



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

**ELECTRONIC CONTROL AND DIGITAL ELECTRONICS
NQF LEVEL 3**

(12041023)

**3 March 2020 (X-paper)
09:00–12:00**

This question paper consists of 6 pages.

219Q1S2003

TIME: 3 HOURS MARKS: 100

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. Start each question on a new page.
 5. Write neatly and legibly.
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QUESTION 1: FUNDAMENTALS OF ELECTRONICS

- 1.1 1.1.1 Give THREE reasons why you would use a digital multimeter instead of an analogue multimeter.  (3)
- 1.1.2 Name TWO control pots that are used to position the trace on the screen of an oscilloscope. (2)
- 1.2 1.2.1 Make use of the formula $2n^2$ to calculate the maximum number of electrons on the third shell of an atom. (2)
- 1.2.2 Explain the key processes of doping that changes semiconductor material to P-type material.  (4)
- 1.3 Draw the EIC symbol of a varactor diode. (2)
- 1.4 Choose a description from COLUMN B that matches an item in COLUMN A. Write only the letter (A–E) next to the question number (1.4.1–1.4.4) in the ANSWER BOOK.

COLUMN A		COLUMN B	
1.4.1	LED	A	voltage regulator
1.4.2	Tunnel diode	B	emits light
1.4.3	Zener diode	C	high-speed switching
1.4.4	Photo diode	D	variable capacitor 
		E	light-intensity switch

(4 × 1) (4)

- 1.5 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (1.5.1–1.5.5) in the ANSWER BOOK.
- 1.5.1 A transistor is biased by applying suitable voltages and currents to it to control its function.
- 1.5.2 A common base amplifier has a no-current gain.
- 1.5.3 Transistors act as amplifiers in the saturation mode.
- 1.5.4 The common collector amplifier has an 180° phase shift between its input and output. 
- 1.5.5 V_{CE} is a symbol of a transistor that indicates the voltage between the collector and emitter.

(5 × 1) (5)

1.6 Power supplies are made up of several stages of operation.

Describe the function of the following stages.

1.6.1 AC voltage transformation

1.6.2 Rectification

1.6.3 Filter

1.6.4 Regulation

1.6.5 Protection

(5 × 1) (5)

1.7 1.7.1 Briefly describe the construction of a P-channel, J-FET. (3)

1.7.2 What are the TWO modes of a MOSFET transistor that are created? (2)

1.8 1.8.1 State THREE characteristics of an operational amplifier integrated circuit (IC) that makes it an ideal amplifier component in electronic circuits. (3)

1.8.2 Draw the labelled circuit diagram of an inverting amplifier, using an operational amplifier integrated circuit (IC). (5)
[40]

QUESTION 2: DIGITAL ELECTRONICS

2.1 Convert between the following number systems:

2.1.1 63_8 to a binary number

2.1.2 $9F_{16}$ to a decimal number

2.1.3 107_{10} to an octal number

(3 × 3) (9)

2.2 BINARY ARITHMETIC

2.2.1 Multiply the following binary numbers:

$$11001_2 \times 101_2$$

2.2.2 Divide the following binary numbers:

$$10110_2 \div 100_2$$

2.2.3 Subtract the following binary numbers:

$$101001_2 - 1110_2$$

(3 × 3) (9)

- 2.3 2.3.1 What are TWO basic components or requirements of a digital counter?  (2)
- 2.3.2 Draw a block circuit diagram of a 2-bit asynchronous up-counter and also draw its timing diagram. (5)
- [25]**

QUESTION 3: ASSEMBLING A PERSONAL COMPUTER

3.1

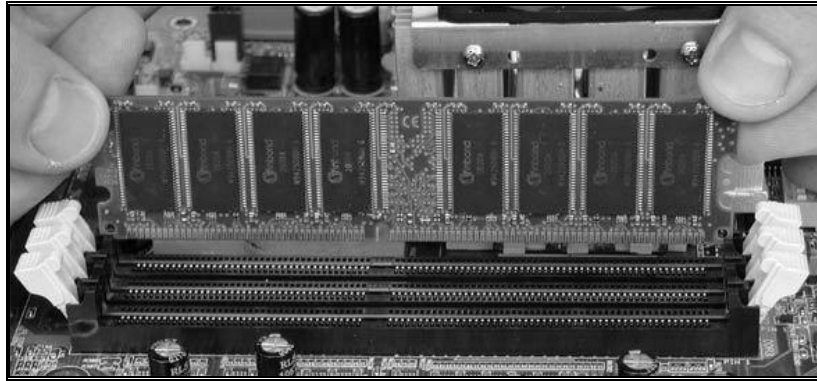


FIGURE 1

- 3.1.1 Name the type of module that is mounted on a motherboard of a desktop computer.  (1)
- 3.1.2 What is the function of the module mentioned in QUESTION 3.1.1, during the operation of a computer? (3)
- 3.2 After starting the computer, you find that the keyboard is not functioning.
How would you troubleshoot to find the cause? (3)
- 3.3 What does the acronym POST with regard to computer start-up, stand for? (1)
- 3.4 You ordered a new desktop computer for a client and have to set up its four main components.  (7)
- Explain, by naming the ports, how you would assemble the computer in order to start it up. **[15]**

QUESTION 4: TRANSDUCERS

4.1 Name THREE types of electrical transducers. (3)

4.2 Choose the correct word or words from those given in brackets describing the capacitive transducer shown in FIGURE 2. Write only the answer next to the question number (4.2.1–4.2.5) in the ANSWER BOOK.

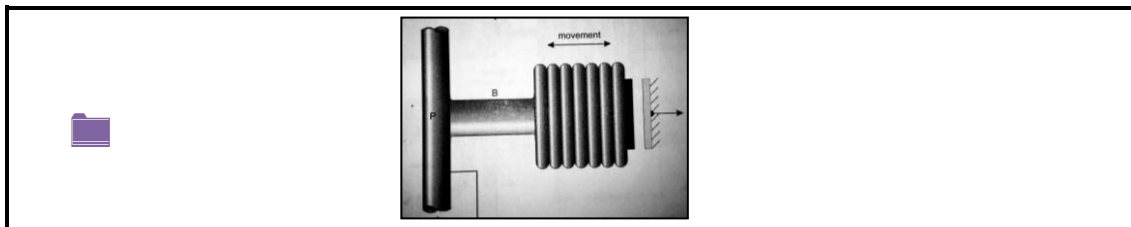


FIGURE 2

4.2.1 The expanding instrument used in this capacitive device is called a (bellows/Bourdon tube).

4.2.2 As pressure enters the system, the instrument (expands/contracts).

4.2.3 The effect between the fixed plate and movable plate changes the (area/distance) between the plates.

4.2.4 The moving plate affects the (capacitance/inductance) between the plates.

4.2.5 The change of capacitance in this device reflects a change in (pressure/level).

(5 × 1) (5)

4.3 Explain how a piezoelectric transducer is used as an audio microphone. (2)
[10]

QUESTION 5: PROGRAMMABLE LOGIC CONTROLLERS

5.1 Name TWO input control devices that can be wired to a PLC's inputs. (2)

5.2 Draw a ladder diagram that indicates a logic OR gate function of two input contacts A and B, that control an output relay M. Include a stop contact C. (4)

5.3 Explain what is meant by the term *latching* or *retaining* when designing a ladder diagram. (4)
[10]

TOTAL: 100