higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

CHEMICAL PLANT OPERATION N4

(8050004)

24 November 2022 (X-paper)
09:00–12:00

Drawing instruments and nonprogrammable calculators may be used.

This question paper consists of 4 pages and 1 formula sheet.

239Q1E2225

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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. Use only 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 The pressure drop due to friction is equal to the value of $\sum F$ divided by the average density.

1.2 The Fanning equation is strictly applicable only to point conditions or to a system in which the fluid density, viscosity and linear velocity are not constant.

1.3 Viscosity of a fluid is a property of the material by virtue of which it resists shearing forces.

1.4 Static pressure is a pressure exerted on a plane perpendicular to the direction of a moving fluid.

1.5 There are three types of pumps ordinarily employed in chemical processes, namely rotary pumps, reciprocating pumps and centrifugal pumps.

(5 × 1) **[5]**

QUESTION 2: SIZE REDUCTION EQUIPMENT

2.1 Name FOUR principal types of size reduction machines. (4)

2.2 Define *the angle of nip*. (2)

2.3 What is the acceptable product size from an intermediate grinder? (1)

2.4 Draw a labelled diagram of a tumbling or ball mill and explain the operation of the machine. (15)

[22]

QUESTION 3: FLUID FLOW

Water is pumped from a reservoir to a tank over a distance of 25 000 cm at a rate of 560 litres per minute through a pipe with a diameter of 150 mm. The tank is 70 m and the reservoir is 20 m to the reference plane. The overall efficiency of the pump motor can be assumed to be 45%.

Calculate the horse power supplied to the pump motor.

HINT: $1H$ p = 745,7 W

Given that:
$\rho_{water} = 990\ kg/m^3$
$f = 0{,}0048$
$Pressure1 = Pressure2 = 101{,}3\ kPa$
$g_c = 1$ (when working with SI units)

[20]

QUESTION 4: ORGANIC PROCESSES AND MATERIALS

4.1 Describe the term *sulphonation.* (4)

4.2 Name FIVE rubbers and elastomers that are widely used as lining materials. (5)

4.3 Give TWO advantages of using glass in chemical industries. (2)

4.4 State FOUR properties of tantalum. (4)

[15]

QUESTION 5: WATER CONDITIONING AND ENVIRONMENTAL PROTECTION

5.1 Sketch the municipal wastewater treatment process. (8)

5.2 Give a chronological description of the hot lime soda process for the conditioning of boiler feed water. (8)

5.3 Define the term *clarification of water*. (2)

5.4 Name TWO types of water hardness. (2)

[20]

QUESTION 6: INDUSTRIAL CHEMICAL GAS PROCESSES

6.1 State THREE uses of nitrogen. (3)

6.2 Draw a labelled diagram and describe the process of the production of liquid and dry ice from carbon dioxide. (15)

[18]

TOTAL: 100

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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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