higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

PLANT OPERATION THEORY N2

(11040012)

20 November 2020 (X-paper)
09:00–12:00

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

195Q1E2020

Copyright reserved

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. Write neatly and legibly.

Copyright reserved

QUESTION 1

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 Oxygen has 6 electrons in 2p orbitals.

1.1.2 Electrons play no part in a chemical reaction.

1.1.3 C_2H_6 is a good example of an alkene.

1.1.4 Hydrocarbons are inorganic compounds.

1.1.5 Electrovalent bonding refers to the sharing of electrons.

(5 × 1) (5)

1.2 Consider the following element:

A. $1s^2$, $2s^2\ 2p^4$ B. $1s^2$, $2s^2\ 2p^6$, $3s^2\ 3p^5$

1.2.1 Define *isotopes.* (2)

1.2.2 Identify the elements in A and B respectively. (2)

1.2.3 Give the atomic number for element B. (1)

1.2.4 If the mass number of element A is 16 how many neutrons does it have? (2)

1.3 Write the symbol and the valency numbers for each of the following:

1.3.1 Argon

1.3.2 Sulphur

(2 × 2) (4)

1.4 Use chemical reaction to illustrate the FIVE chemical properties of ammonia (NH_3) gas. (5)

1.5 Give the chemical names of each of the following:

1.5.1 $KClO_3$

1.5.2 H_2SO_4

(2 × 2) (4)

[25]

Copyright reserved

QUESTION 2

2.1 Explain the difference between the following and state the unit of each:

2.1.1 Power

2.1.2 Work done

(2 × 2) (4)

2.2 A bullet with a mass of 5 kg is shot vertically upwards with an initial velocity of 25 m/sec.

Calculate each of the following:

2.2.1 Initial kinetic energy of projectile (3)

2.2.2 Height bullet would reach (4)

2.3 Water flows at 0,2 m^3/sec in a pipe with a diameter of 0,16 m.

Given: Q = A × V

Calculate the flow velocity. (4)

2.4 A siphon is used to empty a well of 12 metres deep and 20 metres in diameter.

Given: $w = V \times \rho \times g \times h \times \eta$

Accept that density of water = 1 000 kg/m^3

Calculate each of the following:

2.4.1 Work done in megajoule by the siphon to empty the well at efficiency of 75% (3)

2.4.2 Input power of the pump at 80% efficiency, if it takes one minute to complete the task (4)

[22]

Copyright reserved

QUESTION 3

Choose a term from COLUMN B that matches a description in COLUMN A. Write only the letter (A–G) next to the question number (3.1–3.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
3.1	Used to measure pressure	A	hair tube
3.2	Example of sensory element	B	bourdon tube
3.3	Instrument used to measure absolute pressure	C	pH meter
		D	open u-tube
3.4	Instrument used to measure steam level of high pressure	E	packed tower
3.5	Example of a fractionation tower	F	nucleonic type
		G	absorbers

(5 × 2) **[10]**

QUESTION 4

4.1 Name FIVE problems that could be encountered when operating a fractionation tower. (5)

4.2 Explain *temperature gradient* as control variable for effective operation of a distillation tower in producing high quality. (5)

4.3 Explain the difference between a *fractionation tower* and a *distillation* tower. (4)

[14]

QUESTION 5

5.1 What is the difference between *absolute pressure* and *absolute temperature*? (4)

5.2 Convert 25 °C to K. (2)

5.3 Explain, with the aid of a diagram, the use of a differential u-tube. (7)

5.4 An open u-tube is filled with paraffin with a density of 850 kg/m^3 and a differential pressure of 85 kPa.

Determine the pressure difference in mm. (3)

5.5 Explain the construction and operation of a gas pressure-type thermometer. (7)

5.6 Sketch and label an installed thermocouple. (6)

[29]

TOTAL: 100

Copyright reserved

PLANT OPERATION THEORY N2

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. $K = W/m^2K$
27. $Pv = cT$
28. $m = \frac{Pv}{RT}$
29. $n = \frac{Pv}{R_0 T}$
30. $V = A\ell NnR$
31. $K = \frac{Qx}{A\Delta t}$

Copyright reserved