higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

CHEMICAL PLANT OPERATION N5

(8050015)

1 December 2023 (X-paper)
09:00–12:00

Drawing instruments and nonprogrammable calculators may be used.

This question paper consists of 5 pages and a periodic table.

187Q1G2301

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
CHEMICAL PLANT OPERATION N5
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. Use only a blue or black pen.
5. Write neatly and legibly.

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QUESTION 1

Choose a term from COLUMN B that matches a description in COLUMN A. Write only the letter (A–G) next to the question number (1.1–1.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
1.1	Velocity decreases as kinetic energy is given to a moving blade	A	sensible heat
1.2	A vertical cylinder with a conical bottom	B	radial-flow turbine
1.3	A turbine in which only part of the pressure drop occurs in the nozzle	C	axial flow
1.4	Type of acid that produces sodium, copper and nitro-compound, which can be used for photoengraving	D	reaction turbine
1.5	When heat is supplied that causes an immediate rise in temperature	E	nitric acid
		F	sulphuric acid
		G	cyclone

(5 × 1) **[5]**

QUESTION 2

Give ONE term for each of the following descriptions by writing it next to the question number (2.1–2.5) in the ANSWER BOOK.

2.1 A separator that is a modified disc-type centrifuge with a double conical bowl

2.2 Acid that is used in the production of fertilisers

2.3 Can disintegrate scrap rubber and compound the toughest plastic masses

2.4 Made from two cylinders joined to form a 'V' and rotates about a horizontal axis

2.5 Vanes and baffles are built into the air stream to assure proper air-fuel mixing

(5 × 1) **[5]**

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QUESTION 3

3.1 Define the following:

3.1.1 Standard heat of formation

3.1.2 Kopp's rule

3.1.3 The gram mole

(3 × 3) (9)

3.2 One of the techniques for producing hydrogen for various refining and petrochemical operations is to react methane and ethane with steam in the presence of a nickel catalyst.

The analysis on a dry basis of the gases leaving such a reactor is as follows:

CH_4 = 4,6 mol%, C_2H_6 = 2,3 mol%, CO = 18,6 mol%, CO_2 = 4,6 mol% and H_2 = 69,7 mol%

What is the molar ratio of these TWO gases in the feed? (11)

[20]

QUESTION 4

4.1 Write brief notes on each of the following:

4.1.1 Axial-flow turbine

4.1.2 Radial-flow turbine

4.1.3 Nozzle mix burner

(3 × 4) (12)

4.2 Draw a fully labelled diagram of a premix burner. (11)

4.3 State the criteria for good combustion of liquid fuel. (2)

[25]

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QUESTION 5

5.1 List FIVE components of a tubular centrifuge. (5)

5.2 Describe the operation of the following:

5.2.1 Cyclone

5.2.2 Muller mixer

(2 × 5) (10)

5.3 Name TWO types of centrifugal decanters. (2)

5.4 Name the THREE blades in a two-arm kneader and describe the purpose for which each is used. (3 × 2) (6)

5.5 Complete the following reaction:

$CCl_4 + 2H_2O \rightarrow$ (2)

[25]

QUESTION 6

6.1 Nitric acid reacts with most metals and liberates H_2 gas.

Complete the following chemical reactions:

6.1.1 $Mg + 2HNO_3 \rightarrow$

6.1.2 $Mn + 2HNO_3 \rightarrow$

6.1.3 $Zn + 2HNO_3 \rightarrow$

(3 × 2) (6)

6.2 What should you bear in mind to maximise the chemical conversion of SO_2 to SO_3? (5)

6.3 Give THREE properties of sulphuric acid. (3)

6.4 List FOUR raw materials used for the manufacture of nitric acid. (4)

6.5 Name TWO types of gas turbines. (2)

[20]

TOTAL: 100

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(8050015)

THE PERIODIC TABLE OF ELEMENTS
DIE PERIODIEKE TABEL VAN ELEMENTE

