higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

PLANT OPERATION THEORY N2

1 December 2023

This marking guideline consists of 6 pages.

Copyright reserved

QUESTION 1

1.1 False
1.2 False
1.3 False
1.4 True
1.5 True

(5 × 1) **[5]**

QUESTION 2

2.1 F
2.2 G
2.3 H
2.4 A
2.5 C

(5 × 1) **[5]**

QUESTION 3

3.1 3.1.1 Elements are distinct types of matter that will contain only one type of atom. ✓✓

OR

An element is a pure substance that cannot be broken down into simpler substances.

3.1.2 Isotopes are atoms of the same element, but with different atomic masses, because the number of neutrons appearing in the nucleus of the atoms are different. ✓✓

(2 × 2) (4)

3.2 3.2.1 Potassium hydroxide
3.2.2 Calcium carbonate

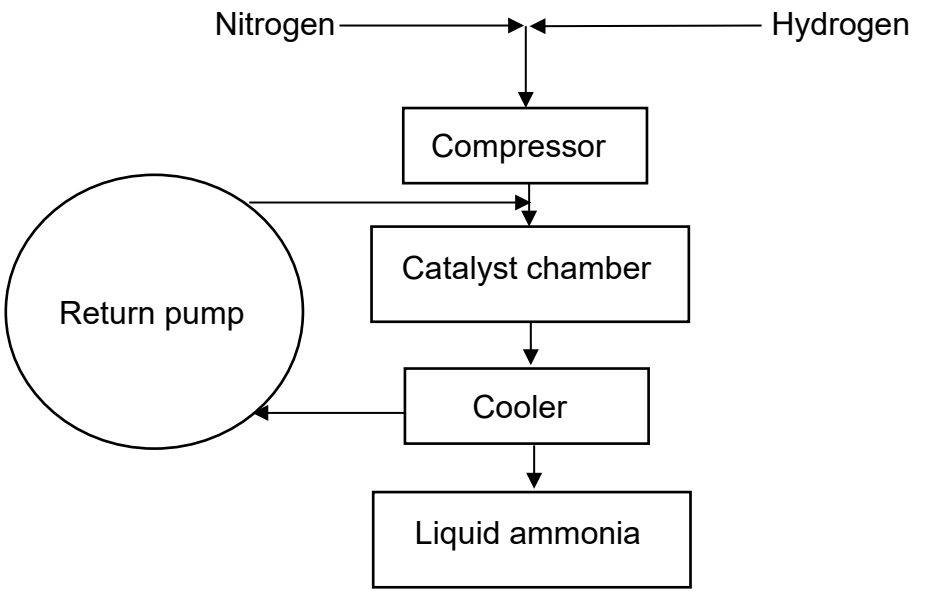
(2 × 2) (4)

3.3
- The first four members are gases at normal temperature and pressure.
- As the molecules grow with an increase in carbon atoms, they become heavier and as a result some of them become liquids and others become solids at normal temperature and pressure. The solids have low melting points.
- They are soluble in water, but dissolve readily in other organic soluble agents and groups of their own kind.
- They do not conduct electricity.
- They all have specific shapes.

(Any 4 × 1) (4)

Copyright reserved

3.4 3.4.1



✓✓✓✓✓✓✓

3.4.2
- Hydrochloric vapours form white smoke vapours when in contact with ammonia. ✓
- Nessler solution is the most sensitive test and forms a reddish-brown colour when ammonia bubbles through the system or when a drop of it is shaken in a flask containing NH_3. ✓
- A light blue copper sulphate solution becomes dark blue when NH_3 is allowed to bubble through it. ✓

(7 + 3) (10)

[22]

QUESTION 4

4.1 4.1.1 One joule refers to work done when one newton is displaced in one metre. ✓✓ (2)

4.1.2 Latent heat of evaporation refers to the heat required to change the state of a liquid ✓ at its boiling point to a gas ✓ or vapour at a constant temperature. ✓ (3)

4.2
- Applying heat causes molecules to move faster, increasing the temperature.
- The physical condition can change, for example, ice to water.
- The material can expand or shrink due to the heat.
- The material can change colour, for example, a lump of iron becomes red due to the heat added. (4 × 1)

(4)

Copyright reserved

4.3 4.3.1 $K_e = \frac{1}{2} mv^2$

$= \frac{1}{2} \times 8\ kg \times (25)^2$

$= 2\ 500\ J$ or $2,5\ kJ$ ✓✓✓ (3)

4.3.2 $K_e = P_e$

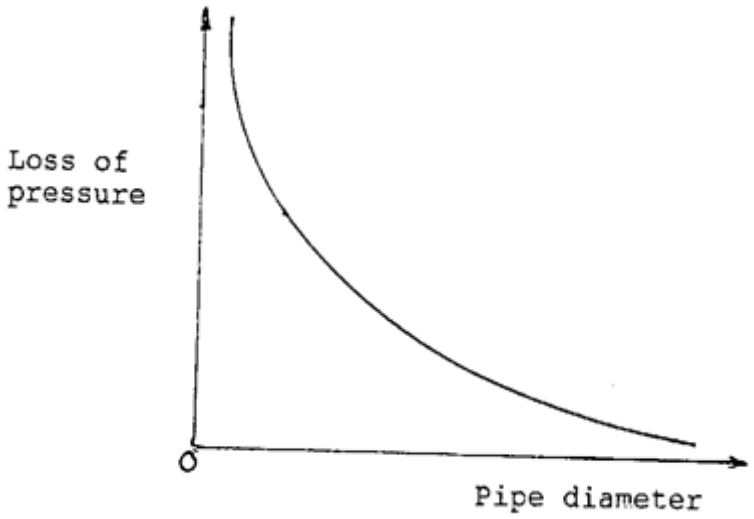
$K_e = m \times g \times h$

$2\ 500J = 8 \times 9,81 \times h$ ✓

$h = \frac{2\ 500}{8 \times 9,81}$ ✓

$= 31,855\ m$ ✓✓ (4)

4.4



✓✓✓✓ (4)
[20]

QUESTION 5

5.1 Fractionation is the separation of a mixture into various compounds or side fractions.

OR (2)

Where distillation only produces an overhead and bottom product, fractionation still produces blends between overhead and bottom. By maintaining the maximum temperature gradient obtained by maximum bottom temperature (without flooding the tower), the purest bottom and top products are obtained.

5.2 The whole process of fractionation depends on evaporation and condensation, which on their part depend on ✓ temperature and pressure ✓ which means that every point in the tower, where heat flows ✓ is introduced into the tower, at a specific place ✓ and at a specific temperature, and therefore, at each of these

Copyright reserved

places there must be control points so that the balance in the tower can be maintained. ✓ The temperature of each boiler, the flow through each, the top

and bottom temperature, as well as that of the feed and the steam are controlled ✓ to keep the temperature gradient within the limits ✓ and each point where control is exercised will depend upon the type of material handled at that point in order to obtain the desired results. ✓ (8)

5.3 Rust or scale builds up, ✓ especially between the stack and the bubble caps. Obstruction in the down pipe, ✓ for example, a bubble cap is blown off, thus landing in the down pipe. ✓ Mechanical breaks, for example, plates that break loose, landing on the bottom plate. Concentration of water on the plates, ✓ especially where the bottom and overhead temperatures ✓ are of such a nature that water is not removed in one of the product streams. ✓ (6)

5.4 A – Cooling in water
B – Bi-product or top product
C – Absorption section
D – Back flow or reflux
E – Light liquid product
F – Stripping section
G – Residue or heavy product
H – Feed

(8 × 1) (8)
[24]

QUESTION 6

6.1
- Primary measuring element or sensory element, ✓ for example, PH electrode. ✓
- Transfer element, ✓ for example, hair tube. ✓
- Indicating element✓ for example, Bourdon tube. ✓ (3 × 2) (6)

6.2 6.2.1 $K = ºC + 273$
$= 75 + 273$ ✓
$= 348\ K$ ✓

6.2.2 $K = ºC + 273$
$ºC = 273 – K$
$= 273 – 25$ ✓
$= 248\ ºC$ ✓

(2 × 2) (4)

6.3 $P = \rho \times g \times h$

$85\ 000 = 13\ 600 \times 9{,}81 \times h$ ✓

$$h = \frac{85\ 000}{13\ 600 \times 9{,}81}$$ ✓

$= 0{,}637$ m or 637 mm ✓✓

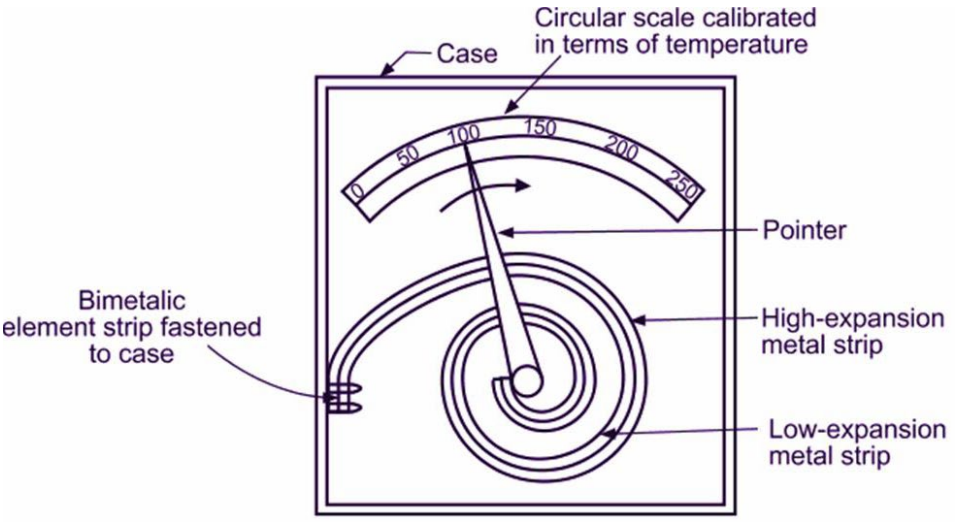
(4)

Copyright reserved

6.4 Absolute pressure is sum of gauge pressure and atmospheric pressure. ✓✓

Absolute temperature is temperature measured using the Kelvin scale where zero is absolute zero. ✓✓ (2 × 2) (4)

6.5 6.5.1



✓✓✓✓

6.5.2 Two metals with different linear expansions are used. ✓ The one with the high expansion coefficient will bend the spiral. ✓ The movement from the free end is transferred on a scale, which reflects the temperature.

OR

- When two strips, each of a different type of metal, with different coefficient of expansion is secured to each other that will be an indication of the temperature of the strip reflected.
- One end of the strip is fixed and the other is allowed to move freely as a result of the bending. The free moving end is connected to a gear mechanism that causes a pointer to move indicating the temperature on a suitable scale.

(4 + 2) (6)

[24]

TOTAL: 100

Copyright reserved