



Province of the
EASTERN CAPE
EDUCATION

**NATIONAL
SENIOR CERTIFICATE**

GRADE 11

NOVEMBER 2018

**ELECTRICAL TECHNOLOGY: DIGITAL
ELECTRONICS**

MARKS: 200

TIME: 3 hours



This question paper consists of 11 pages, including a formula sheet.

INSTRUCTIONS AND INFORMATION

1. This question paper consists of NINE questions.
2. Answer ALL the questions.
3. Sketches and diagrams must be large, neat and fully labelled.
4. Show ALL calculations and round off the answer correctly to TWO decimal places. Show the units for ALL answers of calculations
5. Number the answers correctly according to the numbering system used in this question paper.
6. You may use a non-programmable calculator.
7. A formula sheet is provided at the end of this question paper.
8. Write neatly and legibly.

QUESTION 1: OCCUPATIONAL HEALTH AND SAFETY

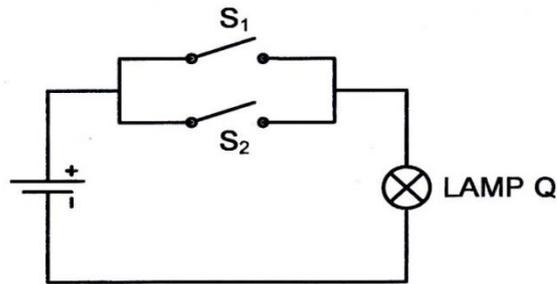
- 1.1 Explain why the Occupational Health and Safety Act is necessary. (2)
- 1.2 Name ONE unsafe act that may result in an injury. (1)
- 1.3 State ONE unsafe condition that must be avoided in a workshop. (1)
- 1.4 Who would use a 'safety lock' while working? (1)
- 1.5 Describe the term *risk*. (1)
- [6]**

QUESTION 2: TOOLS AND MEASURING INSTRUMENTS

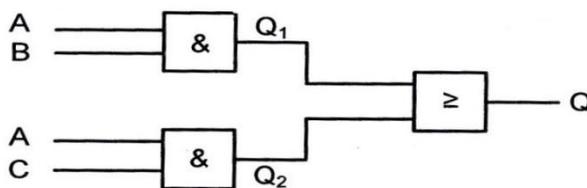
- 2.1 What is the purpose of a crimping lug? (1)
- 2.2 Briefly explain the term *power tool*. (2)
- 2.3 Explain the purpose of a time-base generator in an oscilloscope. (1)
- 2.4 List TWO actions one should avoid when handling tools. (2)
- [6]**

QUESTION 3: LOGIC

3.1 Refer to FIGURE 3.1 below and answer the questions that follow.

**FIGURE 3.1**

- 3.1.1 Identify the logic function of the circuit. (1)
- 3.1.2 Draw the logic symbol that is represented by the circuit. (2)
- 3.1.3 Draw the truth table of the gate. (4)
- 3.1.4 Write the Boolean expression. (2)
- 3.2 Using Boolean algebra, simplify the expression below: (7)
- $$Q = \bar{A}B\bar{C} + AB\bar{C} + A\bar{B}\bar{C} + \bar{A}\bar{B}\bar{C}$$
- 3.3 Use a Karnaugh map to simplify the expression below: (7)
- $$Q = \bar{A}B\bar{C} + AB\bar{C} + A\bar{B}\bar{C} + \bar{A}\bar{B}\bar{C}$$
- 3.4 Draw a fully labelled truth table of a Half adder. (6)
- 3.5 Refer to FIGURE 3.2 below and answer the questions that follow.

**FIGURE 3.2**

- Give the Boolean expression at the following points:
- 3.5.1 Q₁ (2)
- 3.5.2 Q₂ (2)
- 3.5.3 Q (3)
- 3.6 State TWO disadvantages of TTL logic. (2)
- 3.7 Name TWO disadvantages of CMOS logic. (2)

[40]

QUESTION 4: COMMUNICATION SYSTEMS

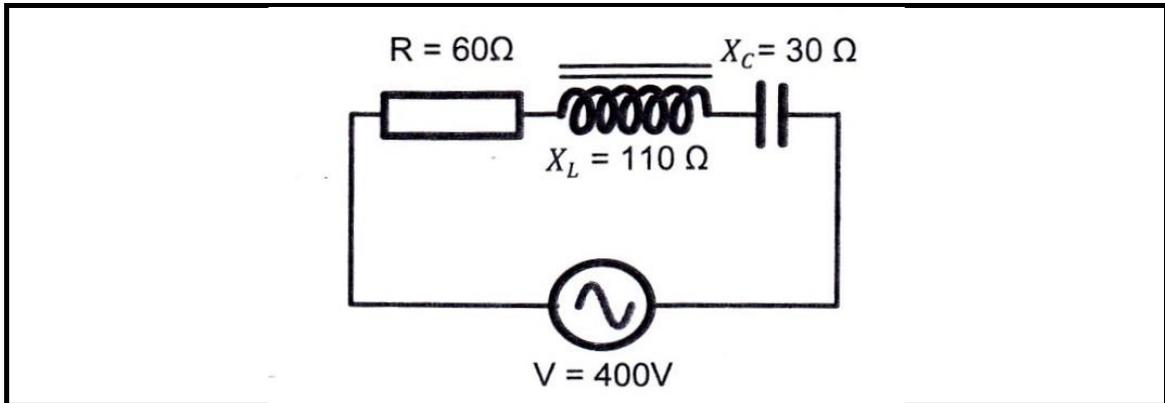
- 4.1 Name any TWO types of oscillator circuits that rely on positive feedback. (2)
- 4.2 Name and explain the term *SSB* when referring to radio transmission. (3)
- 4.3 List TWO methods of radio modulation. (2)
- 4.4 Draw a fully labelled symbol of a varicap diode. (3)
- 4.5 Briefly explain the purpose of a Phase Locked Loop circuit. (3)
- 4.6 Describe, with the aid of a three-waveform graph, how frequency shift keying works. (3)
- 4.7 Briefly explain *resonance*. (2)
- 4.8 Draw a three-block diagram to demonstrate the super heterodyne receiver. (5)
- 4.9 State the main role of a voltage controlled oscillator. (2)
- 4.10 State what the value of an oscillator loop gain should be to be driven into sinusoidal oscillation. (1)

[26]

QUESTION 5: RLC

5.1 Explain the term *impedance* with reference to an RLC circuit. (2)

5.2 FIGURE 5.2 below shows the circuit diagram of a series RLC circuit.

**FIGURE 5.2**

Calculate the following:

5.2.1 The circuit impedance (3)

5.2.2 The total series current (3)

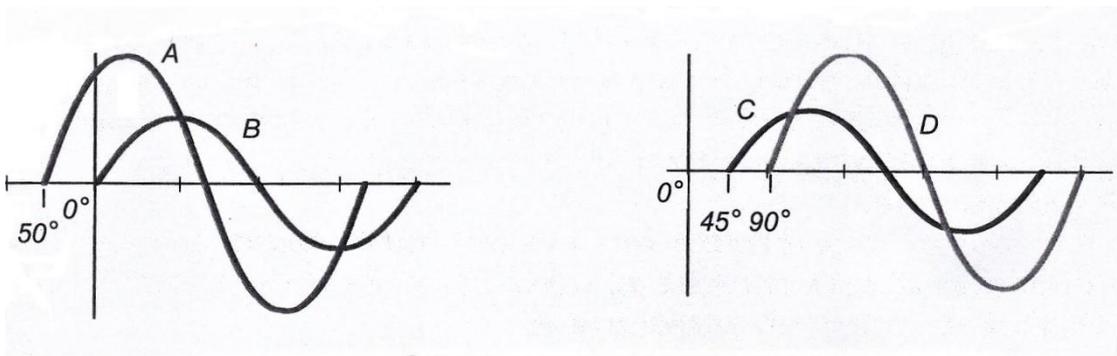
5.2.3 The true power (3)

5.2.4 The apparent power (3)

5.2.5 The phase angle and state whether its lagging or leading (4)

5.2.6 State if a frequency change will affect the value of the inductive reactance. (2)

5.3 Determine the phase angle from the two sets of sine waves in each graph below.

**FIGURE 5.3**

5.4 Describe what occurs to the component reactance of a series RLC circuit when it reaches the point of resonance. (2)

[24]

QUESTION 6: WAVEFORMS

- 6.1 Name the TWO fields that combine to form a radio wave. (2)
- 6.2 Sketch and label TWO digital pulses, one positive-going, the other negative-going. (4)
- 6.3 Explain the following terms with reference to waveforms:
- 6.3.1 Cycle (2)
- 6.3.2 Wavelength (2)
- 6.3.3 Peak to peak value (2)
- 6.4 Sketch the following:
- 6.4.1 The circuit of a positive biased parallel clipping circuit using a 2 V biasing battery (4)
- 6.4.2 The output waveform when the peak sinusoidal voltage of 6 V is applied (4)
- 6.5 An AC supply has an rms voltage of 9 V. Determine its peak voltage. (3)
- 6.6 Find the periodic time of a wave with a frequency of 500 Hz. (3)
- [26]**

QUESTION 7: POWER SUPPLIES

- 7.1 State the main purpose of a rectifier circuit in a DC power supply. (2)
- 7.2 Draw the block diagram of the series voltage regulator. (3)
- 7.3 Draw the circuit diagram of a full wave rectifier circuit which includes a transformer, bridge rectifier, smoothing capacitor and a load resistor. (3)
- 7.4 Name TWO types of inductor filter circuits. (2)
- 7.5 Discuss the operation of the LC filter circuit using a choke in series with the input terminals of the filter. (2)

[12]

QUESTION 8: SEMI-CONDUCTOR DEVICES

- 8.1 What is the Q point of a diode? (1)
- 8.2 Briefly explain the term *majority carriers* in P-type silicon. (1)
- 8.3 Draw a fully labelled characteristic curve of a TRIAC. (4)
- 8.4 Draw fully labelled circuit symbols of:
- 8.4.1 SCR (3)
 - 8.4.2 TRIAC (3)
 - 8.4.3 DIAC (3)
- 8.5 How does a zener diode differ from other diodes? (3)
- 8.6 Sketch a fully labelled sketch of a zener diode regulator circuit. (4)
- 8.7 For the normal operation of a transistor as a switch, which junction should always be:
- 8.7.1 Forward biased? (2)
 - 8.7.2 Reverse biased? (2)
- 8.8 Explain the use of a DIAC. (2)
- 8.9 Sketch the characteristic curve showing both forward and reverse biased regions of a silicon PN junction diode. Clearly label FOUR states into which the diode can be driven. (7)
- 8.10 Describe the following terms with regard to semi-conductors:
- 8.10.1 Forward bias (2)
 - 8.10.2 Reverse bias (2)
- 8.11 Draw a fully labelled circuit symbol of a PNP transistor. (3)
- 8.12 Name any TWO impurities which are added to pure silicon to create P-type material. (2)
- 8.13 List TWO advantages of a TRIAC when compared to a SCR. (2)
- 8.14 Briefly explain TWO ways of switching on the SCR. (2)

[48]

QUESTION 9: SENSORS AND TRANSDUCERS

- 9.1 Give TWO places where electret microphones are used. (2)
- 9.2 List TWO types of humidity sensors. (2)
- 9.3 Explain the following terms:
- 9.3.1 A sensor (2)
- 9.3.2 A proximity sensor (2)
- 9.4 Answer the following questions with reference to the piezo electric effect:
- 9.4.1 Fully explain the *piezo electric effect*. (3)
- 9.4.2 Explain ONE other unique characteristic of the piezo electric effect. (1)
- [12]**

TOTAL: 200

ELECTRICAL TECHNOLOGY/ELEKTRIESE TEGNOLOGIE**FORMULA SHEET/FORMULEBLAD**

$$f = \frac{1}{T}$$

$$PF = \frac{P}{Pa}$$

$$Pa = I^2 Z$$

$$P_r = I^2 \times (X_L - X_C)$$

$$P = I^2 R$$

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

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