higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T1290**(E)**(A4)T

NATIONAL CERTIFICATE

PLANT OPERATION THEORY N1

(11040001)

4 April 2019 (X-Paper)
09:00–12:00

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. Sketches must be large, neat and fully labelled.
5. Write neatly and legibly.

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QUESTION 1: CHEMISTRY

1.1 State FOUR physical properties of non-metals. (4)

1.2 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (1.2.1–1.2.5) in the ANSWER BOOK.

1.2.1 Sodium oxide is a common oxide compound.

1.2.2 Potassium hydroxide is a common hydroxide.

1.2.3 A mixture is formed by a variable mixing of two or more pure substances.

1.2.4 Compounds can be separated into their constituent elements by chemical or electrochemical methods.

1.2.5 The number of protons in the nucleus of an atom is not unique for each element.

(5 × 1) (5)

1.3 Consider the following atom and answer the questions:

$$\frac{40}{20}X$$

1.3.1 What is the name of this element? (1)

1.3.2 How many protons and neutrons does this element have? (2)

1.3.3 What is the mass number of this element? (1)

1.4 Write a balanced chemical reaction which occurs when calcium reacts with oxygen. (2)

1.5 Draw the molecular structure of isobutylene. (5)

[20]

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QUESTION 2: VALVES AND PIPES

2.1 The use and development of pipes started in historical times and the Bible also mentions their use.

State THREE ways in which pipes were used mentioning names and mention the cultures/kingdoms they belonged to. (3 × 2) (6)

2.2 2.2.1 Explain how you would manually regulate the pressure in a container and keep it constant while gas is drawn from the container. (4)

2.2.2 Draw a simple block diagram of the system mentioned in QUESTION 2.2.1. (4)

2.3 State the advantages and disadvantages of using rubber as a packing material. (4)

2.4 Define the term *valve.* (2)
[20]

QUESTION 3: PUMPS AND INSTRUMENTATION

3.1 State the FOUR factors on which the energy depends that has to be supplied to a pump. (4)

3.2 A pump delivers about 300 m^3 water to a height of 50 m. The density of water is 999 kg/m^3. Ignore the friction factor which causes loss of pressure.

Calculate the following:

3.2.1 Work done by the pump in kilojoule

3.2.2 Power consumption if the pump runs for 3 hours

3.2.3 The power consumption if the pump has efficiency

Given: Work (F) = F × h
P = F/t
n = Output/Input × 100%

(3 × 3) (9)

3.3 Make a neat, labelled sketch of a vane pump. (7)
[20]

QUESTION 4: DISTILLATION AND WATER TREATMENT

4.1 Explain or define the following terms:

4.1.1 Conduction

4.1.2 Convection

4.1.3 Radiation

(3 × 2) (6)

4.2 Sketch and label part of a distillation tower and clearly indicate the direction of flow in the different levels. (6)

4.3 Explain the hot lime process of softening water and give applicable chemical reactions. (6)

4.4 State TWO disadvantages of hard water. (2)

[20]

QUESTION 5: SAFETY AND STORAGE

5.1 5.1.1 Explain when pressure vessels will be used for storage of hydrocarbons. (3)

5.1.2 Briefly state the advantages and disadvantages of the use of pressure vessels as mentioned in QUESTION 5.1.1. (7)

5.2 Name THREE firefighting methods and state the principle of operation of each method of extinguishing a fire. (3 × 2) (6)

5.3 Calculate the volume of a cylindrical tank with a flat bottom and a diameter of 400 cm and a height of 5 m. (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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