higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

PROCESS CONTROL
NQF LEVEL 4

(6050414)

19 November 2018 (Y-Paper)
13:00–16:00

Non-programmable calculators may be used.

This question paper consists of 10 pages.

NCV

TIME: 3 HOURS
MARKS: 150

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. Accurately approximate ALL final answers to TWO decimal places.
6. Write neatly and legibly.

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SECTION A

QUESTION 1

Give ONE term for each of the following descriptions. Write only the word/term next to the question number (1.1–1.5) in the ANSWER BOOK.

1.1 They connect the system output in suitable format to the field device.

1.2 It defines all the aspects and requirements that ensure human health and safety within process plants.

1.3 They are used to manage information flow between components making certain that an operation happens at the correct time.

1.4 A set of rules issued or developed by authoritative body to govern how products are supposed to be manufactured.

1.5 A process of detecting potential problems or non-conformance and eliminating them.

(5 × 2) **[10]**

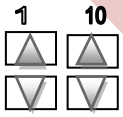
QUESTION 2

Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (2.1–2.5) in the ANSWER BOOK.

2.1 Which ONE of the following is NOT an advantage of quality control?

A Manufacturing companies meet their own expectations
B Problems are corrected as they occur
C Company's positive image is maintained
D Safety is ensured

2.2 What is indicated by the following symbol in a DCS screen schematics?



A Temperature alarm high
B Temperature indicator control
C Historical data icon
D Set point change buttons

2.3 Data falling through the central line suddenly rise or drop:

A Run
B Jump
C Trend
D Cycle

2.4 It is focused on data gathering:

A DCS
B PLC
C SCADA
D RTU

2.5 Which ONE of the following is NOT a purpose of DCS screen schematic?

A To show a process flow in the plant
B To show the actual process condition in the plant
C To retrieve historical data to monitor trends
D To find out why deviation occurs

(5 × 2) **[10]**

QUESTION 3

Choose an item from COLUMN B that matches a description in COLUMN A. Write only the letter (A–H) next to the question number (3.1–3.5) on the ANSWER BOOK.

COLUMN A		COLUMN B	
3.1	Remote terminal units.	A	in-line measurement
3.2	International organisation for standards.	B	CAR
3.3	The sample is removed from a process stream, isolated and analysed.	C	automatic control mode
3.4	Corrective action report.	D	RTU
3.5	A process control system that controls the entire process without human involvement.	E	cascade control mode
		F	ISO 9001
		G	CAPA
		H	at-line measurement

(5 × 1) **[5]**

QUESTION 4

Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (4.1–4.5) in the ANSWER BOOK.

4.1 Abnormal deviation is also known as assignable deviation because they occur naturally.

4.2 In feedback control, the output is measured and compared to the set point.

4.3 Viscosity is the property of fluid related to its resistance to flow.

4.4 A lock-out procedure makes it possible for a worker to come in contact with an uncontrolled energy source.

4.5 When a process is out of control, one of the variables has gone either above or below the control limits.

(5 × 2) **[10]**

TOTAL SECTION A: 35

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SECTION B

QUESTION 5

5.1 Quality is consistently meeting standards appropriate for a specific product or service. Quality is so important in process plants that it needs to be measured.

5.1.1 Which tool is used in a process plant to measure quality? (1)

5.1.2 For quality control to be effective certain tests need to be performed accurately on the processed products.

Name FOUR ways how these tests must be performed. (4)

5.1.3 Poorly executed quality control measures can have negative effects on the organisation.

Briefly indicate THREE effects. (3)

5.1.4 Briefly discuss contamination of raw materials and how it affects the overall quality of processed products. (3)

5.1.5 Name TWO benefits of SPC. (2)

5.1.6 List FOUR types of control charts and give a brief explanation of each. (4)

5.2 Name TWO ways of identifying non-conforming products. (2)

5.3 Briefly explain the following reasons for rejecting non-conforming products:

5.3.1 Company's image

5.3.2 Law suits

5.3.3 Customer satisfaction

(3 × 2) (6)

[25]

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QUESTION 6

Use the following data to answer the questions.

24	30	20
18	18	22
18	34	29
19	10	17
13	28	26
31	17	16
21	35	15
23	27	18
15	27	18
27	22	25

6.1 Calculate the mean. (3)

6.2 Calculate the range. (2)

6.3 Calculate the median. (2)

6.4 Calculate the mode. (2)

6.5 Construct a frequency distribution table. (5)

6.6 Draw a histogram. (6)

[20]

QUESTION 7

7.1 Analysers are identified by their principle of operation and/or their specific applications.

7.1.1 Name TWO functions of a common analyser.

7.1.2 Define the term *sampling.*

7.1.3 Explain how in-situ probe or sampling is performed.

(3 × 2) (6)

7.2 Give TWO advantages of in-line analysers. (2)

7.3 An unknown solution has a concentration of 0,001 mol/dm^3.

7.3.1 Calculate the pH of the solution. (3)

7.3.2 Is the solution acidic or basic? (1)

[12]

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QUESTION 8

8.1 Sketch the following PFD symbols:

8.1.1 Air cooler

8.1.2 Filter

8.1.3 Tube bundle

8.1.4 Reciprocating pump

8.1.5 Finned tube heat exchanger

(5 × 2) (10)

8.2 Use a troubleshooting guide to complete the table below. Write only the answer next to the question number (8.2.1–8.2.6) in the ANSWER BOOK.

SYMPTOMS	CAUSE	SOLUTION
Smoking	8.2.1	ESP fouled or tripped
8.2.2	8.2.3	Replace control valve
8.2.4	Recuperator fouled	8.2.5
	Tube fouling (fireside)	8.2.6

(6)

8.3 List SIX steps of problem-solving methodology in sequence. (6)

8.4 A data retrieval process may take many forms.

Name FOUR forms of data retrieval. (4)

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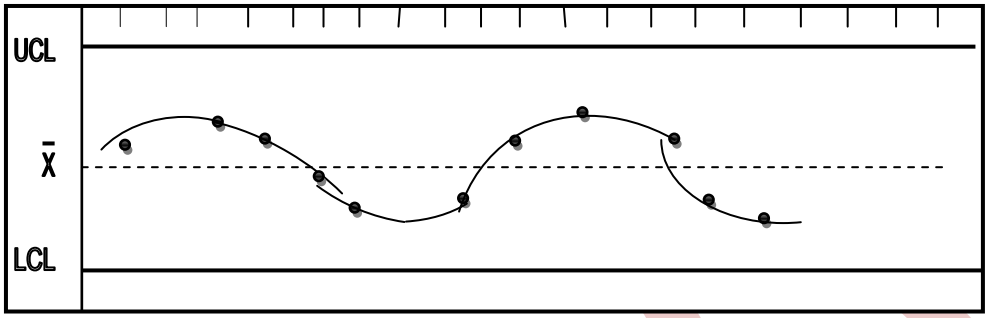
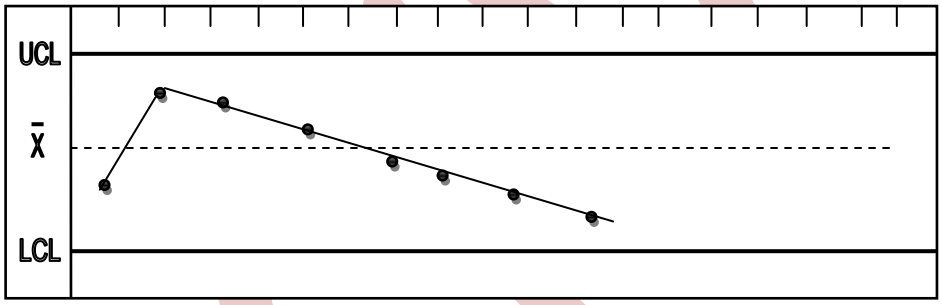
QUESTION 9

9.1 Study the control charts below and answer the questions.

A



B



9.1.1 What is the main purpose of a control chart? (2)

9.1.2 What do UCL and LCL stand for? (2)

9.1.3 Which ONE of the two charts represent a process that is in control? (1)

9.1.4 Explain the trend of data points in chart A. (3)

9.1.5 Briefly explain the trend of data in chart B. (2)

9.1.6 Name FOUR possible problems that are associated with the trend of data represented by chart A. (4)

9.1.7 Briefly explain a run and the problems that are associated with it. (2)

9.2 Part of the responsibilities of plant operators is to send and receive messages during a shutdown process.

9.2.1 State TWO reasons why process plants sometimes need to shut down.

9.2.2 Briefly explain why it is important to send clear messages during the shutdown process.

(2 × 2) (4)

[20]

QUESTION 10

10.1 Dangerous situations that may lead to damage to equipment and risk the safety of personnel may potentially occur at any time in a process plant.

10.1.1 Which instrument is used to sound alarms during abnormal or unsafe conditions? (1)

10.1.2 On the basis of operation principles, differentiate between a lower-selector switch (LSS) and a high selector switch (HSS). (4)

10.2 Indicate whether the following actions are automatic, cascade or manual:

10.2.1 A self-regulating plant in which the role of the operator is to adjust the values of the set points.

10.2.2 An operator monitors the level of a solvent tank and adjusts the supply valve.

10.2.3 A control system with a master and slave loop where the output of the master controller is the set point of the slave controller.

(3 × 1) (3)

10.3 Briefly explain the basic function of ratio control in process plants. (4)

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TOTAL SECTION B: 115
GRAND TOTAL: 150

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