higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

PLANT OPERATION THEORY N1

(11040001)

7 April 2020
09:00–12:00

Calculators may be used.

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

152Q1A2007

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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 What is meant by the following terms:

1.1.1 Lewis structure

1.1.2 Neutral atom

1.1.3 Element of group seven

(3 × 2) (6)

1.2 State FIVE physical properties of nonmetals. (5)

1.3 Give the relative atomic number of the following elements:

1.3.1 Carbon

1.3.2 Oxygen

1.3.3 Magnesium

1.3.4 Phosphorus

1.3.5 Potassium

(5 × 1) (5)

1.4 Calculate the molecular mass of the following reaction:

$HCl + NaOH \longrightarrow NaCl + H_2O$ (4)

[20]

QUESTION 2: PIPES AND VALVES

2.1 Make a neat, fully labelled sketch of a release valve. (8)

2.2 Gate valves are used to stop fluid from flowing or to allow flow. The gate faces can be parallel but are most commonly wedge-shaped.

State THREE types of gate valves. (3)

2.3 State THREE groups in which an operator would classify pipes into the schedule according to the wall thickness. (3)

2.4 Which TWO methods are used for galvanising pipes? (2)

2.5 Calculate the pressure exerted by water on a pipe. The length of the pipe is 3 m and the gravitational force is 9,81 m/s^2. Assume that the density of water is 998 kg/m^3.

Given: $P = p \times g \times h$ (4)

[20]

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QUESTION 3: PUMPS AND INSTRUMENTATION

3.1 A pump delivers 2 500 m^3 of liquid to a height of 30 metres. The density of water is 1 000 kg/m^3. Ignore any factors that cause loss of pressure.

Given: Work (F) = P × h, P = F ÷ t, Efficiency = Output ÷ Input × 100%

Calculate the following:

3.1.1 The work done by the pump in megajoule

3.1.2 The power consumption in kilowatt if the pump works for TWO hours

3.1.3 The power consumption if the efficiency of the pump is 40%

(3 × 3) (9)

3.2 Name FOUR types of process variables to be measured in a chemical industry. (4)

3.3 Describe how you will start the operation of a centrifugal pump. (7)

[20]

QUESTION 4: DISTILLATION AND WATER TREATMENT

4.1 Water is of vital importance in our daily lives.

Name the THREE groups in which water can be classified. (3)

4.2 Name TWO ways in which water can be classified. (2)

4.3 Explain how the resin can be redeemed to the zeolite after the ion exchange process took place and state the necessary reactions. (6)

4.4 How much energy is needed to heat 50 kg of copper from 30 °C to 120 °C, if the specific heat capacity of copper is 390 J/kg K°C? (5)

4.5 Define the following terms:

4.5.1 Evaporation

4.5.2 Condensation

(2 × 2) (4)

[20]

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QUESTION 5: STORAGE AND FIRE

5.1 Name FOUR classes of fire and the most effective method of extinguishing each class. (4 × 2) (8)

5.2 5.2.1 Explain the use of pressure vessels for the storage of hydrocarbons. (2)

5.2.2 State the advantages and disadvantages of the procedure mentioned in QUESTION 5.2.1. (2 × 3) (6)

5.3 Name FOUR types of personal protective equipment. (4)

[20]

TOTAL: 100

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PLANT OPERATION THEORY N1

FORMULA SHEET

Any other applicable formula may also 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. $K = Wm^2K$
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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