higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

PROCESS TECHNOLOGY
NQF LEVEL 4

(6050364)

15 November 2024 (X-paper)
09:00–12:00

Scientific calculators may be used.

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

235Q1N2415

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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 (1.1–1.4) in the ANSWER BOOK.

1.1 Flow of a liquid entering an agitated film evaporator occurs in this order:

A Feed inlet, heat exchanger, rotor and outlet
B Feed inlet, jacketed vessel wall, liquor chamber and outlet
C Feed inlet, heat exchanger, jacketed vessel wall and outlet
D Feed inlet, rotor, jacketed vessel wall and outlet

1.2 Distillation is the process of separating different substances based on their …

A volatilities and boiling points.
B triple points.
C densities and boiling points.
D densities and evaporation.

1.3 Volume is measured in …

A cubic metre.
B square metre.
C metre per second.
D litre per second.

1.4 … is the process in which gas changes to a solid.

A Deposition
B Sublimation
C Freezing
D Melting

(4 × 1) **[4]**

QUESTION 2

Give ONE term for each of the following descriptions by writing only the answer next to the question number (2.1–2.4) in the ANSWER BOOK.

2.1 The process where gas changes to a liquid.

2.2 It describes the relationship between mass and volume.

2.3 It is formed by a combination of two or more substances.

2.4 The transfer of heat through solid materials.

(4 × 1) **[4]**

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QUESTION 3

Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (3.1–3.4) in the ANSWER BOOK.

3.1 The less important components of the CCD (counter-current decantation) process are agitators and thickeners.

3.2 Weight is a scalar quantity.

3.3 Kinetic energy is the energy due to the motion of an object.

3.4 The plasma phase of Materials is similar to the gaseous phase.

(4 × 1) **[4]**

TOTAL SECTION A: 12

SECTION B

QUESTION 4

4.1 Define the following terms:

4.1.1 Circulation

4.1.2 Heat exchanger

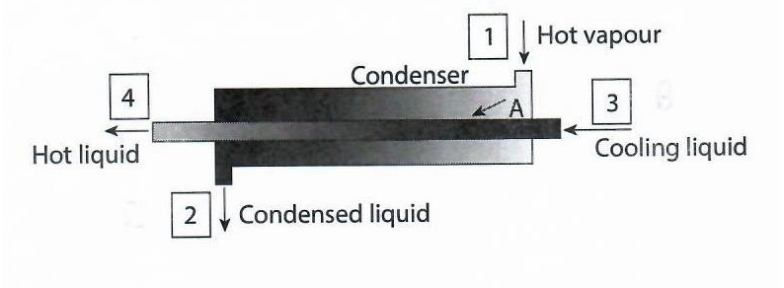
(2 × 2) (4)

4.2 Name THREE components that a *forced circulation evaporator* consists of. (3)

4.3 The flashing process of a *flash evaporator* can be broken down into THREE separate phases. Name these THREE phases. (3)

4.4 State TWO ways in which direct-contact condensers can work. (2)

4.5 Shown in the figure below is a block diagram of an indirect contact condenser. Explain the operation thereof. (8)



4.6 Name SIX types of distillation processes used in the industry. (6)
[26]

QUESTION 5

5.1 Explain the following terms:

5.1.1 Mass follow rate

5.1.2 Flow rate

(2 × 2) (4)

5.2 Explain the application of the law of conservation of matter to fluid dynamics in terms of material flow. (2)

5.3 Calculate the density of a substance with a mass of 300 tons and a volume of 24 m^3. (4)

5.4 5.4.1 Sketch a pipe system to illustrate a mass flow system with a single inflow and triple outlet flows.

5.4.2 Explain the operation of you sketch in Q. 5.4.1 above.

5.4.3 Write down an equation to define the output flow in terms of the input flow for this system.

(3 × 2) (6)

5.5 Calculate the equivalent value in parts per million of 4×10^{-6} mol per litre of sulphuric acid. (6)

5.6 Balance the following reaction equation:

$$A\ell_2(CO_3)_3 + H_3PO_4 \longrightarrow A\ell PO_4 + CO_2 + H_2O$$

(4)
[26]

QUESTION 6

6.1 Define the term *heat capacity* as it is found in thermodynamic principles of materials. (3)

6.2 Name the type of energy processed if the following scenarios:

6.2.1 A dog running after a passing car

6.2.2 An old man sitting on a chair

(2 × 2) (4)

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6.3 Define the term, *control volume systems*. (2)

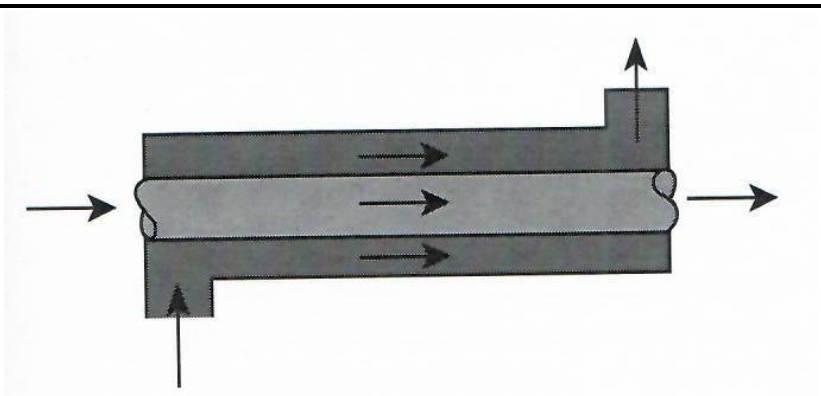
6.4 Name THREE different scales by which temperature can be measured. (3)

6.5 A cone-shaped container contains water with a density of 58 kg/m³ that is boiling at 100 °C. The diameter of the container is 4 m while the level of the water inside the container is 12 cm.

Calculate how much energy is absorbed by the water if the latent heat of vaporisation is 2 257 kJ/kg. (10)

6.6 Write down a mathematical equation to express the rate of heat exchange by means of convection. (1)

6.7 Study the figure below and answer the questions that follow.



6.7.1 Identify the piece of equipment in the figure.

6.7.2 Briefly explain the operation thereof.

(1 + 2) (3)

[26]

QUESTION 7

7.1 Ceramics are inorganic and non-metallic materials.

Explain the following properties of Ceramics:

7.1.1 Brittle

7.1.2 Porous

(2 + 2) (4)

7.2 Name the type of material which is used to produce each of the following types of items:

7.2.1 Surgical instruments

7.2.2 Soft drink bottles

7.2.3 Bone implants

(3 × 1) (3)

7.3 Name a popular fastener that is used to bind wood together. (1)

7.4 Name TWO types of liquid-like fasteners / adhesives. (2)

[10]

TOTAL SECTION B: 88
GRAND TOTAL: 100

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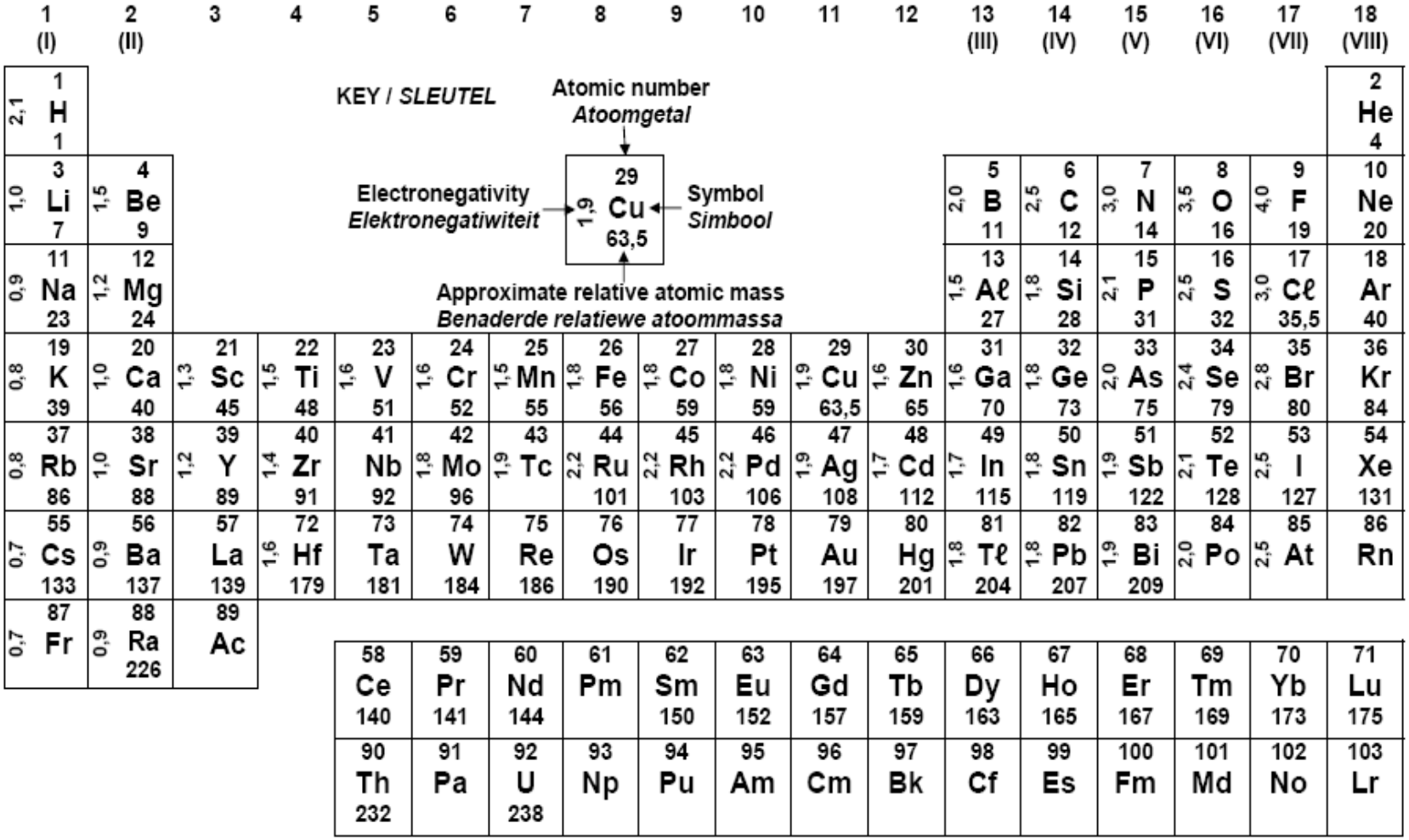
THE PERIODIC TABLE OF ELEMENTS
DIE PERIODIEKE TABEL VAN ELEMENTE



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