higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

PLANT OPERATION THEORY N2

24 November 2022

This marking guideline consists of 6 pages.

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QUESTION 1

1.1 A
1.2 C
1.3 D
1.4 B
1.5 C

(5 × 1) **[5]**

QUESTION 2

2.1 False
2.2 True
2.3 False
2.4 True
2.5 True

(5 × 1) **[5]**

QUESTION 3

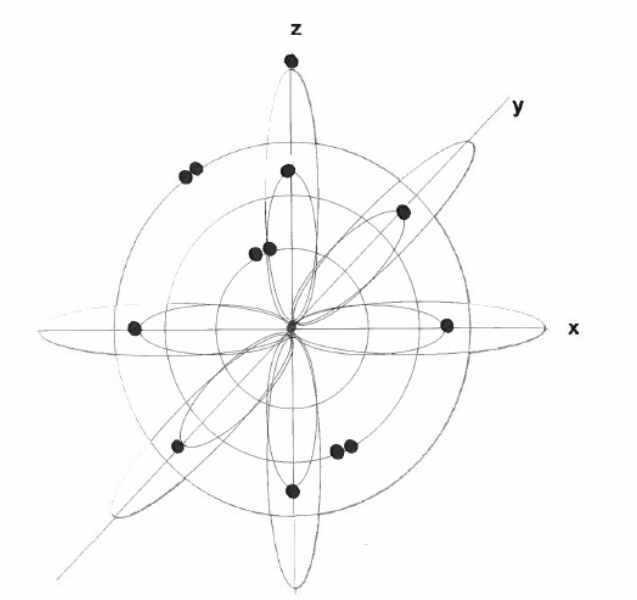
3.1 3.1.1 Anything occupying space with mass which can be seen, smelt, felt or heard.

3.1.2 Smallest particle of a compound still possessing the characteristics of that compound.

(2 × 2) (4)

3.2 Two molecules of propane ✓ formed from a chemical bond between three carbon atoms ✓ and eight hydrogen atoms. ✓ (3)

3.3



$^{27}_{13}A\ell$: $1s^2$, $2s^2$ $2p^6$ $3s^2$ $3p^1$ (5)

3.4 $CaCO_3 + 2HCl \longrightarrow CaCl_2 + CO_2 + H_2O$ (3)

3.5 By **reducing** carbon monoxide:
$CO2 + C_{(s)} \longrightarrow 2CO_{(g)}$

By **action** of steam on hot coke:
$C_{(s)} + H2O_{(g)} \longrightarrow CO_{(g)} + H_{2(g)}$

By **decomposition** of formic acid:
$HCOOH_{(aq)} \longrightarrow H_2O_{(l)} + CO_{2\,(g)}$

(3 × 2) (6)
[21]

QUESTION 4

4.1 4.1.1 The heat required to change the state of a liquid at constant temperature. (2)

4.1.2 When a heavy object is immersed in a liquid ✓ it experiences an apparent loss of mass ✓ as a result of the upward pressure of the liquid against the object. The loss of mass is equal to the liquid being displaced.✓ The more displacement there is, the larger the apparent loss of weight. ✓ (4)

4.2 $Q = A \times V$

$= \frac{\pi d^2}{4} \times V$

$= \left[\frac{Д \times d^2}{4}\right] \times V$ ✓

$= \frac{Д \times 0{,}024^2}{4} \times 5\ m/s$ ✓

$= 0{,}0023\ m^3/s$ ✓ (Also accept $0{,}00226\ m^3/s$ (3)

4.3 $P = \frac{W}{t}$

$= \frac{mgh}{t}$ ✓✓

$= \frac{1\,500\ kg \times 9{,}81\ m/s^2 \times 180\ m}{60\ s}$ ✓✓

$= 44\,145\ W$ ✓

$= 44{,}145\ kW$ ✓ (6)

4.4 4.4.1 $1{,}2 \text{ ton} \times 1\,000 = 1\,200 \text{ kg}$

$W = mg$
$= 1\,200 \text{ kg} \times 9{,}81 \text{ m/s}^2$
$= 11\,772 \text{ N}$ ✓ (1)

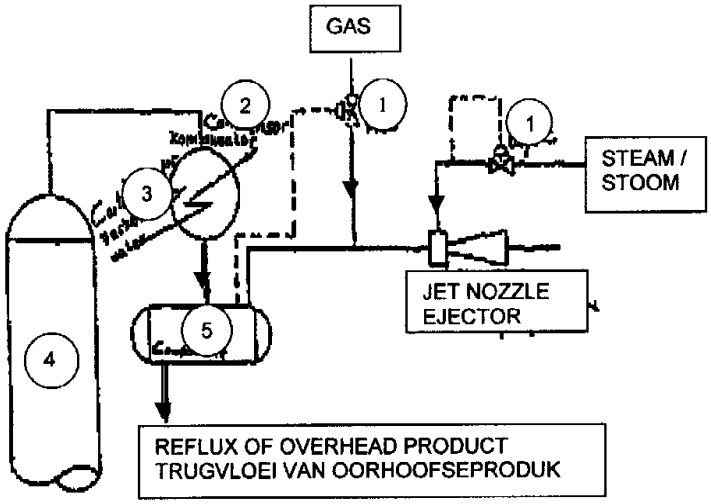
4.4.2 $P_e = mgh$
$= 1\,200 \text{ kg} \times 9{,}81 \times 10 \text{ m}$ ✓
$= 117\,720 \text{ J}$ ✓
$= 117{,}72 \text{ kJ}$ ✓ (3)

4.4.3 $Ke = \frac{1}{2}mv^2$
$Pe = Ke$
$= 1\,200 \text{ kg} \times 9{,}81 \text{ m/s}^2 \times 6 \text{ m}$ ✓
$= 70\,632 \text{ J}$ ✓
$= 70{,}632 \text{ kJ}$ ✓ (3)
[22]

QUESTION 5

5.1 The breaking up of any hydrocarbon in such a way that carbon-carbon bonds break up to form a new hydrocarbon product, e.g. $C_3H_8 \longleftrightarrow C_2H_4 + CH_4$ (3)

5.2



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 liquid tank pressure, ✓ 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 maximum capacity of the steam ejector is available for any surge or abnormal occurrence in the system. ✓

(5 + 5) (10)

5.3
- Heads or light oil
- Fatty acids
- Distilled tall oil
- Rosin
- Pitch
- Kerosene/Naphtha

(Any 5 × 1) (5)

5.4
- Overloading
- Poor control of column temperature
- Incorrect supply (feed) inlet position
- Incorrect supply (feed) temperature
- Variation / Fluctuation of supply temperature
- Poor maintenance
- Incorrect quantities reflux

(7 × 1) (7)
[25]

QUESTION 6

6.1 6.1.1 A gauge plus atmospheric pressure. When atmospheric pressure is measured in gauge pressure it is 0 kPa. Atmospheric pressure at sea level is 101,32 kPa.

6.1.2 The temperature read on the Kelvin scale where the melting point of ice is 273 K which is equal to 0 °C

(2 × 2) (4)

6.2
- Level meter
- Pulley
- Link chain
- Counter balance
- Tank
- Float
- Liquid

(7)

6.3 $P_{(abs)} = P_{(atm)} + P_{(gauge)}$
$= 101,3 + (24,5)$ ✓
$= 125,8\ kPa$

$h = \frac{125,8\ kPa.}{136\ 00 \times 9,81}$ ✓

$= 0,000943\ mHg$ ✓

(4)

6.4 **Advantages:**

- As a result of the slanted shape it allows solids through more easily (does not block easily).
- No special provision has to be made for vapours or liquids.
- The pressure loss across the meter is less than in the orifice plate.
- If accurately manufactured and calibrated, it gives accurate readings.
- The shape does not cause obstruction so that the tube will not be easily blocked.

Disadvantages:

- Accurate machining is essential and characteristics of each tubes have to be determined experimentally.
- The cost is higher than that of the orifice.

(5 + 2) (7)
[22]

TOTAL: 100

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