higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T310**(E)**(A9)T

NATIONAL CERTIFICATE

CHEMICAL PLANT OPERATION N4

(8050004)

9 April 2018 (X-Paper)
09:00–12:00

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

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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. Write neatly and legibly.

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QUESTION 1

Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (1.1–1.5) in the ANSWER BOOK.

1.1 Ozone gas can be used to disinfect waste water.

1.2 Crushers describe a variety of size reduction machines for intermediate duty.

1.3 Poiseuille's law is applied in place of the Fanning equation when the Reynolds number is greater than 2100.

1.4 Sulphur dioxide can be used to prevent mould in the drying of food.

1.5 Mild steel is widely used in the manufacture of motorcar bodies.

(5 × 1) **[5]**

QUESTION 2

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

COLUMN A		COLUMN B	
2.1	The flow expressed as volume per unit time divided by the cross-sectional area of the pipe	A	viscosity
2.2	A type of hammer mill that contains a high-speed rotor turning inside a cylindrical casing	B	sulphonation
2.3	This is produced as a by-product of the lime-kiln operation	C	permanent hardness
2.4	A type of hardness that can be reduced by using chemicals	D	average linear velocity
2.5	A process during which isomers are produced	E	impactors
		F	temporary hardness
		G	oxygen
		H	carbon dioxide
		I	esterification
		J	smooth roll crusher

(5 × 1) **[5]**

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QUESTION 3

3.1 If a fluid is flowing at a rate of 250 m^3/min through a pipe having an inside diameter of 3 m, calculate the average linear velocity of the fluid. (4)

3.2 Write brief clarifying notes on how to determine the friction factor (*f*) in the Fanning equation. (5)

3.3 Differentiate between the following:

3.3.1 Impact pressure and static pressure (2 × 2) (4)

3.3.2 Turbulent flow and streamline flow (2 × 2) (4)

3.4 Name THREE variables which serve to indicate whether the flow is streamline flow or turbulent flow. (3)
[20]

QUESTION 4

4.1 Name FOUR types of intermediate and fine grinders. (4)

4.2 Draw a fully labelled diagram of a jaw crusher. (10)

4.3 Define the following:

4.3.1 Critical speed (ball mill)

4.3.2 Grinder

4.3.3 Angle of nip (smooth roll crusher)

(3 × 2) (6)
[20]

QUESTION 5

5.1 State THREE commercial processes for the manufacturing of carbon dioxide. (3)

5.2 Sulphur dioxide is produced industrially by the burning of sulphur.

5.2.1 Draw a flow diagram of liquid sulphur dioxide production. (10)

5.2.2 Give a chronological description of the process in QUESTION 5.2.1. (7)
[20]

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QUESTION 6

6.1 Copper and its alloys are widely used in chemical processing where heat and electrical conductivity are important factors.

6.1.1 Name TWO methods that can be used to join copper. (2)

6.1.2 Name THREE types of copper alloys. (3)

6.2 State TWO properties of titanium. (2)

6.3 Name THREE raw materials that can be used in the making of ester. (3)

6.4 Give FIVE reasons why oxygen is preferred to air in the industry. (5)
[15]

QUESTION 7

7.1 Hard water may cause scaling in pipes and also make it more difficult for soap to clean effectively.

7.1.1 Differentiate between permanent hardness and temporary hardness. (2 × 2) (4)

7.1.2 What are the main causes of water hardness? (2)

7.2 Draw a fully labelled diagram of the municipal water-purification plant process. (9)
[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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