



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

**NATIONAL CERTIFICATE
INDUSTRIAL INSTRUMENTS N6**

(8080216)

**26 July 2021 (X-paper)
09:00–12:00**

Nonprogrammable calculators and drawing instruments may be used.

This question paper consists of 4 pages and 1 formula sheet.



028Q1G2126

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA
NATIONAL CERTIFICATE
INDUSTRIAL INSTRUMENTS N6
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.
-



QUESTION 1: ANALYSERS

- 1.1 Spectrometry is the science of the measurement of wavelength position within a spectrum.
- 1.1.1 Make a neat, labelled sketch of an optical emission spectrochemical analyser.  (6)
- 1.1.2 Explain how samples can be analysed using an emission spectrometer for quantitative analysis. (5)
- 1.2 Make a neat, labelled sketch illustrating the origin of an X-ray spectrum due to electron bombardment. (5)
- 1.3 Many materials absorb ultraviolet radiation quite readily, and thus the concentration of these materials in an unknown mixture can be determined by using ultraviolet absorption analysis.
- 1.3.1 Make a neat, labelled sketch of an opposed-beam ultraviolet analyser.  (6)
- 1.3.2 Explain the working principle of the analyser in QUESTION 1.3.1 (5)
- 1.4 Name THREE factors that will affect the output of a single-beam ultraviolet analyser. (3)
- [30]**



QUESTION 2: AUTOMATIC CONTROL AND VALVES

- 2.1 Define the following terms:
- 2.1.1 Offset  (6)
- 2.1.2 Inherent regulation
- 2.1.3 Split range (3 × 2) (6)
- 2.2 A control valve for water flow is required. The flow is 6 000 l/h at a supply pressure of 6 bar, a downstream pressure of 3,6 bar, water temperature of 6 °C and atmospheric pressure of 0,87 bar. Assume the specific gravity of water to be one.
- Calculate the valve flow coefficient. (6)
- 2.3 Define the term *flashing*.  (3)
- 2.4 Name and explain TWO parameters that must be determined when adjusting a controller using the ultimate sensitivity method. (6)
- 2.5 Describe the limitations of the reaction curve method. (4)
- [25]**

QUESTION 3: DISTILLATION COLUMN AND BOILERS

- 3.1 Explain the purpose of distillation in process control. (3)
- 3.2 Make a neat, labelled sketch showing the construction of the fractionating section of the distillation column.  (4)
- 3.3 Make a neat, labelled sketch to show how temperature cascaded onto the steam flow controller to the reboiler is achieved in the stripping section of the distillation column. (5)
- 3.4 Draw a two-element feed water control system and explain how the water level in a boiler drum is controlled by the system.  (12)
- 3.5 List any SIX sources of pressure differential that can control of the air to fuel ratio successfully. (6)
- [30]**

QUESTION 4: INTRINSIC SAFETY

- 4.1 Name the THREE most important reasons for a fire or an explosion. (3)
- 4.2 State TWO requirements for explosive-proof housing in addition to explosion tests.  (2)
- 4.3 Describe the burnout test for a transformer.  (4)
- 4.4 Differentiate between *Class I*, *Class II* and *Class III* locations. (6)
- [15]**

TOTAL: 100

INDUSTRIAL INSTRUMENTS N6

FORMULA SHEET

1.
$$C_v = 1.16Q \sqrt{\frac{G_f}{\Delta P}}$$

2.
$$C_v = \frac{1.16W}{\sqrt{G_f \Delta P}}$$

3.
$$C_v = \frac{Q}{295} \sqrt{\frac{G.T}{\Delta P(P_1 + P_2)}}$$

4.
$$C_v = \frac{47,2W}{\sqrt{\Delta P(P_1 + P_2)}}$$

5.
$$C_v = \frac{72,4W}{\sqrt{\Delta P(P_1 + P_2)}}$$