higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

PROCESS TECHNOLOGY
NQF LEVEL 4

(6050364)

21 November 2023 (X-paper)
09:00–12:00

Calculators may be used.

This question paper consists of 7 pages and a periodic table.

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)
PROCESS TECHNOLOGY
NQF LEVEL 4
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. Use 3,14 for the value of π
5. Start each section on a new page.
6. Use only a black or blue pen.
7. Write neatly and legibly.

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SECTION A

QUESTION 1

Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1–1.5) in the ANSWER BOOK.

1.1 An evaporator that purifies liquids and assists in biofuel creation is known as …

A an agitated film evaporator
B a falling film evaporator
C a rising film evaporator
D a flash evaporator

1.2 The line that represents the boundary where liquids and gas can exist together in a stable manner:

A Condensation line
B Evaporation line
C Solid line
D Double line

1.3 The function of the distillation column is to …

A allow contact between the liquid and vapour
B separate the liquid and vapour
C allow the vapour to rise upward while the liquid remains at the bottom
D store the condensed vapour

1.4 It is defined as the volume of a substance divided by the total volume of the solution:

A Volume concentration
B Volume
C Concentration
D Molar concentration

1.5 The internal energy is related to the molecular structure and the . . .

A molecular volume
B molecular concentration
C molecular activity
D physical structure

(5 × 1) **[5]**

QUESTION 2

Choose a/an word/item 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	Its purpose is to separate the solute from a solution by evaporating the solvent	A	mixing chamber
		B	potential energy
2.2	It is also known as a heat transfer process	C	forced circulation evaporation
		D	calandria
2.3	A cylindrical vessel in which the solution is reheated so that it can pass through the mixing chamber	E	mass flow
		F	flash evaporation
2.4	An equation that can only be applied to a system that has a single inlet and a single outlet	G	kinetic energy
		H	condensation
2.5	Energy that involves gravitational acceleration	I	co-current decoration
		J	mass conservation

(5 × 1) **[5]**

QUESTION 3

Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (3.1–3.10) in the ANSWER BOOK.

3.1 The setup of the indirect condenser is similar to the heat exchange used in the evaporation process.

3.2 A reactive distillation process is used with reversible reactions.

3.3 An open system has a boundary that closes it off from its surroundings.

3.4 The definition of density applies to the conservation of mass.

3.5 Weight is a scalar quantity with magnitude only.

3.6 A chemical equation is used to represent a real chemical reaction.

3.7 In a pump work is put into the pump in order to pump the fluid.

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3.8 Rate form is when something changes a certain rate and is a function of time.

3.9 The Kelvin scale is a universal temperature scale.

3.10 When heat is transferred to a system, the only change that occurs is in the internal energy.

(10 × 2) **[20]**

TOTAL SECTION A: 30

SECTION B

QUESTION 4

4.1 *Forced circulation evaporation* processes are used in the industry for different applications.

4.1.1 Define the term *forced circulation evaporation* process.

4.1.2 What is the purpose of a heat exchanger in this type of evaporator?

4.1.3 How will the circulation pump affect the process if it is not working properly?

(3 × 2) (6)

4.2 List THREE factors that cause poor performance of a condenser. (3)

4.3 Name the TWO most common uses of distillation. (2)

4.4 There are FOUR different types of column configuration used in the industrial distillation column.

Draw sketches of the following configurations:

4.4.1 Baffle configuration

4.4.2 Double crossflow

(2 × 2) (4)

4.5 What is the cause of tiny cracks in decanting equipment? (1)

4.6 Provide the remedies for the following problems listed below in decanters:

4.6.1 Fouling

4.6.2 Corrosion

(2 × 2) (4)

[20]

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QUESTION 5

5.1 A tank has 20 000 kg of water that feeds into a tube with a radius of 20 mm.

The water that flows into the tube at a rate of 100 kg/s has a density of 1000 kg/m^3.

5.1.1 Calculate the velocity of the water flowing into the tube. (6)

5.1.2 If the water is allowed to flow into the tube for 6 minutes, calculate the volume of the water that must be in the tank to ensure that the tank is completely empty after 6 minutes. (5)

5.2 Write the molecular weight of the following molecules:

5.2.1 NH_4OH (2)

5.2.2 $Al_2(CO_3)_3$ (3)

5.3 Differentiate between *chemical equations* and *chemical reaction*. (4)

[20]

QUESTION 6

6.1 Write the names for the systems below:

6.1.1 A system where there is no flow of mass, in or out of the system.

6.1.2 A system where there is no change of energy.

6.1.3 A system with a mass flowing into and out of the system.

(3 × 2) (6)

6.2 Name THREE methods of heat transfer between two systems. (3)

6.3 Draw freehand diagrams indicating the following phases of matter and write a brief explanation for each one:

6.3.1 Solid phase

6.3.2 Liquids phase

6.3.3 Plasma

(3 × 3) (9)

6.4 Define the term *specific heat*. (2)

[20]

QUESTION 7

7.1 List THREE properties of *thermosetting* plastics. (3)

7.2 Define the term *thermal expansion*. (2)

7.3 Explain what the following forms of metal is used for in the construction of process equipment:

7.3.1 Sheet metal

7.3.2 Bars

(2 × 2) (4)

7.4 List ONE application of the *forging* metal production process. (1)

[10]

TOTAL SECTION B: 70
GRAND TOTAL: 100

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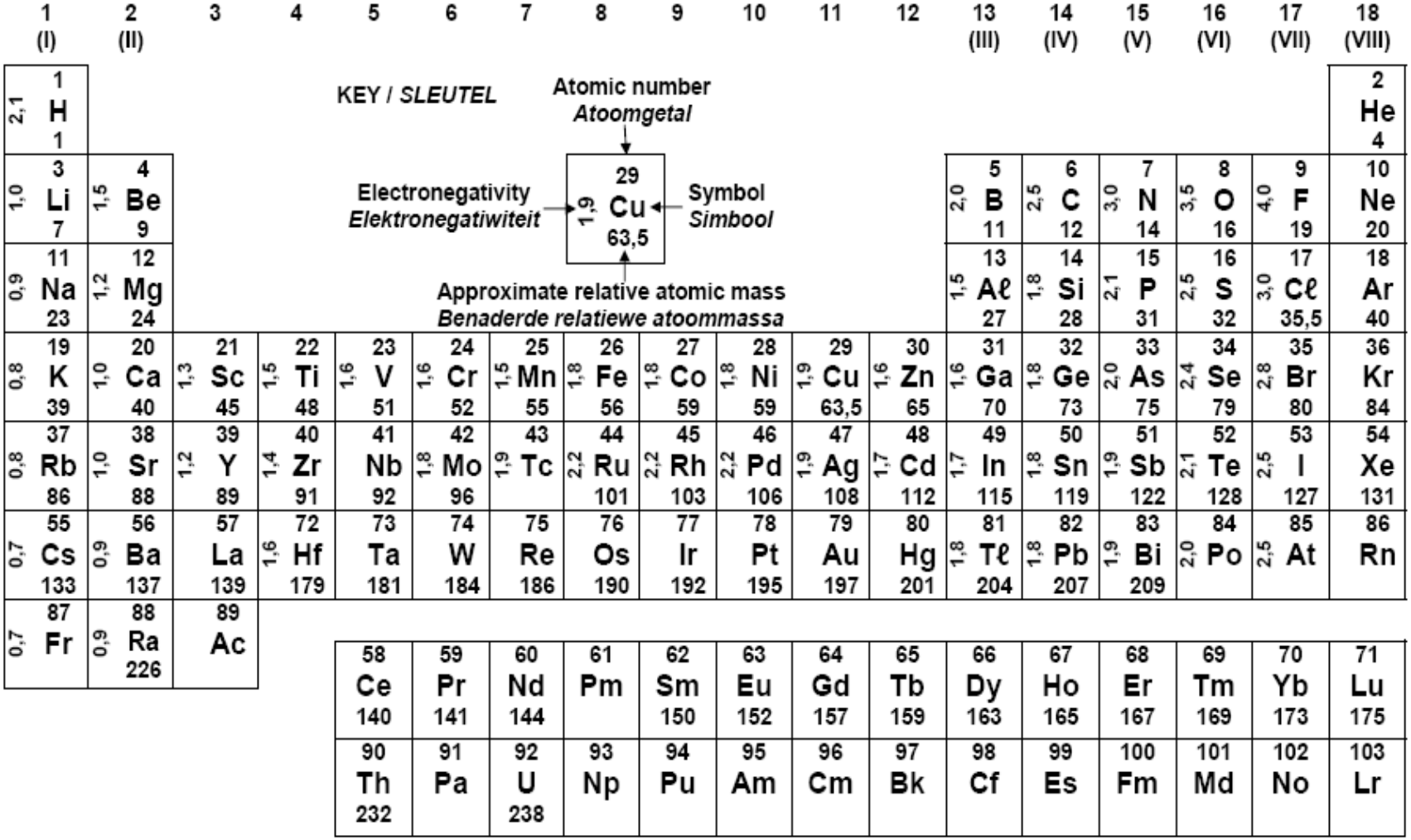
THE PERIODIC TABLE OF ELEMENTS
DIE PERIODIEKE TABEL VAN ELEMENTE



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