higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

PLANT OPERATION THEORY N2

16 April 2021

This marking guideline consists of 5 pages.

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QUESTION 1

1.1 1.1.1 False
1.1.2 True
1.1.3 True
1.1.4 True
1.1.5 True
(5 × 1) (5)

1.2 1.2.1 Potassium (1)

1.2.2 Period 4 (1)

1.2.3
- Shiny
- Malleable
- Ductile
- Good conductor of heat and electricity (Any 2 × 1) (2)

1.2.4 Potassium oxide (2)

1.2.5 One ✓ (1)

1.3 N: 2 × 14 = 28✓
H: 2(4 × 1) = 8✓
S: 1 × 32 = 32
O: 4 × 16 = 64✓
= 132 amu✓ (4)

1.4
- Collect an amount of H_2 in a flask by the downward displacement of water. ✓
- The flask should be held upside down near a flame.
- A loud popping sound will be heard, and water will be formed.
- Place dry white copper sulphate crystals in the flask.
- The crystals will turn blue (test for water). (5)

1.5 1.5.1 $CaCO_3$
1.5.2 $MgSO_4$
(2 × 2) (4)
[25]

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QUESTION 2

2.1 Pascal's law: The pressure applied ✓ to a fluid is proportionally distributed ✓ in all directions. ✓
Application: Dead-weight tester ✓✓ (5)

2.2 $Q = K\sqrt{h}$

$K = \frac{Q}{\sqrt{h}}$

$= \frac{25}{5}$ ✓

$= 5$ ✓

$h = (20 \div 5)^2$ ✓

$= 16$ kPa ✓ (4)

2.3 $Q = A \times v$

$Q = 15\,000\ l/min = \frac{15\ m^3}{60\ s} = 0{,}25 m^3/s$ ✓

$A = \frac{Q}{v}$

$A = \frac{0{,}25\ m^3/s}{1{,}5\ m/s}$ ✓

$A = \frac{1}{6} m^2$ ✓

$\frac{1}{6} m^2 = \frac{\pi \times D^2}{4}$ ✓

$D = \sqrt[2]{\frac{4}{\pi \times 6}}$ ✓ $= 0{,}46065\ m = 461\ mm$ ✓ (6)

2.4 2.4.1

- Kinematic viscosity✓ is measured in poise. ✓
- Dynamic viscosity ✓ is measured in stokes. ✓ (2 × 2) (4)

2.4.2

- A ball with a specific mass, density and radius
- is dropped in a measured glass tube filled with liquid with a known density.
- The time taken for the ball to reach the bottom of the tube is measured.
- The velocity of the falling ball is measured
- This shows the viscosity of the liquid.
- The longer the time taken by the ball to reach the bottom, the higher the viscosity. (5)

[24]

QUESTION 3

3.1 B
3.2 D
3.3 F
3.4 A
3.5 H

(5 × 1) **[5]**

QUESTION 4

4.1
- The absorption or rectification section refers to the part above the feed.
- The aim of this section is to remove the heavy molecules
- still present in the upward moving vapour
- by cooling the feed and therefore condensing it.
- This is accomplished by the downward moving liquid supported by the flow back (reflux) of the liquid.
- This ensures that the light and heavy products are pure and well-separated.
- The temperature difference between the top and the bottom products should be maintained. (7)

4.2
- Rust or scale builds up, especially between the stack and the bubble caps.
- There could be an obstruction in the downpipe, e.g. a bubble cap blows off and lands in the downpipe.
- Mechanical breaks can occur such as plates or parts of plates
- which break loose and land on the bottom plate.
- There is a concentration of water on the plates
- especially where the bottom and overhead temperatures are such that water is not removed in one of the product streams. (6)

4.3
- Ethanol
- Glycerol
- Acetone
- Ethylene glycol
- Benzene
- Toluene (Any 5 × 1) (5)

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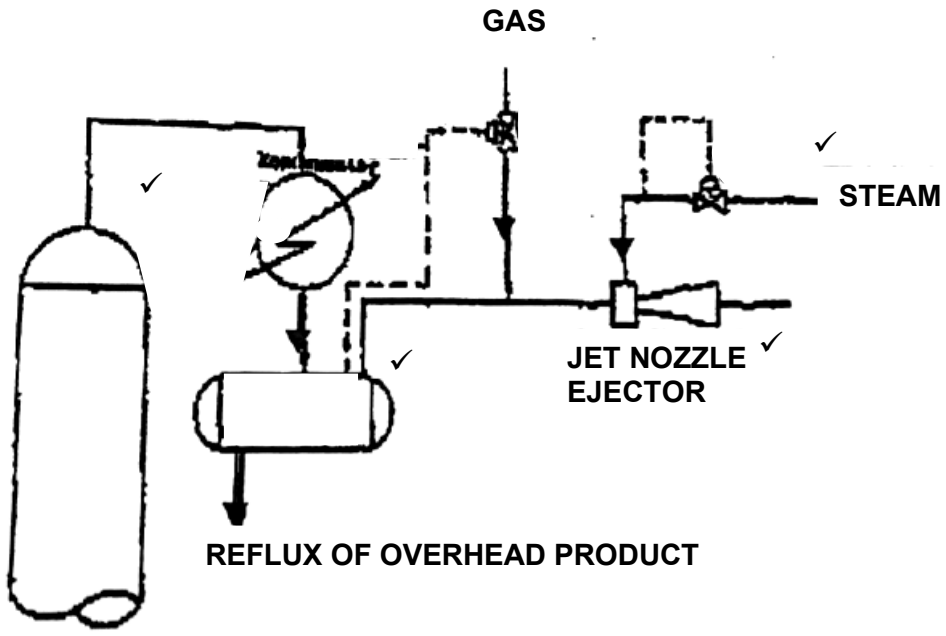
4.4



(4)

- A steam ejector is often used to produce a vacuum but due to sensitivity to changes in steam pressure
- it is necessary to use a pressure controller in the steam line to maintain maximum steam pressure for the steam ejector.
- The controller which is activated by the pressure in the liquid tank
- permits enough gas in the pipe just before the ejector, to maintain a constant column pressure which in this case is negative.
- In this way the maximum capacity of the steam ejector is available for any surge or abnormal occurrence in the system. (5)

[27]

QUESTION 5

5.1 5.1.1
- Celsius (°C)
- Kelvin (K) (2)

5.1.2
- Measured in Celsius the designated boiling point of water is 100 °C ✓ and the freezing point as 0 °C. ✓
- Measured in the Kelvin scale the designated boiling of water point is 373 K ✓ and the freezing point is 273 K. ✓ (2 × 2) (4)

5.2 5.2.1 C-type tube
5.2.2 Spiral tube
5.2.3 Helical tube

(3 × 1) (3)

5.3 $P = \rho \times g \times h$
$\rho = P \div (g \times h)$
$= 2\,800 \div (9{,}81 \times 2{,}5)$✓
$= 114{,}17\ kg/m^3$✓ ✓ (3)

5.4 A – Weights
B – Ram
C – Test gauge
D – Piston
E – Oil
F – Plunger
G – Hand wheel (7)
[19]

TOTAL: 100

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