higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

CHEMICAL PLANT OPERATION N4

(8050004)

10 August 2021 (X-paper)
09:00–12:00

Nonprogrammable calculators may be used.

This question paper consists of 6 pages and 1 formula sheet.

243Q1G2110

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
CHEMICAL PLANT OPERATION N4
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. Only use 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 (1.1–1.5) in the ANSWER BOOK.

1.1 Tantalum is an important construction material; it is strong and of medium weight.

1.2 The Fanning equation is strictly applicable to a system in which the fluid density, viscosity and linear velocity are constant.

1.3 The sodium cation exchange process is regenerated to restore the sodium resin with a salt solution.

1.4 The esterification process is used in the making of isomers.

1.5 Oxygen and carbon dioxide are the two primary components of air in the atmosphere.

(5 × 1) **[5]**

QUESTION 2

Choose a term from COLUMN B that matches a description in COLUMN A. Write only the letter (A–H) next to the question number (2.1–2.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
2.1	Hammer mill with internal classification	A	sulphuric acid
2.2	Type of energy that may be expressed as $(Z\ (g/gc)$	B	fluid energy mill
2.3	Type of hardness that can be reduced by heating water	C	toothed roll
2.4	Catalyst used during esterification	D	bicarbonates
2.5	Crusher which handles softer feeds like coal, bone and soft shale	E	micro-atomiser
		F	internal energy
		G	potential energy
		H	carbonates

(5 × 1) **[5]**

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QUESTION 3

3.1 Define the *expression* $\sum F$. (2)

3.2 What does the expression in QUESTION 3.1 represent? (1)

3.3 Describe a *water hammer*. (4)

3.4 Explain how you would eliminate water hammer. (2)

3.5 A fluid is travelling at a speed of 0,173 m^3/min through a pipe with an inside diameter of 590 mm. The density is 581 kg/m^3 and the viscosity of fluid is 0,023 kg/ms.

3.5.1 Calculate the average linear velocity. (5)

3.5.2 Determine the type of fluid flow that is travelling through the pipe. (4)

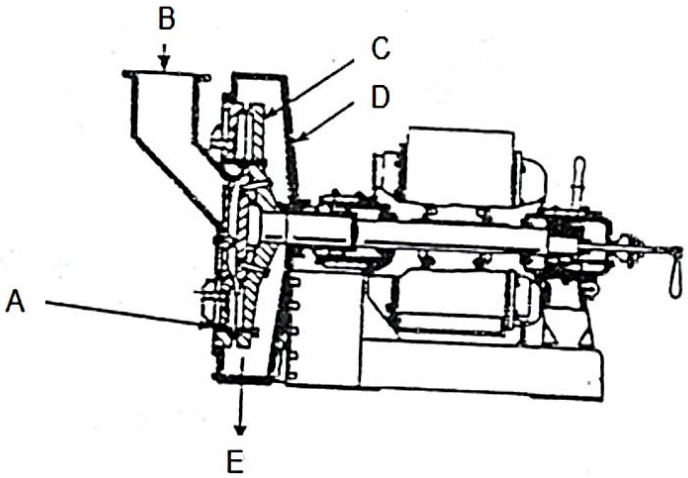
3.6 List TWO types of energy that are required for fluid to flow through any type of conduct. (2)

[20]

QUESTION 4

4.1 Describe *grinders*. (2)

4.2 The FIGURE below shows an attrition mill. Label the parts by writing down each name next to the letter (A–E) in the ANSWER BOOK.



FIGURE

(5 × 1) (5)

4.3 Sketch a fully labelled diagram of smooth-roll crusher and describe its operation. (10)

4.4 Name THREE types of grinders. (3)

[20]

QUESTION 5

5.1 Complete the following paragraph on the production of oxygen and nitrogen via the cryogenic process by writing down the missing words next to the question number (5.1.1–5.1.11) in the ANSWER BOOK.

Filtered air is compressed in a (5.1.1) … and cooled. After separating out all liquid water, the air enters a (5.1.2) … and is cooled by exchanging heat with the outgoing (5.1.3) … products. As the air cools, moisture is condensed and (5.1.4) … on the walls of the (5.1.5) … passage. At the lower temperature, (5.1.6) … also freezes. The air emerging from the heat exchanger is thus completely dry and free of (5.1.7) … . The cleaned gas is then fed to the bottom tray in the lower column of the double-column rectifier. Because (5.1.8) … is more volatile than oxygen, it will ascend each (5.1.9) …

The oxygen product is removed as (5.1.10) … vapour from the main (5.1.11) …, and a high-purity nitrogen product is removed as saturated vapour from the top of the upper column.

(11 × 1) (11)

5.2 State FOUR methods that are used in the manufacturing of carbon dioxide. (4)

5.3 Give FIVE uses of nitrogen. (5)

[20]

QUESTION 6

6.1 Halogenation and chlorination are used mainly to affect the entrance into the hydrocarbon ring.

6.1.1 Name THREE ways in which chlorination can take place. (3)

6.1.2 Define *halogenation*. (2)

6.1.3 Complete and balance the following reaction equation on halogenation:

$C_6H_6 + HCl + \frac{1}{2} O_2 \longrightarrow$ (3)

6.2 List THREE types of copper alloys. (3)

6.3 State FOUR properties of steel. (4)

[15]

QUESTION 7

7.1 Differentiate between *cation exchange* and *anion exchange.* (2)

7.2 Give the steps of hot lime-soda treatment in sequence. (9)

7.3 Define *biochemical oxygen demand.* (2)

7.4 Complete and balance the following reaction equation:

$CaR_2 + 2NaCl \longrightarrow$ (2)

[15]

TOTAL: 100

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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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