higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T1310**(E)**(J31)T

NATIONAL CERTIFICATE

PLANT OPERATION THEORY N3

(11040023)

31 July 2018 (X-Paper)
09:00–12:00

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

Copyright reserved

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

Copyright reserved

QUESTION 1: CHEMISTRY AND CHEMICAL PROCESSES

1.1 Name THREE different ways whereby molecules of monomers enlarge with the addition of atoms to form polymers. (3)

1.2 Explain *gasification of coal*. (2)

1.3 Write down the condensed structural formula of natural rubber. (4)

1.4 Explain the properties of thermoplastic polymers like PVC. (4)

1.5 Discuss the general mechanism by which a catalyst speeds up a chemical process. Use a neat, labelled graph to explain the similarities between a catalysed and uncatalysed chemical process. (7)

[20]

QUESTION 2: COMBUSTION, FUELS AND THERMAL INSULATION

2.1 Name FOUR types of thermal insulation. (4)

2.2 Name THREE reasons why thermal insulation is necessary in industry. (3)

2.3 State the THREE main reasons for the failure of insulation materials. (3)

2.4 Explain the term *complete combustion.* (2)

2.5 A fuel gas consists of 15% oxygen; 20% hydrogen; 35% carbon monoxide and 30% methane.

Calculate the following:

2.5.1 Theoretical quantity of oxygen required for the complete combustion of 70 m^3 of this fuel (8)

2.5.2 Quantity of air required if combustion takes place in the presence of 3% excess air (2)

[22]

QUESTION 3: STEAM BOILERS AND STEAM TRAPS

3.1 Sketch a thermostatic steam trap and briefly discuss its operation. (8)

3.2 Explain the purpose of each of the following:

3.2.1 Economiser

3.2.2 Vaporiser

3.2.3 Preheater

(3 × 2) (6)

3.3 Name THREE general categories of steam traps. (3)

[17]

Copyright reserved

QUESTION 4: HEAT TRANSFER AND HEAT EXCHANGERS

4.1 Name SIX types of media that usually passes through the tube side. (6)

4.2 Name THREE direct methods of heat exchange. (3)

4.3 State the SIX reasons for poor work performance of heat exchangers. (6)

4.4 Explain the purpose of each of the following:

4.4.1 Cross-flow baffles (3)

4.4.2 Thermal resistance to heat transfer (2)

[20]

QUESTION 5: COMPRESSION, COOLING, PUMPS AND INSTRUMENTATION

5.1 Draw a labelled graph to illustrate Boyle's law. (5)

5.2 Explain the term *isothermal compression* of a gas. (5)

5.3 Explain each of the following terms:

5.3.1 Absorption type refrigeration system (5)

5.3.2 Volumetric efficiency of a compressor (3)

5.3.3 Multistage control (3)

[21]

TOTAL: 100

Copyright reserved

FORMULA SHEET

Any other applicable formula may be also 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. $K = \frac{Qx}{A\Delta t}$

Copyright reserved