higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE (VOCATIONAL)

PROCESS TECHNOLOGY
NQF LEVEL 4

15 November 2024

This marking guideline consists of 5 pages.

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SECTION A

QUESTION 1

1.1 D
1.2 A
1.3 A
1.4 A

(4 × 1) **[4]**

QUESTION 2

2.1 Condensation
2.2 Density
2.3 Product
2.4 Conduction

(4 × 1) **[4]**

QUESTION 3

3.1 False
3.2 False
3.3 True
3.4 True

(4 × 1) **[4]**

TOTAL SECTION A: 12

SECTION B

QUESTION 4

4.1 4.1.1 Continuous movement of liquid or flow through a system of vessels such as pipes.

4.1.2 A system that makes the transfer of heat between two substances possible.

(2 × 2) (4)

4.2
- heat exchanger
- pump
- exchange tubes
- flash vessel
- vapour extractor

(Any 3 × 1) (3)

4.3
- the heat input phase
- flashing and recovery phase
- and heat rejection phase (3)

4.4
- Drop-type direct-contact condenser
- Vapour-bubble contact condenser (2)

4.5
- Hot vapour enters the condenser at point 1 in the vapour phase. ✓
- At the same time, cold liquid enters at point 3 in a liquid state. ✓
- The heat transfer process takes place at point A. ✓
- Heat is transferred from the hot vapour through the pipe or tube surface ✓ and to the cold liquid. ✓
- Heat is removed from the vapour and as it is cooled, ✓it passes the saturation point and becomes a liquid. ✓
- The cooling water temperature increases since heat is transferred to it and exits at point 4 with a higher temperature. ✓ (8)

4.6
- Normal distillation
- Batch distillation
- Vacuum distillation
- Steam distillation
- Extractive distillation
- Reaction distillation (6)

[26]

QUESTION 5

5.1 5.1.1 It measures the mass ✓ of a substance per second. ✓

5.1.2 It measures the volume ✓ of a substance per second. ✓

(2 × 2) (4)

5.2 It states that the mass of material that flows into a system must be equal ✓ to the mass of a material that flows out of the system. ✓ (2)

5.3 1 ton = 1 000 kg

300 tons = x

x = 300 × 1 000 kg

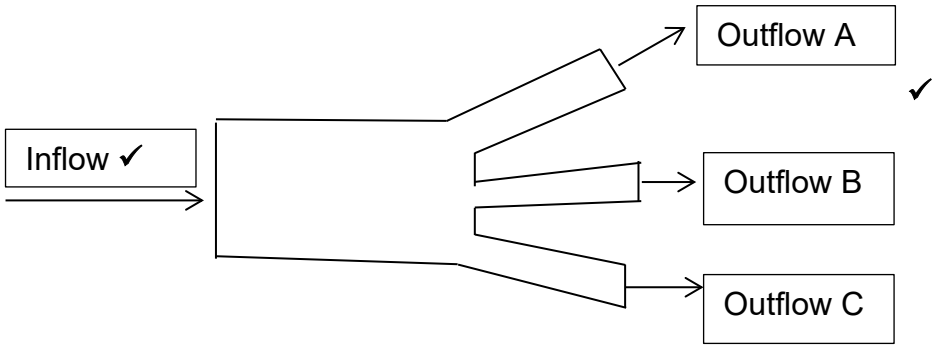
= 300 000 kg ✓

$\rho = \frac{m}{v}$ ✓

$\rho = \frac{300\,000\ kg}{24\ m3}$ ✓

= 12 500 kg/m³ ✓ (4)

5.4 5.4.1



5.4.2 The mass flow entering the system is equal to the sum of the mass flow leaving the system. ✓✓

5.4.3 $Q_{m\ In} = Q_{mA} + Q_{mB} + Q_{mC}$ ✓✓

(3 × 2) (6)

5.5 In 1 litre of H_2SO_4 there is 4×10^{-6} mol available.

$M_{H_2SO_4} = (1 \times 2) + (32) + (16 \times 4)$ ✓
$= 2 + 32 + 64$
$= 98$ g/mol ✓
$n = \frac{m}{M}$ ✓
$m = n \times M$
$= 4 \times 10^{-6} \times 98$ g ✓
$= 392 \times 10^{-6}$ g ✓

In 1 litre there is 392×10^{-6} g of sulphuric acid which is 392×10^{-6} ppm. ✓ (6)

5.6 $A\ell_2(CO_3)_3 + 2H_3PO_4$ ✓ $\longrightarrow$ $2A\ell PO_4$ ✓ + $3CO_2$ ✓ + $3H_2O$ ✓ (4)

[26]

QUESTION 6

6.1 Heat capacity denoted by the symbol C, ✓ is a measure of how much heat is required to raise the temperature ✓ of an object by a certain amount. ✓ (3)

6.2 6.2.1 Kinetic energy

6.2.2 Potential energy

(2 × 2) (4)

6.3 These are systems where mass is flowing into and out of the system. (2)

6.4
- Celsius scale
- Fahrenheit scale
- Kelvin scale (3)

6.5 $V = \pi r^2 h/3$ ✓
$= 3,14 \times (2\ m)^2 \times 0,12\ m/3$ ✓
$= 3,14 \times 4\ m^2 \times 0,12\ m/3$ ✓
$= 1,5072/3$
$= 0,502\ m^3$ ✓

$\rho = m/V$ ✓
$m = \rho \times V$
$= 958\ kg/m^3 \times 0,502\ m^3$ ✓
$= 480,916\ kg$ ✓

$Q = mL$ ✓
$= 480,916\ kg \times 2\ 257\ kJ/kg$ ✓
$= 1\ 085\ 427,4\ kJ$ ✓ (1, 085 MJ) (10)

6.6 $Q_{dot} = Ah\Delta T$ (1)

6.7 6.7.1 Co-current heat exchanger. ✓

6.7.2 Hot and cold fluid inside the heat exchanger ✓ flow in the same direction. ✓

(1 + 2) (3)
[26]

QUESTION 7

7.1 7.1.1
- Ceramics break before any plastic deformation occurs due to the type of bond present.

OR

- They break into small pieces. (Any 1 × 2)

7.1.2 Ceramics have gaps known as imperfections that reduce their toughness.

(2 + 2) (4)

7.2 7.2.1 Stainless steel
7.2.2 Plastics/glass (Any ONE)
7.2.3 Ceramics

(3 × 1) (3)

7.3 Nails (1)

7.4
- Glue
- Silicone

(2 × 1) (2)
[10]

TOTAL SECTION B: 88
GRAND TOTAL: 100

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