higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

CHEMICAL PLANT OPERATION N4

(805004)

4 December 2023 (X-paper)
09:00–12:00

Drawing instruments and nonprogrammable calculators may be used.

This question paper consists of 5 pages and 1 formula sheet.

239Q1G2304

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
CHEMICAL PLANT OPERATION
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 blue or black pen.
6. 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–I) next to the question number (1.1–1.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
1.1	Total energy put into a system in unit time must equal the amount of energy leaving the system in unit time, plus any accumulation	A	crushers
		B	static pressure
		C	nitration
1.2	Gives particles their definite size and shape	D	sulphonation
1.3	Device used for measuring local or point velocities	E	law of conservation of energy
		F	cutters
1.4	When pressure is measured on a plane perpendicular to the direction of the fluid flow	G	impact pressure
		H	pitot tube
1.5	Process during which sulphur chemically bonds to hydrocarbons	I	rotameter

(5 × 1) **[5]**

QUESTION 2

2.1 State FOUR variables affecting the amount of frictional losses. (4)

2.2 Write brief notes on velocity distribution in pipes. (6)

2.3 A fluid flows at a rate of 5,34 m^3/min through a pipe with an inside diameter of 62,5 mm. The fluid density is 800 kg/m^3 and the viscosity is 0.00521 kg/m.s. The pipe is 10 m long and the friction factor is 0.0085.

Calculate:

2.3.1 The Reynolds number (6)

2.3.2 The mechanical energy because of friction (4)

2.3.3 The pressure drop because of friction (2)

[22]

QUESTION 3

3.1 Define the following terms:

3.1.1 Grinders

3.1.2 Angle of nip (smooth roll crusher)

(2 × 2) (4)

3.2 Make a labelled sketch of a tumbling mill or a ball mill. (7)

3.3 Describe the operation of a toothed roll crusher. (7)

[18]

QUESTION 4

4.1 Describe the cold lime process. (4)

4.2 Define *softening*. (2)

4.3 Describe *desalting*. (6)

4.4 Describe the sodium cation exchanger process. (8)

[20]

QUESTION 5

5.1 State FIVE uses of hydrogen. (5)

5.2 State FIVE uses of oxygen. (5)

5.3 Describe FOUR commercial products of carbon dioxide. (4)

5.4 Give a chronological description of the process to produce sulphur dioxide by burning sulphur. (6)

[20]

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QUESTION 6

6.1 Discuss the effect that the following will have on aluminium:

6.1.1 Atmospheric conditions

6.1.2 Concentrated nitric acid

6.1.3 A strong sodium hydroxide solution

(3 × 1) (3)

6.2 State the disadvantages of titanium. (4)

6.3 Define *oxidation*. (3)

6.4 Why is it more economical to use oxygen instead of air in chemical industries?

Give FIVE reasons. (5)

[15]

TOTAL: 100

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(805004)

CHEMICAL PLANT OPERATION N4

FORMULA SHEET

$$N_{RE} = \frac{DV\rho}{\mu}$$

$$Z_1 \frac{g}{g_c} + \rho_1 \upsilon_1 + \frac{V_1^2}{2\alpha_1 g_c} + \int_1^2 \rho \, d\upsilon + W_o = Z_2 \frac{g}{g_c} + \frac{V_2^2}{2\alpha_n g_c} + \rho_2 \upsilon_2 + \Sigma F$$

$$F = 2f\frac{V^2 L}{g_c D}$$

$$f = \frac{32_{\mu} VL}{g_c D^2 \rho}$$

$$F_e = \frac{(V_1 - V_2)^2}{2\alpha g_c}$$

$$F_c = K_c \frac{V_2^2}{2\alpha g_c}$$

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