higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

PROCESS TECHNOLOGY
NQF LEVEL 4

(6050364)

1 December 2020 (X-paper)
09:00–12:00

This question paper consists of 7 pages.

163Q1N2001

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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 blue or black 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 (1.1–1.6) in the ANSWER BOOK.

1.1 A liquid in which something is dissolved:

A Solute
B Solution
C Solvent
D Distillate

1.2 Converts vapour to liquid:

A Evaporator
B Condenser
C Decanter
D Absorber

1.3 Formula for density:

A Mass per unit volume
B Volume per unit mass
C Mass per unit area
D Area per unit mass

1.4 Unit for weight:

A Newton
B Kilogram
C Newton per kilogram
D Metre per second squared

1.5 The first law of thermodynamics:

A First law of conservation of mass
B Law of momentum
C Newton's law of motion
D First law of conservation of energy

1.6 Which ONE of the following is not a phase of matter?

A Solid
B Liquid
C Gas
D Distillate

(6 × 1) **[6]**

QUESTION 2

Choose a term from COLUMN B that matches a description in COLUMN A. Write only the letter (A–L) next to the question number (2.1–2.6) in the ANSWER BOOK.

COLUMN A		COLUMN B	
2.1	Evaporators using the thermo-siphon principle	A	solubility
2.2	Ability of a substance to be dissolved by another substance	B	MgO
2.3	Concentration that is more of a ratio than actual measurement	C	falling film
2.4	Chemical formula for magnesium oxide	D	steady system
2.5	System with no flow of mass into or out of the system	E	desalinate
2.6	Temperature scale known as universal temperature	F	rising film
		G	Kelvin
		H	volume concentration
		I	MgO_2
		J	Fahrenheit
		K	molar concentrate
		L	control mass system

(6 × 1) **[6]**

QUESTION 3

Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (3.1–3.9) in the ANSWER BOOK.

3.1 Distillation is a process of separating different substances based on their volatily and boiling point.

3.2 The overhead system is that part of distillation where vapour is extracted from the distillation column, condensed back into liquid and fed back into the system as reflux.

3.3 One of the uses of packed columns is the cooling of gas.

3.4 The volume of a cuboid is the area cubed.

3.5 The conservation of mass in fluid dynamics is explained in terms of material flow.

3.6 An object will be denser if the particles inside the object are spaced closer together.

3.7 Density describes the relationship between mass and volume.

3.8 Temperature does not remain constant during a phase change and the energy decreases.

3.9 Convection is a heat-transfer method in which heat is exchanged through fluid movement.

(9 × 2) **[18]**

TOTAL SECTION A: 30

SECTION B

QUESTION 4

4.1 Describe the function of each of the following components of a *forced-circulation evaporator* below.

4.1.1 Heat exchanger

4.1.2 Flash vessel

(2 × 2) (4)

4.2 Describe the difference between the *falling-film* evaporator and the *rising-film* evaporator. (2)

4.3 Name FOUR ways in which mechanical failure may occur in evaporators. (4)

4.4 Explain why condensation is called a heat-transfer process. (3)

4.5 Name TWO applications of the *direct-contact* method in condensers. (2)

4.6 Write brief notes on vapour-liquid equilibrium (VLE). (5)

[20]

QUESTION 5

5.1 State the law of conservation of mass. (3)

5.2 Write down the formula of the conservation of mass in a closed system considering the density, area and volume. (3)

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5.3 Define each of the following terms:

5.3.1 Volume

5.3.2 Mole

5.3.3 Molar concentration

(3 × 2) (6)

5.4 Balance each of the following reactions:

5.4.1 $SO_2 + HF \longrightarrow SF_4 + H_2O$ (4)

5.4.2 $NaBH_4 + H_2SO_4 \longrightarrow B_2H_6 + H_2 + Na_2SO_4$ (4)

[20]

QUESTION 6

6.1 Define the term *energy*. (2)

6.2 State THREE forms of energy that exist within a system. (3)

6.3 Differentiate between *kinetic energy* and *potential energy* by making use of equations, and also state the SI unit for each one. (6)

6.4 Calculate the mass of an object with a potential energy of 100 J falling freely through a height of 5 m. (5)

6.5 Indicate whether the following scenarios represent CONVECTION, CONDUCTION or RADIATION by writing only 'Convection', 'Conduction' or 'Radiation' next to the question number (6.5.1–6.5.2) in the ANSWER BOOK.

6.5.1 Heating a room with an electric heater.

6.5.2 Holding your hand near a hot object feeling the heat it emits without touching the object.

(2 × 2) (4)

[20]

QUESTION 7

7.1 Metals consist of atomic particles known as cations which are positively charged.

Briefly describe the physical properties of metals based on each of the following:



7.1.1 Excellent heat conductor

7.1.2 High density

(2 × 2) (4)

7.2 Polymers are formed by atoms or small molecules known as monomers.

Name FOUR materials that are examples of man-made polymers. (4)

7.3 Explain the term *slide ability*. (2)



[10]

TOTAL SECTION B: 70
GRAND TOTAL: 100

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