higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T310**(E)**(A7)T

NATIONAL CERTIFICATE

CHEMICAL PLANT OPERATION N4

(8050004)

7 August 2019 (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. Sketches must be large, neat and fully labelled.
5. 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 Fluid with a high viscosity offers less resistance to a shearing force than fluid with a low viscosity.

1.2 In a smooth roll crusher the feed is admitted between two jaws forming a V-shape at the bottom.

1.3 Hydrogen gas can be used to produce margarine.

1.4 Rubber and glass are widely used in the industry as lining materials.

1.5 Activated sludge contains aerobic microorganisms which digest raw sewage.

(5 × 1) **[5]**

QUESTION 2

2.1 Water flows at a constant mass rate through a long section of a uniform diameter pipe. The density of water is 1 000 kg/m^3. Because water may be considered as a noncompressible fluid, the velocity is constant throughout the pipe. The section exit is 4,5 m higher than the entrance. The entrance pressure is 106 kPa and the exit pressure is absolute 172,4 kPa. A pump supplies 170,5 J/kg of flowing water. Water density in the section may be assumed as constant and the Reynolds number is higher than 2 100 throughout the system.

Calculate the mechanical energy loss in the pipe due to friction. (10)

2.2 Name and define TWO types of steady flow. (2 × 3) (6)

2.3 Define each of the following:

2.3.1 Fluid flow

2.3.2 Loss in mechanical energy caused by friction effect

(2 × 2) (4)

[20]

QUESTION 3

3.1 Size reduction equipment is divided into crushers, grinders, ultrafine grinders and cutting machines.

3.1.1 What is the difference between a *crusher* and a *grinder*? (4)

3.1.2 Which type of size reduction equipment gives particles of a definite size and shape of 2 to 10 mm in length? (1)

3.1.3 Name the equipment which CANNOT accept feed particles larger than 6 mm. (1)

3.2 Draw a labelled diagram of a cutting machine. (6)

3.3 Describe the operation of a hammer mill with internal classification (mikro-atomiser). (8)
[20]

QUESTION 4

4.1 Give THREE ways in which hydrogen can be produced. (3)

4.2 Draw a labelled flow diagram for the manufacturing of carbon dioxide through a fermentation process and give a chronological description of the process. (17)
[20]

QUESTION 5

5.1 Draw a flow diagram of a municipal waste-water treatment plant. (8)

5.2 Name FIVE methods that can be used to soften water in the industry. (5)

5.3 Define *activated sludge treatment.* (3)

5.4 What is an *aeration tank*? (2)

5.5 Name the TWO main gases produced in an anaerobic digester. (2)
[20]

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QUESTION 6

6.1 Cl, Br, and F are examples of halogens.

Define *halogenation.* (3)

6.2 Complete and balance each of the following reaction equations:

6.2.1 $CH_2 = CH_2 + HCl \rightarrow$

6.2.2 $C_6H_6 + HCl + ½O \rightarrow$

(2 × 2) (4)

6.3 Give FOUR disadvantages of wood. (4)

6.4 List FOUR properties of glass. (4)
[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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