higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

CHEMICAL PLANT OPERATION N4

(8050004)

19 April 2021 (X-paper)
09:00–12:00

Calculators may be used.

This question paper consists of 6 pages.

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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 section on a new page.
5. Use only blue or black pen.
6. Write neatly and legibly.

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QUESTION 1

Give ONE term for each of the following descriptions by writing it next to the question number (1.1–1.5) in the ANSWER BOOK.

1.1 The total energy put into a system in unit time must be equal to the amount of energy leaving the system in unit time plus any accumulation.

1.2 The speed at which the balls will be carried over centrifuging and drawn off into the crushing zone.

1.3 A process whereby hydrogen is produced by passing electrical current through an aqueous solution.

1.4 Ratio of inertial forces to viscous forces.

1.5 A process in which ions are removed from water.

(5 × 1) **[5]**

QUESTION 2

Choose an item 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	The work of expansion or contraction in pressure between two points in a system	A	roller mill
2.2	It is applicable to a condition or system in which the fluid density, viscosity and linear velocity are constant	B	fanning equation
2.3	A ball mill	C	temporary hardness
2.4	The enrichment of water with nutrients	D	permanent hardness
2.5	It is caused by the chlorides and the sulphate of calcium and magnesium salts	E	$\int_1^2 pdv$
		F	pebble mill
		G	fertilisation
		H	eutrophication

(5 × 1) **[5]**

QUESTION 3

3.1 Water hammer is a surge or wave that results when a fluid in motion is forced to stop or change direction suddenly.

3.1.1 Define *water hammer*. (2)

3.1.2 Give THREE variables that influence water hammer. (3)

3.1.3 List THREE methods that can be used to eliminate water hammer. (3)

3.2 Water flows through a straight pipe which is 10 m long, and with an inner diameter of 50 cm. The density of water is 1 000 kg/m^3 and its viscosity is 0,0050 kg/ms.

Calculate the following:

3.2.1 The area of the pipe. (3)

3.2.2 The volume of the tank, if the flow rate into the tank is 760 ℓ/s and the tank is filled in 22 hours. (5)

HINT: Volume = flow rate in litres per seconds.

3.3 Define the following:

3.3.1 Viscosity of the fluid

3.3.2 Average linear velocity

(2 × 2) (4)
[20]

QUESTION 4

4.1 A toothed roll crusher operates by tearing the feed apart as well as crushing it.

4.1.1 List THREE examples of materials that can be handled by toothed roll crusher. (3)

4.1.2 Draw a labelled diagram of a single-roll toothed crusher and describe its operation. (14)

4.2 Name THREE types of tumbling mills. (3)
[20]

QUESTION 5

5.1 Draw a process flow diagram for producing hydrogen from propane. (11)

5.2 What are the TWO primary components of air in the atmosphere? (2)

5.3 Give a chemical reaction for the decomposition of water. (4)

5.4 State THREE methods used in the production of sulphur dioxide. (3)

[20]

QUESTION 6

6.1 Differentiate between *purification* and *softening of water.* (2 × 2) (4)

6.2 Give TWO lime soda processes used to remove hardness in water. (2)

6.3 Treatment of municipal water is necessary to provide potable and safe water.

Name FIVE requisites of a safe municipal water supply. (5)

6.4 List THREE methods that can be used to disinfect water. (3)

6.5 Define *biochemical oxygen demand*. (2)

6.6 Complete and balance the following equations:

6.6.1 $MgR_2 + H_2SO_4 \rightarrow$

6.6.2 $CaR_2 + 2NaCl \rightarrow$

(2 × 2) (4)

[20]

QUESTION 7

7.1 Discuss corrosion resistance of copper alloys. (2)

7.2 State TWO properties of tantalum. (2)

7.3 Name the agent reacting with hydrocarbon during the following processes:

7.3.1 Oxidation

7.3.2 Sulphonation

7.3.3 Halogenation

7.3.4 Nitration

(4 × 1) (4)

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7.4 Esterification is the process whereby esters are formed.

7.4.1 Name the catalyst used during esterification.

7.4.2 Why is water added to the condensate after it has been removed from the column?

(2 × 1) (2)
[10]

TOTAL: 100

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