higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

PLANT OPERATION THEORY N1

(11040001)

22 November 2022 (X-paper)
09:00–12:00

Drawing instruments and nonprogrammable calculators may be used.

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

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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

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 List THREE properties of acids. (3)

1.2 List THREE properties of metals. (3)

1.3 Sketch the structural formula of ethylene C_2H_4. (3)

1.4 Explain, with applicable examples, the difference between *molecules* and *atoms*. (3 + 3) (6)

1.5 Indicate the symbol and number of valence electrons of each of the following atoms:

1.5.1 Silicon

1.5.2 Phosphorus

1.5.3 Sulphur

1.5.4 Sodium

1.5.5 Potassium

(5 × 1) (5)

[20]

QUESTION 2: VALVES AND PIPES

2.1 Draw a neat, labelled sketch of a needle valve. (8)

2.2 List FOUR joining methods for steel pipes. (4)

2.3 Name and give ONE use of each type of valve classified according to its closing mechanism. (3 × 2) (6)

2.4 Explain the term *valve*. (2)

[20]

QUESTION 3: PUMPS AND INSTRUMENTATION

3.1 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (3.1.1–3.1.5) in the ANSWER BOOK.

3.1.1 The efficiency of a machine is determined by comparing the work done by the machine with the energy supplied to the machine.

3.1.2 Static pressure head is equal to suction head minus delivery head.

3.1.3 Gear pumps are mainly used to handle oil products.

3.1.4 An open-vane impeller is suitable for water that contains sand.

3.1.5 A pyrometer can measure flow.

(5 × 1) (5)

3.2 List THREE classifications of pumps. (3)

3.3 Make a neat, labelled sketch of blade-type rotary pump. (7)

3.4 Give FIVE advantages of using a vane pump. (5)
[20]

QUESTION 4: DISTILLATION WATER TREATMENT

4.1 Explain each of the following stages in the distillation of liquids:

4.1.1 Distillation

4.1.2 Evaporation

4.1.3 Condensation

(3 × 2) (6)

4.2 List 10 components of a distillation tower. (10)

4.3 State FOUR causes of the temporary hardness of water. (4)
[20]

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QUESTION 5: SAFETY AND STORAGE

5.1 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (5.1.1–5.1.5) in the ANSWER BOOK.

5.1.1 Oil is an example of a combustible material.

5.1.2 Containers containing flammable gas in liquid form are normally painted black.

5.1.3 Liquids with low flash points should preferably be stored in floating roof tanks.

5.1.4 A fire cannot proceed if the O_2 content in combustion air is 20%.

5.1.5 Gases and fumes are good examples of class A fires.

(5 × 1) (5)

5.2 Name a typical fuel for a class A and a class B fire and state the most effective method of extinguishing each. (2 + 2) (4)

5.3 Calculate the quantity of liquid stored in a sphere which is 75% full. The diameter of the sphere is 5 m.

Given: Sphere volume $= 4 \div 3\pi r^3$ (3)

5.4 List FOUR shapes of a fixed roof. (4)

5.5 Give FOUR advantages of using an internal floating roof. (4)

[20]

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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