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Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

# NATIONAL CERTIFICATE

# PLANT OPERATION THEORY N2

(1140012)

**9 April 2020 (X-paper)**
**09:00–12:00**

**Calculators may be used.**

**This question paper consists of 6 pages and 1 formula sheet.**

217Q1A2009

# DEPARTMENT OF HIGHER EDUCATION AND TRAINING
# REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
PLANT OPERATION THEORY N2
TIME: 3 HOURS
MARKS: 100

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

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## 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 The mass of a proton is approximately equal to the mass of hydrogen.

1.1.2 A molecule is the smallest particle of an element.

1.1.3 The IUPAC name of alkenes is paraffin.

1.1.4 The general formula of alkynes is $C_nH_{2n-2}$.

1.1.5 Isotopes are atoms with the same molecular formula but different in structure.

(5 × 1) (5)

1.2 Consider the following: $C_4H_{10}$

1.2.1 Draw the structural formula of this compound. (2)

1.2.2 What is the general formula of this compound? (1)

1.2.3 Classify the compound as either saturated or unsaturated hydrocarbon and explain the answer. (2)

1.2.4 Name the products that are formed when the compound above reacts with oxygen. (2)

1.2.5 Name THREE uses of this compound. (3)

1.3 Determine the molecular mass of hydrogen carbonate ($H_2CO_3$). (4)

1.4 Use $H_2O$ and explain which one of its elements is monovalent and divalent. (4)

1.5 Complete the following reaction:

$C_{(s)} + H_2O_{(g)} \longrightarrow ... + ...$ (2)

**[25]**

## QUESTION 2

2.1 Explain Bernoulli's theory with reference to fluid flow in pipe. (5)

2.2 The diameter of a pipe is 120 mm and it transports 12 $m^3$ fluid per minute.

Calculate the following:

2.2.1 Velocity of the fluid in m/s (4)

2.2.2 Ratio of the fluid if the velocity changes to 5 m/s (3)

Given: Q = A × V

2.3 A pipe transports 35 litres of water per second against a pressure difference of 25 kPa.

Calculate the pressure difference in kPa if the flow is reduced to 25 litres per second. (5)

Given: Q = K $\sqrt{h}$

2.4 Explain the total equivalent pressure head. (4)

**[21]**

## 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 | Energy of an object due to its position | A | watt |
| 3.2 | Unit that measures heat | B | potential energy |
| 3.3 | Taking place in the tower below the feed | C | hydro water power |
| 3.4 | Process where the force of water is converted to electricity | D | joule |
| | | E | tidal force |
| 3.5 | Energy of water in motion, which is utilised to generate electricity | F | stripping |
| | | G | absorbers |

(5 × 2) **[10]**

## QUESTION 4

4.1 During distillation, the mixture is heated until the boiling point of one substance in the mixture is reached.

4.1.1 Explain the term *distillation.* (2)

4.1.2 Describe the function of the portion of a distillation tower above the feeding point. (4)

4.2 Temperature is one of the variables that is applied to control the composition in a fraction column.

4.2.1 Name TWO points of temperature control. (2)

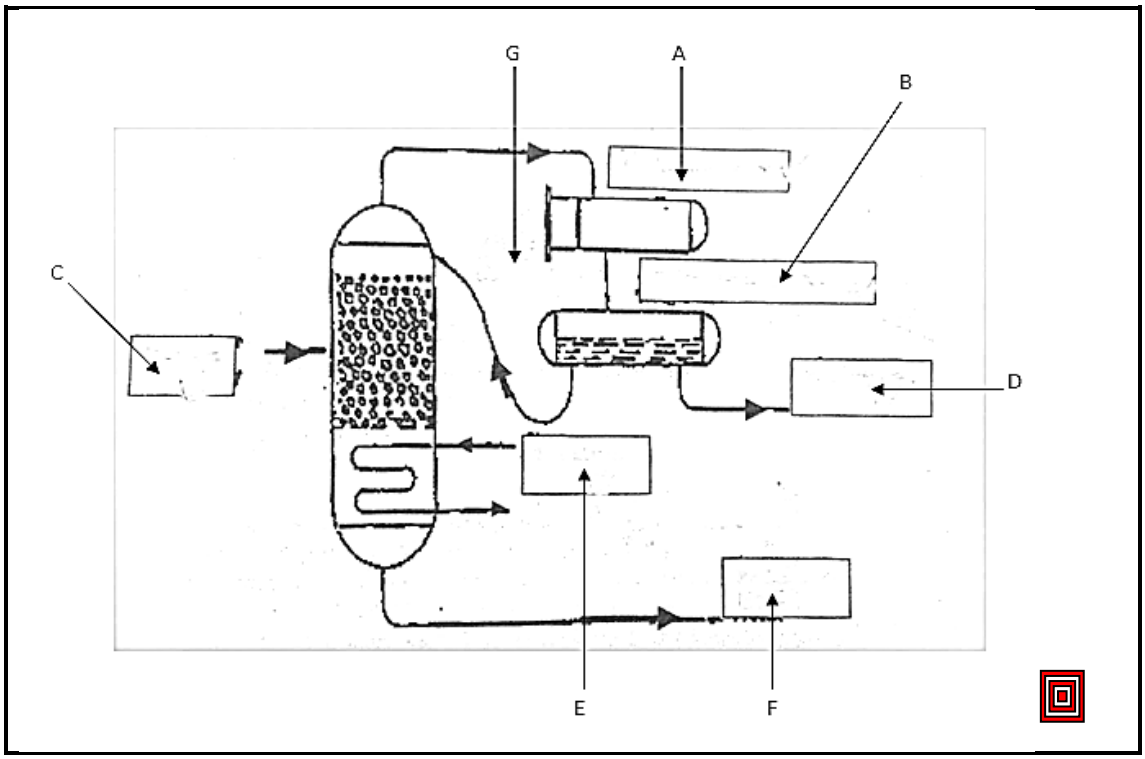
4.2.2 State FIVE aspects that should be kept in mind when temperature control is applied. (5)

4.3 A packed tower is filled with porcelain rings and charcoal. It is small and is used for special applications in the industry.

4.3.1 Name THREE characteristics of packed towers. (3)

4.3.2 State TWO disadvantages of packed towers. (2)

4.4 Name the parts of the construction of the packed tower indicated on the sketch by writing only the answer next to the letter (A–G) in the ANSWER BOOK.




(7 × 1) (7)

**[25]**

## QUESTION 5

5.1 Write brief, explanatory notes on how linear expansion on metal can be utilised to measure temperature. (6)

5.2 Make a neat, labelled sketch of a slant-leg manometer indicating the relation between the incline and the scale. (6)

5.3 Calculate the scale reading on the inclined leg of the manometer if the angle of inclination is $30^{\circ}$ and the vertical mercury level differs with140 mm. Use the following information to do the calculation:

Sin $30^{\circ}$ = 0,5 (3)

5.4 A positive displacement meter measures the actual quantity of liquid flowing through the meter to determine how much fluid is used.

Name FOUR types of displacement meters. (4)

**[19]**

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