higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T1300(**E**)(A6)T

NATIONAL CERTIFICATE

PLANT OPERATION THEORY N2

(11040012)

6 April 2018 (X-Paper)
09:00–12:00

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

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
PLANT OPERATION THEORY N2
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.

QUESTION 1: CHEMISTRY

1.1 Indicate whether the following statements are TRUE or FALSE. Write only 'true' or 'false' next to the question number (1.1.1–1.1.5) in the ANSWER BOOK.

1.1.1 Electrovalent refers to the sharing of the electrons.

1.1.2 Group 1 elements on the periodic table are alkali metals.

1.1.3 The 'p' orbitals can accommodate 6 electrons.

1.1.4 NH_3 is lighter than air.

1.1.5 Helium refers to a noble gas.

(5 × 1) (5)

1.2 Give the symbol and valency number of each of the following elements:

1.2.1 Aluminium

1.2.2 Argon

(2 × 2) (4)

1.3 Define or explain each of the following:

1.3.1 Isomers

1.3.2 Di-olefines

(2 × 2) (4)

1.4 List SIX uses of carbon monoxide (CO). (6)

1.5 With the aid of the appropriate chemical reaction, explain a method for the preparation of hydrogen by means of an acid. (6)

[25]

QUESTION 2: ENERGY AND FLUID FLOW

2.1 Define or explain each of the following:

2.1.1 Pascal's law - also state its application (3)

2.1.2 One joule (2)

2.1.3 Internal energy (2)

2.2 Name TWO types of flow patterns in a pipeline. (2)

2.3 Explain the method that is used to determine the viscosity of a fluid, and name the TWO units in which it is measured. (5)

2.4 In an open vertical tube attached to the water main, water is shown to a height of 1,62 m.

Calculate the total pressure of the water in kPa.

Assume the density of water is 1 000 kg/m^3 and the atmospheric pressure is 101.3 kPa.

Given: $P_{total} = \rho gh + P_{atm}$ (4)

2.5 A pump delivers fluid with a density of 998 kg/m^3 into the bottom of an open container. The maximum height is 15 m above the pump. The depth/height of the container is 3 m.

Calculate the *delivery pressure* of the pump. Ignore the friction and suction pressure.

Given: $P_{del} = pg\ (h_1+h_2) \div 2$ (4)

2.6 Water flows at 15 m^3/min in a pipe with a diameter of 190 mm.

Calculate the flow of velocity of the water in m/s.

Given: $Q = (\pi d^2 \div 4)\ x\ v$ (3)
[25]

QUESTION 3: DISTILLATION AND FRACTIONATION

3.1 Explain the reflux process in a distillation tower. (4)

3.2 Explain the influence of pressure and temperature on condensation and on evaporation. (4)

3.3 Study the sketch of the tower in FIGURE 1 below and answer the questions.

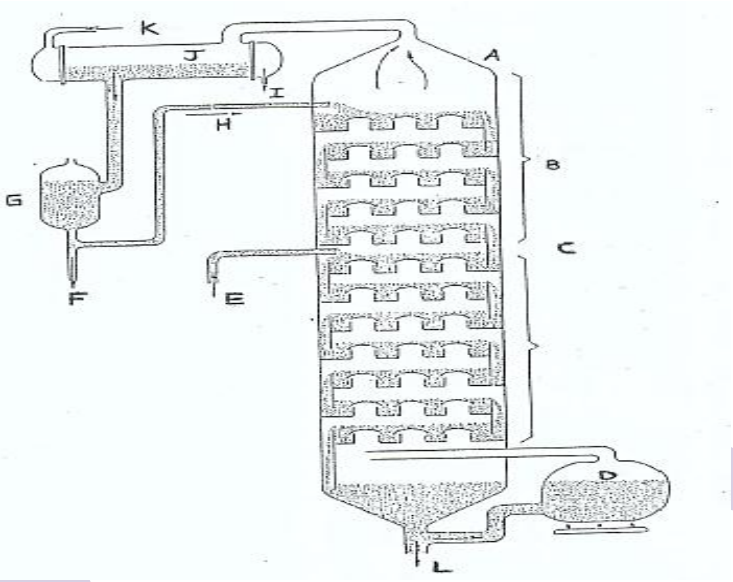

FIGURE 1

3.3.1 What is the name of the tower in FIGURE 1 above? (1)

3.3.2 Label the parts marked A–L in FIGURE 1 above. Write only the answer next to the letter (A–L) in the ANSWER BOOK. (12)

3.4 State FOUR possible problems that can be encountered when operating a fractionation tower. (4)
[25]

QUESTION 4: INSTRUMENTATION

4.1 State the advantages and the disadvantages of Venturi tubes. (7)

4.2 Make a neat, labelled sketch of a float level indicator controller used for a closed container. (7)

4.3 Study the sketch of the 'C' Bourdon tube in FIGURE 2 below and answer the questions.

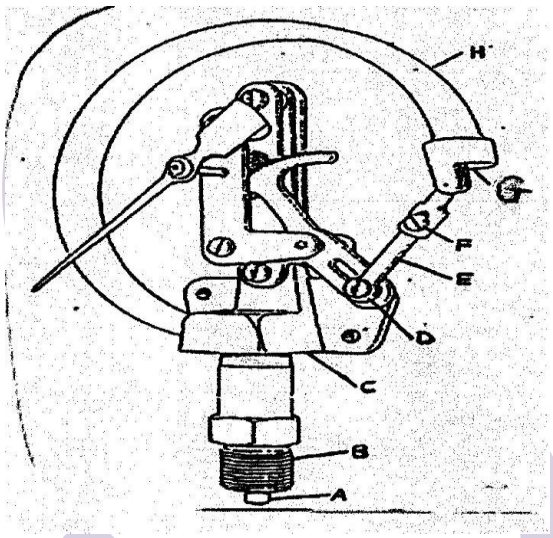

FIGURE 2

4.3.1 Label the parts marked A–H in FIGURE 2 above. Write only the answer next to the letter (A–H) in the ANSWER BOOK. (8 × 1) (8)

4.3.2 Name THREE pressure-type thermometers used in the Bourdon tube. (3)

[25]

TOTAL: 100

PLANT OPERATION THEORY N2

FORMULA SHEET

Any 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. $K = \frac{Qx}{A\Delta t}$