higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

PROFESSIONAL ENGINEERING PRACTICE
NQF LEVEL 4

(6021014)

3 December 2020 (X-paper)
09:00–12:00

This question paper consists of 9 pages.

275Q1N2003

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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 section on a new page.
5. Use only a black or blue pen.
6. Write neatly and legibly.

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QUESTION 1

1.1 Nuclear waste is a highly radioactive and dangerously toxic waste product from the generation of electricity from nuclear power stations.

1.1.1 Fully explain what is meant by the half-life of a radioactive substance. (3)

1.1.2 If a substance has a half-life of 100 million years, determine how long it will take for 75% of the atoms of this substance to decay. (3)

1.1.3 How are the highly radioactive waste products, generated by nuclear power stations, disposed of by law? (2)

1.1.4 Indicate whether the following statement is True or False:

'Coal power stations produce less waste than nuclear power stations'. (1)

1.2 Choose a description from COLUMN B that matches a term in COLUMN A. Write only the letter (A–M) next to the question number (1.2.1–1.2.10) in the ANSWER BOOK.

COLUMN A		COLUMN B	
1.2.1	Quality of work	A	happiness with fellow workers' achievements
1.2.2	Recognition	B	how well work is performed
1.2.3	Job satisfaction	C	state of mind regarding the nature of an employee's work
1.2.4	Friendliness	D	abstaining from discussing company issues with outsiders
1.2.5	Helpfulness	E	proper information sharing among workers
1.2.6	Responsibility	F	making sensitive professional judgements
1.2.7	Integrity	G	serving customers' interests by having luncheons and sports events
1.2.8	Effective communication	H	services rendered in exchange for favours
1.2.9	Empathy	I	honest and candid employee trait
1.2.10	Confidentiality	J	interpretation of employees' states of mind
		K	should not be faked using a forced smile
		L	showing sympathy towards fellow workers
		M	assisting fellow workers

(10 × 1) (10)

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1.3 Road traffic congestion in our cities is the cause of much frustration among road users.

1.3.1 Define the term *traffic congestion.*

1.3.2 Name TWO ways in which the public can assist to minimise traffic congestion on our city roads.

(2 × 2) (4)

1.4 State TWO principles of the South African Institute of Mechanical Engineering. (2)

[25]

QUESTION 2

2.1 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (2.1.1–2.1.5) in the ANSWER BOOK.

2.1.1 In engineering design, a prototype is an exact, same-size replica of the design solution, but is not used for testing purposes.

2.1.2 A physical model in engineering is similar to a prototype, but larger.

2.1.3 Mathematical modelling uses equations to describe a physical reality.

2.1.4 A simulation is a computer program that mimics a real process.

2.1.5 Mock-ups are used to show what a product will look like but does not show functions of the product.

(5 × 1) (5)

2.2 A customer wants a specific component to be designed.

2.2.1 Who is responsible for compiling the design brief? (1)

2.2.2 Who is responsible for creating the design proposal? (1)

2.2.3 Name FIVE aspects that must be covered in the design proposal. (5)

2.3 In engineering design, the customer creates a list of requirements to which the final design solution must adhere.

Define the following customer requirements:

2.3.1 Ergonomic considerations

2.3.2 Whole-life cost

2.3.3 Aesthetic considerations

(3 × 2) (6)

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2.4 The concept selection matrix (CSM) is used to find the best possible design solution from a small number of possible concepts. Analyse the CSM below and answer the questions

Criteria	Weighting factor	Concept 1		Concept 2		Concept 3	
		RF	Cr T	RF	Cr T	RF	Cr T
Cost	7	5	35	9	63	**(2.4.3)**	
Safety	9	7	63	1	9	7	63
Reliability	6	6	36	8	48	4	24
Functionality	4	5	20	9	36	3	12
Concept total:		154		156		127	

2.4.1 Which criterion is regarded as the least important? (1)

2.4.2 From the matrix, give a reason for your answer to QUESTION 2.4.1 (1)

2.4.3 Calculate the rating factor (RF) for Cost of Concept 3. Show all calculations. (2)

2.4.4 The design team chose Concept 1 as their final concept.

From the matrix, provide a comprehensive reason for this choice. (3)

[25]

QUESTION 3

3.1 Various options are given as possible answers to the following questions. Choose the correct answer and write only the letter (A–D) next to the question number (3.1.1–3.1.5) in the ANSWER BOOK.

3.1.1 Which of the following does not appear on the cover page of a technical report?

A Title of report.
B Action that should be taken.
C Name of author.
D Date on which report was written.

3.1.2 Which section of a technical report precedes the body of the report?

A Recommendations.
B Introduction.
C Conclusions.
D References.

3.1.3 To use other peoples' work without there permission as part as a report is called ...

A plagerism.
B opportunity.
C standard practice.
D constitutional right.

3.1.4 Charts, diagrams and drawings will normally be found in the following section of a technical report:

A Cover page
B Introduction
C Appendices
D Executive summary

3.1.5 Actions to be taken as a result of findings will be found in the following section of a technical report:

A Conclusions
B Introduction
C References
D Recommendations

(5 × 1) (5)

3.2 FIGURE 1 shows an electric circuit comprising a battery, switches A and B in the open position and a light bulb C (off).

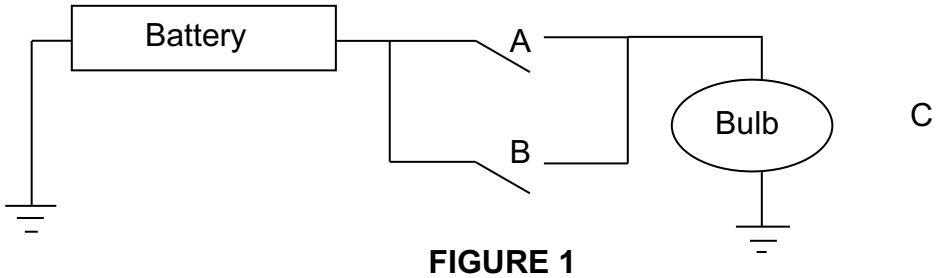

FIGURE 1

For the OR logical network function, the truth table below indicates the condition of the circuit as indicated above, as well as the condition when switch A is closed. Redraw the truth table in your ANSWER BOOK and complete the remainder of the table, to include the other two possible conditions:

Switch A	Switch B	Bulb C
0	0	0
1	0	1

(6)

3.3 On an engineering drawing, the following dimension appears as the outside diameter of a specific component: $100 \pm 0.015\,mm$

3.3.1 Define the term *tolerance* used in an engineering context? (2)

3.3.2 What is the exact outer dimension for this component in millimetres? (1)

3.3.3 Calculate the lower limit for this dimension in millimetres. (2)

3.3.4 Calculate the upper limit for this dimension in millimetres. (2)

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3.3.5 When this component is removed from the lathe, the quality assurance inspector measures the diameter of the component and finds that it is equal to 100,02 mm.

Explain in detail what must be done with this component. (4)

3.4 Write the following symbols found on engineering drawings in full:

3.4.1 PCD

3.4.2 NTS

3.4.3 R

(3 × 1) (3)
[25]

QUESTION 4

4.1 Complete the following sentences by choosing a word or words from the list below. Write only the answer next to the question number (4.1.1–4.1.5) in the ANSWER BOOK.

case; expression; branching; IF; FOR; operators; variables; while; consecutive structures

4.1.1 A/An … is a combination of statements and variables that must be evaluated.

4.1.2 … are the signs used to perform addition, subtraction, division, etc.

4.1.3 … loops are used to repeat a group of statements a set number of times.

4.1.4 … loops are used when the exact number of iterations is not known.

4.1.5 The … statement evaluates input against multiple conditions and supplies an output.

(5 × 1) (5)

4.2 High-level computer languages are easier to use and understand than low-level computer languages.

Define the following models of execution for high-level languages:

4.2.1 Interpreted languages

4.2.2 Compiled languages

(2 × 2) (4)

4.3 How many kilobytes are equal to TWO megabytes? (1)

4.4 Computer data storage can be divided into two types of storage known as primary storage and secondary storage. Redraw the table below in the ANSWER BOOK and compare the two types of storage as in the given example, taking the hints into account:

	Hint	Primary storage	Secondary storage
Example	Duration of data storage	It holds data currently in use	It stores data on long-term basis
4.4.1	Accessibility by CPU		
4.4.2	Data lost/retained during power failure		
4.4.3	Speed		

(3 × 2) (6)

4.5 The spreadsheet below indicates the sales of items for a small business enterprise called George's Hardware Shop for the first quarter of the year. Analyse the spreadsheet, and answer the questions that follow:

	A	B	C	D	E	F	G
1	***GEORGE'S HARDWARE SHOP (SALES FOR 1ST QUARTER)***						
2							
3		January	February	March			
4							
5	Drilling machines	18	24	16	58	24	
6	Hammers (4 lb)	34	42	21	97	42	
7	Chisels	23	21	38	82	38	
8	Hacksaws	9	7	11	27	11	
9	Planers	4	3	6	13	6	
10							
11	Total units/month	88	97	92			
12							
13	Highest sales (any item) – 1st Quarter:			42			
14							

4.5.1 Apart from merging, which other font styles have been used in Cells A1 to G1? (4)

4.5.2 What specific information is indicated by the data in cells F5 to F9? (1)

4.5.3 The merged and right aligned cells A13 to C13 indicates the information that is shown in cell D13.

Give TWO different range formulae that can be used to calculate the data as indicated in cell D13. (2 × 2) (4)

[25]

TOTAL: 100

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