higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T1310**(E)**(A4)T

NATIONAL CERTIFICATE

PLANT OPERATION THEORY N3

(11040023)

4 April 2019 (X-Paper)
09:00–12:00

Nonprogrammable calculators may be used.

This question paper consists of 4 pages and 1 formula sheet.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
PLANT OPERATION THEORY N3
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.

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QUESTION 1: CHEMISTRY AND CHEMICAL PROCESSES

1.1 Define the following terms:

1.1.1 Dehydrogenation

1.1.2 Homogenous catalysis

1.1.3 Carbonisation

1.1.4 Vulcanisation

(4 × 2) (8)

1.2 Explain in which FIVE respects thermoplastic polymers are like polyvinyl chloride (PVC). (5)

1.3 Use applicable reactions to explain the following:

1.3.1 Synthesis of ammonia

1.3.2 Production of ethanol

1.3.3 Synthesis of sulphur trioxide

(3 × 3) (9)

1.4 Give the condensed formula of glucose. (3)

[25]

QUESTION 2: COMBUSTION, FUELS AND THERMAL INSULATION

2.1 Name SIX types of pipe thermal materials. (6)

2.2 Briefly explain the characteristics of anthracite coal. (5)

2.3 State FIVE ways in which insulation material protects. (5)

2.4 Tabulate TWO different characteristics of semi-coke and petroleum coke. (4)

[20]

QUESTION 3: STEAM BOILERS AND STEAM TRAPS

3.1 Use a labelled temperature/heat graph to illustrate the *sensible heat* and *latent heat phases* of ice, water and steam. (10)

3.2 Define granular insulation. (2)

3.3 Name THREE examples of foam plastics used for cellular insulation. (3)

[15]

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QUESTION 4: HEAT TRANSFER

4.1 Conduction is one of the mechanisms by which heat can be transferred from one location to another.

4.1.1 Define *conduction*. (2)

4.1.2 State FIVE factors that will determine the amount of heat transferred by conduction. (5)

4.1.3 Use a sketch to explain the type of material through which the heat is transferred from thermal resistance to heat transfer. (5)

4.2 Calculate the heat absorbed by 5kg of alcohol with a specific heat capacity of 2,328 to have a change of 6 Kelvins. (3)

4.3 Use a labelled graph to illustrate the two types of flow pattern used in the design of shell and tube heat exchangers. (5)

[20]

QUESTION 5: COMPRESSION, COOLING, PUMPS AND INSTRUMENTATION

5.1 What is the exclusive purpose of control system? (2)

5.2 A gas at a temperature of 68°C and a pressure of 250 kPa has a volume of 23 m^3. The gas is compressed to a volume of 18 m^3 at a pressure of 400 kPa.

Calculate the final temperature of the gas in Kelvin. (4)

5.3 Explain the following terms:

5.3.1 Isothermal compression of a gas (6)

5.3.2 Process variable (2)

5.4 Name THREE types of reciprocating pumps. (3)

5.5 Name THREE main categories of measureable variables. (3)

[20]

TOTAL: 100

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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. $p = \frac{F}{A}$
9. $A = \pi r^2$
10. $A = \pi \frac{d^2}{4} = \pi r^2$
11. $\rho_1 gh = \rho_2 gh$
12. $Q = Av$
13. $k = \frac{Q}{\sqrt{h}}$
14. $E = \frac{mv^2}{2}$
15. $E = mgh$
16. $V = \pi DN$
17. $V = \frac{a}{t}$
18. $V = \sqrt{2gh}$
19. $PA = mg$
20. $h_{su} = m\{(h_f + gh_{fg}) + C_s(t_{su} - t_s) - (C_w \times t_w)\}$
21. $m = \rho v$
22. $A = \frac{F}{p}$
23. $Pv = cT$
24. $m = \frac{Pv}{RT}$
25. $n = \frac{Pv}{R_0 T}$
26. $V = A\ell NnR$
27. $K = \frac{Qx}{A\Delta t}$

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