higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

PLANT OPERATION THEORY N1

(11040001)

13 April 2021
09:00–12:00

Calculators may be used.

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

152Q1A2113

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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. Use only a black or blue pen.
5. Write neatly and legibly.

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QUESTION 1: CHEMISTRY

1.1 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (1.1.1–1.1.5) in the ANSWER BOOK.

1.1.1 The nucleus consists of positively charged protons and neutral neutrons.

1.1.2 Elements in Group I are known as alkali metals.

1.1.3 Ionic boding refers to the sharing of electrons.

1.1.4 The pH of an acid is higher than 14.

1.1.5 Neutrons do not have an electrical charge.

(5 × 1) (5)

1.2 What is the valency number of each of the following elements?

1.2.1 Argon

1.2.2 Oxygen

1.2.3 Potassium

1.2.4 Nitrogen

(4 × 1) (4)

1.3 Show the formation of a salt substance with the aid of a reaction. (6)

1.4 Determine the molecular mass of magnesium bicarbonate $Mg(HCO_3)_2$. Show all calculations. (5)

[20]

QUESTION 2: VALVES AND PIPES

2.1 Give THREE advantages and THREE disadvantages of plastic pipes. (6)

2.2 Calculate the total pressure exceeded by a siphon if the water supply has a density of 481,3 kg/m^3 and the pipe is 6 m long. Assume that the gravitational force is 9,81 m/s^2. The gauge pressure is 101,3 kPa. (5)

2.3 Make a neat level sketch of a globe valve. (7)

2.4 Name TWO types of valves. (2)

[20]

QUESTION 3: PUMPS AND INSTRUMENTATION

3.1 State FOUR factors that the power/energy supply to a pump system depends on. (4)

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

3.3 Draw a fully labelled sectional view of a turbine pump. (6)

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 Give FOUR reasons why water for industrial use is purified. (4)

4.2 Define each of the following terms:

4.2.1 Temporary water hardness

4.2.2 Permanent water hardness

4.2.3 Softening

4.2.4 Purification

(4 × 2) (8)

4.3 Which process variable affects the rate of evaporation? (2)

4.4 Draw a graph to indicate how the vapour pressure of a mixture of the liquids ethane and ethylene affects valves when the mixture varies. (4)

4.5 Define the term *volatile liquid.* (2)

[20]

QUESTION 5: SAFETY AND STORAGE

5.1 Explain, with the aid of a sketch, the operating principle of a foam extinguisher. (7)

5.2 List THREE components required to cause a fire. (3)

5.3 A cylindrical container with domed-shaped ends is 40% full. The diameter of the cylinder is 4 m and the length is 6 m.

Calculate the volume of the container. (6)

5.4 Name FOUR types of material to be burned in a class D fire. (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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