_L I_L$$

DELTA

$$V_L = V_{PH/F}$$

$$I_L = \sqrt{3} I_{PH/F}$$

STAR

$$V_L = \sqrt{3} V_{PH/F}$$

$$I_L = I_{PH/F}$$

$$\frac{V_p}{V_s} = \frac{N_p}{N_s} = \frac{I_s}{I_p}$$

$$N = \frac{f.60}{p}$$

$$s = \frac{n - n_r}{n}$$

$$\omega = 2\pi f$$

The next five formulae are also true for voltage

$$i = I_m \sin(\omega t)$$

$$I_{rms} = 0{,}707\ I_m$$

$$I_{ave} = 0{,}637\ I_m$$

$$I_{rms} = \sqrt{\frac{i_1{}^2 + i_2{}^2 + \ldots i_n{}^2}{n}}$$

$$I_{ave} = \frac{i_1 + i_2 + .. i_n}{n}$$

$$\text{Form factor} = \frac{\text{RMS-value}}{\text{AVE-value}}$$

$$\text{Crest factor} = \frac{\text{MAX-value}}{\text{RMS-value}}$$

SERIES

$$R_T = R_1 + R_2 + \ldots R_n$$

PARALLEL

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots \frac{1}{R_n}$$