higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

PROCESS CONTROL
NQF LEVEL 3

(6050403)

15 November 2022 (X-paper)
09:00–12:00

This question paper consists of 6 pages.

345Q1N2215

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

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QUESTION 1

Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (1.1–1.10) in the ANSWER BOOK.

1.1 Manual recording involves capturing information on a record book.

1.2 A remote field instrument is a device used to sense a physical parameter such as pressure or temperature from a distance by using electronic signals.

1.3 The pneumatic actuator needs no air supply for operation.

1.4 A sight glass gauge is a level-measurement device consisting of a transparent tube and gauge attached to a vessel that allows an operator to see the corresponding liquid level.

1.5 Interlock is a device that prevents damage to equipment and personnel by stopping or preventing the start of certain equipment if a preset condition has not been met.

1.6 A process flow diagram (PFD) is a simplified sketch that uses symbols to identify instruments and vessels and to describe the primary flow path through a unit.

1.7 A trip is a safety device that lowers the risk of unwanted events happening by cutting off power to the device that causes potential danger.

1.8 An open-loop control system does not require a human operator to take corrective measures.

1.9 A differential U-tube manometer is used to measure liquid levels.

1.10 Calibration is a process of setting the device to a base level or starting point that is convenient and does not change often.

(10 × 1) **[10]**

QUESTION 2

2.1 Describe the importance and reasons for using a standardised system of units. (7)

2.2 Explain the following signal transfer methods concerning their industry standards as used in process control applications.

2.2.1 Pneumatic signal transfer methods (4)

2.2.2 Electrical signal transfer methods (6)

2.2.3 Radio signal transfer methods (2)

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2.3 Convert the following:

2.3.1 400K to °C (2)

2.3.2 35 °F to Kelvin (3)
[24]

QUESTION 3

3.1 Differentiate between a *direct level measurement* and an *indirect level measuremen*t. (4)

3.2 There are FOUR types of flow meters: differential, area flow, open channel, and positive displacement flow meters.

3.2.1 Name THREE types of positive displacement flow meters. (3)

3.2.2 Draw a labelled diagram of the *Pitot tube.* (5)

3.3 Temperature is the degree or intensity of heat measured on a definite scale.

3.3.1 Phenomena that govern the behaviour of a thermocouple are the *Seebeck effect* and the *Peltier effect.* (6)
State the Seebeck- and Peltier effect.

3.3.2 The principle of differential-thermal expansion is the basis of operation for some thermometers such as bi-metallic expansion thermometers.
Explain the operating principles of the bi-metallic strip. (5)
[23]

QUESTION 4

4.1 There are numerous fail-safe systems and configurations used in control systems.

4.1.1 Define the concept of a *fail-safe system*. (3)

4.1.2 What is an *interlock*? (2)

4.2 Complete the following control-loop terminology by indicating the meaning of the following acronyms or abbreviations.

4.2.1 FCE

4.2.2 PT

4.2.3 TIR

4.2.4 PIC

4.2.5 LIC

4.2.6 TT

(6 × 1) (6)

4.3 An alarm is used to alert personnel of variable changes from normal operation.

4.3.1 What is *alarm management*? (2)

4.3.2 Explain the functions of the following alarm elements.

(a) Warning lights
(b) Audible alarm

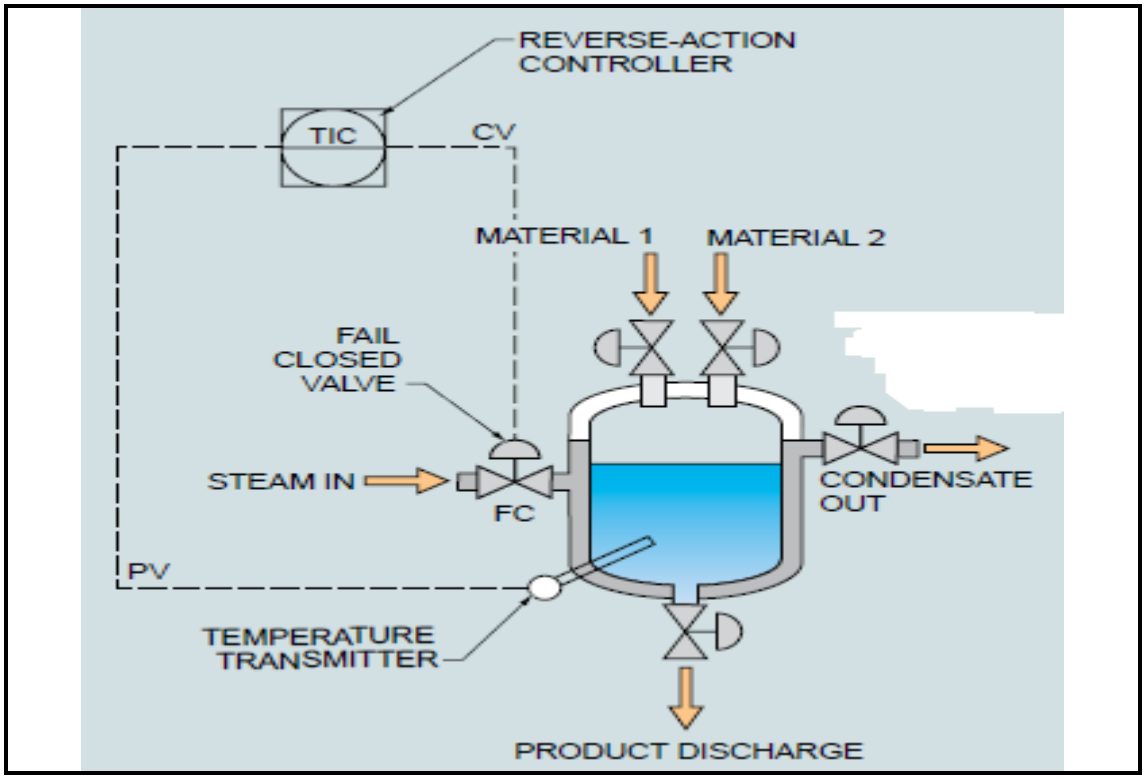
(2 × 2) (4)

4.4 List FOUR things that may cause a nuisance alarm to be seen or heard in a process plant. (4)

[21]

QUESTION 5

5.1 Study the diagram below of a heating process that uses a fail-closed steam control valve and answer the questions below:



5.1 5.1.1 What type of a control loop is used in the diagram?  (2)

5.1.2 Draw a fully labelled block diagram of the control loop indicated by the diagram above. (6)

5.2 Explain the logic of the following level control systems as used in a boiler water drum.

5.2.1 Single-element feedwater drum (5)



5.2.2 Two-element feedwater drum (4)

5.3 List FIVE sub-units in a separator drum. (5)

[22]

TOTAL: 100

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