higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T310**(E)**(A2)T

NATIONAL CERTIFICATE

CHEMICAL PLANT OPERATION N4

(8050004)

2 August 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 Silica is removed from water by using hydrogen cation exchange.

1.2 Particles in an impactor hammer mill are broken by a rubbing action.

1.3 Carbon dioxide can be produced from the combustion of fuel oil in a boiler plant generating the required steam.

1.4 Fluids having low viscosities offer less resistance to a shearing force.

1.5 Titanium can be used as a construction material.

(5 × 1) **[5]**

QUESTION 2

Choose an item/a word 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 Reynolds number range falls between 2 100 and 4 000	A	softening
2.2	Slow-speed machines used for coarse reduction of large quantities of solid materials	B	esterification
2.3	The type of gas produced by the rectification of the air process	C	critical region
2.4	Removal of microorganisms and organic matter from water	D	sulfonation
2.5	A process in which medicines and perfumes are formed	E	nitrogen
		F	crushers
		G	sulphur dioxide
		H	turbulent flow
		I	purification
		J	grinders

(5 × 1) **[5]**

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QUESTION 3

3.1 Define the following:

3.1.1 Static pressure

3.1.2 Absolute viscosity

3.1.3 Velocity pressure

(3 × 2) (6)

3.2 Use a formula to prove that the Reynolds number is dimensionless. (5)

3.3 A fluid flowing through any type of conduit contains three fundamental types of energy.

Name and define the THREE types of energy. (6)

3.4 Describe the law of conservation of energy. (3)

[20]

QUESTION 4

4.1 Name TWO types of each of the following grinders:

4.1.1 Tumbling mills

4.1.2 Rolling compression mills

(2 × 2) (4)

4.2 Make a labelled sketch of a classifying hammer mill (micro atomiser). (10)

4.3 Discuss ultrafine grinders. (2)

4.4 Describe the operation of the smooth roll crusher. (4)

[20]

QUESTION 5

5.1 Hydrogen is the most abundant gas in the universe and it is made up of two hydrogen atoms.

State FOUR methods used in the production of hydrogen. (4)

5.2 Draw a process flow diagram in the production of carbon dioxide (CO_2) from oil or natural gas. (10)

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5.3 State FOUR uses of oxygen. (4)

5.4 What are the TWO main steps used in the fractional distillation of air (cryogenic process) to produce nitrogen and oxygen? (2)
[20]

QUESTION 6

6.1 There are more than 70 standard types of stainless steel used to produce many special alloys.

State THREE properties of stainless steel. (3)

6.2 Alloy steel contains one or more alloying agents to improve its mechanical and corrosion resistant properties to be better than those of carbon steel.

Give TWO examples of these agents. (2)

6.3 State FOUR advantages of plastics. (4)

6.4 Define the following:

6.4.1 Sulfonation

6.4.2 Oxidation

(2 × 3) (6)
[15]

QUESTION 7

7.1 Draw a flow diagram of the municipal waste-water treatment process. (8)

7.2 Define the following:

7.2.1 Ion exchange (3)

7.2.2 Softening (2)

7.2.3 Temporary hardness (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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