higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

PLANT OPERATION THEORY N1

(11040001)

22 November 2019 (X-Paper)
09:00–12:00

This question paper consists of 4 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. Sketches must be large, neat and fully labelled.
5. Write neatly and legibly.

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QUESTION 1: CHEMISTRY

1.1 Sketch a simple atom with the three parts and indicate their locations within the nucleus. (6)

1.2 Briefly explain how a salt is formed chemically and discuss the properties of salts. (1 + 3) (4)

1.3 Write the valence electrons structure of the following element.

1.3.1 Be

1.3.2 Na

(2 × 2) (4)

1.4 Describe the following groups in the periodic table:

1.4.1 Alkali metals

1.4.2 Alkali earth metals

(2 × 2) (4)

1.5 Show examples of isotopes using element chlorine. (2)

[20]

QUESTION 2: PIPES AND VALVES

2.1 Make a neat, labelled drawing of a needle valve. (7)

2.2 Briefly explain the operation and use of needle valves. (5)

2.3 Name FOUR fittings used for fixing pipes. (4)

2.4 Name FOUR steps used in controlling the process of fixing pipes. (4)

[20]

QUESTION 3: PUMPS AND INSTRUMENTATION

3.1 How much work (in megajoules) is done by a pump when it has to pump 2 500 cubic meters of water up to a height of 100 meters above the pump when density of water is 1 000 kg/m^3? Ignore the friction factor. (5)

3.2 If a job has to be done in 8 hours, calculate the power supplied by the pump in Question 3.1. (4)

3.3 Calculate the input power supplied by the pump in question 3.2 if the pump has 75% efficiency. (3)

3.4 Explain the operation of centrifugal pumps. (6)

3.5 What is the function of vent valves during the careering process? (2)

[20]

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QUESTION 4: DISTILLATION AND WATER TREATMENT

4.1 Make a simple sketch of simple distillation system and indicate the possible composition of vapour and liquid in each container. (9)

4.2 Write and balance the following reaction which occurs during softening of water:

4.2.1 $Mg(HCO_3)_2 + Ca(OH)_2 \longrightarrow$ (3)

4.2.2 $Ca(HCO_3)_2 + Ca(OH)_2 \longrightarrow$ (2)

4.2.3 $MgCl_2 + Na_2CO_3 \longrightarrow$ (2)

4.2.4 $MgSO_4 + Na_2CO_3 \longrightarrow$ (2)

4.3 Name TWO kinds of hardness in water. (2)
[20]

QUESTION 5: SAFETY AND STORAGE

5.1 Draw a neat, labelled sketch of a team fire extinguisher and explain the operating procedure. (8)

5.2 A cylinder container with domed shaped ends is 50% full. The diameter of the cylinder is 4 meters and its length is 8 meters.

Calculate the volume of fluid in the container. (6)

5.3 Define the term *fire.* (2)

5.4 Give FOUR advantages of using an internal floating roof storage. (4)
[20]

TOTAL: 100

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PLANT OPERATION THEORY N1

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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