higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

# NATIONAL CERTIFICATE

# PLANT OPERATION THEORY N1

(11040001)

**2 August 2021**
**09:00–12:00 (X-paper)**

**Drawing instruments and nonprogrammable calculators may be used.**

**This question paper consists of 5 pages and 1 formula sheet.**

156Q1G2102

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# DEPARTMENT OF HIGHER EDUCATION AND TRAINING
# REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
PLANT OPERATION THEORY N1
TIME: 3 HOURS
MARKS: 100

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**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: CHEMISTRY

1.1 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 (1.1.1–1.1.5) in the ANSWER BOOK.

1.1.1 The elements of Group 0 are known as …

A earth metals.
B alkali earth metals.
C halides.
D noble gases.

1.1.2 How many electrons can p-orbitals accommodate?

A 0
B 2
C 6
D 8

1.1.3 The chemical formula for sodium sulphate is …

A $NaSO_4$.
B $Na(SO_4)_2$.
C $Na_2SO_4$.
D $Na(SO_4)_2$.

1.1.4 Which ONE of the following electron configurations represents an ion of an alkali metal?

A $1s^2$
B $1s^2\ 2s^2$
C $1s^2\ 2s^2\ 2p^5$
D $1s^2\ 2s^2\ 2p^6\ 3s^1$

1.1.5 Which ONE of the following is a mixture?

A A diamond
B Air
C Distilled water
D Sodium chloride

(5 × 1) (5)

1.2 State FIVE properties of alkaline metals. (5)

1.3 Write down the valence electrons of the following elements:

1.3.1 Carbon

1.3.2 Oxygen

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1.3.3 Magnesium

1.3.4 Phosphorus

1.3.5 Potassium

(5 × 1) (5)

1.4 Calculate the molecular mass of the following chemical reaction:

$$HCl + NaOH \longrightarrow NaCl + H_2O$$ (5)

**[20]**

## QUESTION 2: PIPES AND VALVES

2.1 State the properties and uses of Teflon pipes. (4)

2.2 Name FOUR main functions of valves. (4)

2.3 Explain what is meant by *carbon steel pipes*. (3)

2.4 List EIGHT components of a relief valve. (8)

2.5 What are the causes of leaking valves? (3)

**[22]**

## QUESTION 3: PUMPS AND INSTRUMENTATION

3.1 State FOUR factors on which power supply to a pump system depends. (4)

3.2 List FOUR types of impellers used in centrifugal pumps and state an appropriate application for each one. (4 × 2) (8)

3.3 A pump delivers 180 000 kg of liquid at a height of 5 m in 45 minutes.

Given: Work (F) = P × h

P = F ÷ t

Efficiency = output ÷ input × 100%

Calculate the following:

3.3.1 The power output of the pump in kW (4)

3.3.2 The efficiency of the pump with a power input of 8 kW (2)

3.4 Explain the term *vacuum* and name the type of gauge with which it can be measured. (2)

**[20]**

## QUESTION 4: DISTILLATION AND WATER TREATMENT

4.1 State FOUR substances that cause permanent hardness of water. (4)

4.2 Define the following terms:

4.2.1 Suspended solids

4.2.2 Softening of water

4.2.3 Balanced water

(3 × 2) (6)

4.3 Show by means of graphs the changes of temperature vapour pressure and boiling point.

Explain the process that is shown by the graphs. (10)
**[20]**

## QUESTION 5: SAFETY AND STORAGE

5.1 Name the components required for causing a fire. (3)

5.2 State the precautions to be taken when flammable gases in liquid form are stored under pressure. (5)

5.3 Explain, with the aid of a sketch, the working of a foam extinguisher. (10)
**[18]**

**TOTAL: 100**

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## FORMULA SHEET

Any other applicable formula may be used.

1. $\rho = \frac{p}{gh}$
2. $V = \ell bh$
3. $V = \pi \frac{d^3}{6}$
4. $V = 4\pi \frac{r^3}{3}$
5. $V = x\left(\frac{\pi d^2 h}{12} + V_1\right)$
6. $\Delta P = \rho gh$
7. $V = \pi \frac{d^2}{4} \times h$
8. $\rho = \frac{F}{A}$
9. $A = \pi d^2$
10. $A = \pi \frac{d^2}{4} = \pi r^2$
11. $A = 4\pi r^2$
12. $R = \frac{output}{input} \times 100\%$
13. $\rho_1 gh = \rho_2 gh$
14. $Q = Av = C$
15. $k = \frac{Q}{\sqrt{h}}$
16. $E = \frac{mv^2}{2}$
17. $E = mgh$
18. $V = \pi DN$
19. $V = \frac{a}{t}$
20. $V = \sqrt{2gh}$
21. $PA = mg$
22. $h_{su} = m\{(h_f + gh_{fg}) + C_s(t_{su} - t_s) - (C_w \times t_w)\}$
23. $m = \rho v$
24. $A = \frac{F}{p}$
25. $K = \frac{mv^2}{2}$
26. $K = W/m^2K$
27. $Pv = cT$
28. $m = \frac{Pv}{RT}$
29. $n = \frac{Pv}{R_0 T}$
30. $V = A\ell NnR$
31. $K = \frac{Qx}{A\Delta t}$

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