higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

PLANT OPERATION THEORY N2

6 August 2021

This marking guideline consists of 5 pages.

Copyright reserved

QUESTION 1

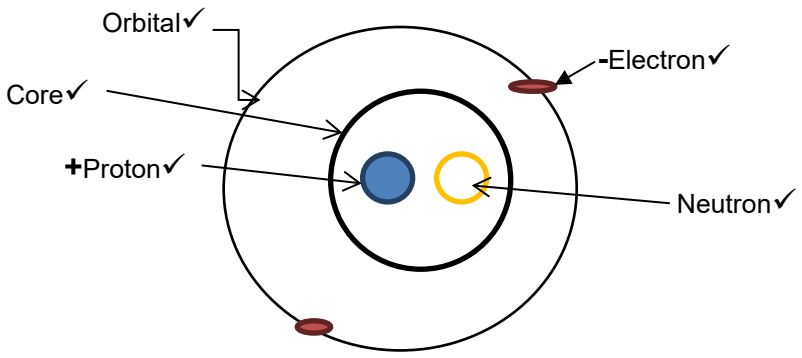
1.1 True
1.2 True
1.3 False
1.4 False
1.5 True

(5 × 1) **[5]**

QUESTION 2: CHEMISTRY

2.1 2.1.1 Oxygen (2)

2.1.2



(1 for correctness + 5 for labels) (6)

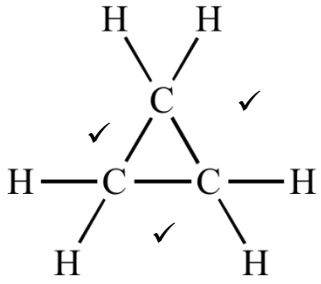
2.2. 2.2.1 Alkali earth metals
2.2.2 Halogens

(2 × 2) (4)

2.3 2.3.1 Carbon dioxide gas (2)

2.3.2
- The first four members are gases at normal temperature and pressure.
- As the molecules increase in the number of carbon atoms, it becomes heavier and as a result some become liquids and other solids at normal temperature and pressure.
- The solids have low melting points.
- It is insoluble in water, but dissolve readily in other organic solvents.
- It does not conduct electricity.
- All have specific shapes. (Any 3 × 1) (3)

Copyright reserved

2.3.3 

C_3H_6 ✓ (4)

2.4 $2Na(s)$✓ + $2H_2O$✓ → $2NaOH$✓ + H_2✓ (6)
✓ ✓ (two marks balancing) (Any relevant metal)

[27]

QUESTION 3: ENERGY AND FLUID FLOW

3.1 The total equivalent pressure head is the sum of the actual static head H_s✓ plus the pressure head H_p✓ plus the friction head H_f,✓ (5)

i.e. $H_T = H_s + H_p + H_f$.✓✓

3.2 3.2.1 Work done = V × density × g × h
= [(πd^2 ÷ 4) × 1 000 × 9,81 × 25 × 0,7] ÷ 10^6✓
= [π(10)^2 ÷ 4] × 1 000 × 9,81 × 25 × 0,7 ÷10^6✓
= 13,48 MJ✓ (3)

3.2.2 Input power = (w ÷ t) × efficiency
= (13,48 ÷ 1 s) ✓ × 0,75 ✓
= 10,11 ✓ MW ✓ (4)

3.3 Q = k (h)^{½} or $Q = k \times \sqrt[2]{h}$ ✓

K = Q ÷ (h)^{½} or $k = \frac{Q}{\sqrt[2]{h}}$
= 12 ÷ (25)^{½} or $k = \frac{12}{\sqrt[2]{25}}$ ✓

= 2,4 ✓

h = (16 ÷2,4)^2 or $h = \left(\frac{16}{2,4}\right)^2$ ✓

= 44 kPa ✓ (5)

3.4 3.4.1
- Dynamic viscosity:✓ stokes or centistokes✓
- Kinematic viscosity:✓ poise or centipoise✓ (2 × 2) (4)

3.4.2 Pressure will not influence the viscosity of a fluid. Temperature will influence the viscosity of a fluid as heated fluids will flow more easily than cold fluids. (2 + 2) (4)

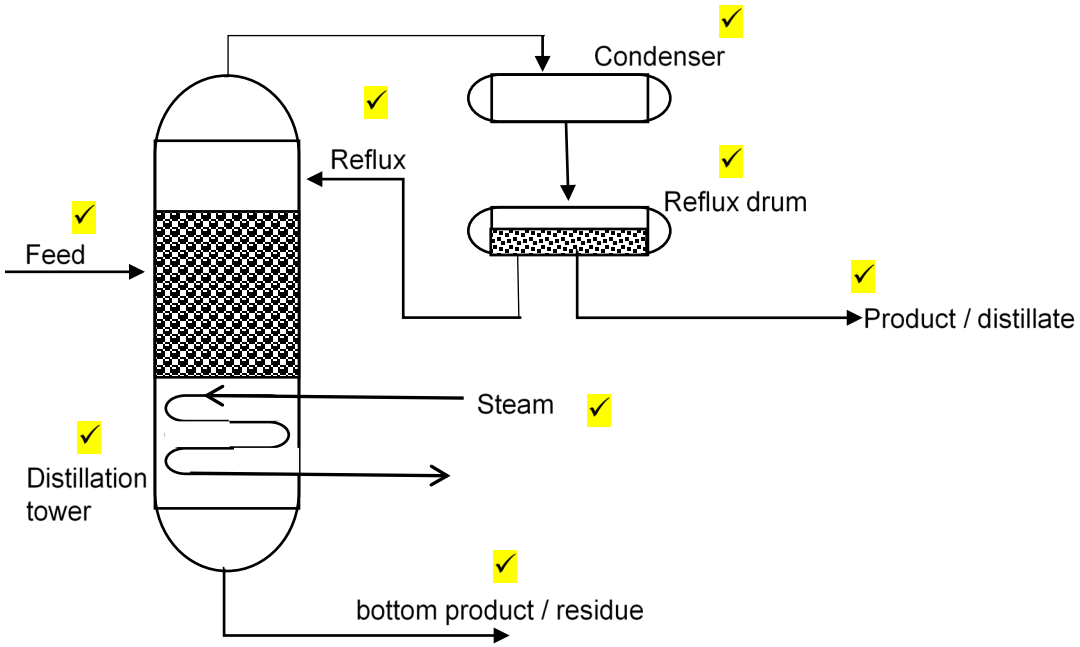
[25]

QUESTION 4: DISTILLATION AND FRACTIONATION

4.1 The top product refers to the light component extracted from the feed mixture and which is normally a pure vapour or gas.✓ It is tapped from the top of the tower and taken to the condenser✓ where it is cooled down to condensate.✓ The part that cannot be condensed is removed as a vapour or gas under pressure controlled conditions.✓ The bottom product or residue✓ is the heavy product tapped from the bottom of the tower and contains little or no light product in the feed.✓ This product is often a thick tar type of liquid which does not flow easily.✓ (3 + 3) (6)

4.2 The distillate removed from the condenser flows into a level-controlled accumulator.✓ Part of the distillate is returned to the top of the tower.✓ Because its temperature is lower than the top plate, it will cool down the top product and✓ any heavy vapours still left will be condensed and will flow downwards with the products from each plate.✓ (4)

4.3



(8)

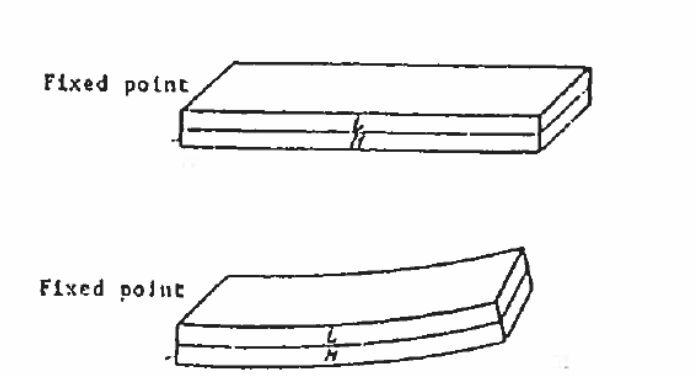
4.4 Cracking is the breaking down of large molecules into smaller molecules to form a new product. (3)

[21]

QUESTION 5: INSTRUMENTATION

5.1
- Celsius scale
- Kelvin scale (2)

5.2 The degree of expansion of a metal is proportional✓ to the temperature. When two strips of different types of metal with different coefficients of expansion✓ are secured to one another it will be an indication of the temperature✓ of the strip (known as a bimetal strip).✓



L – Low coefficient✓
H – High coefficient✓ (6)

5.3 **Advantages**
- It is cheaper than most other meters.
- It is easier to replace.
- It gives a small pressure loss.
- Depending on the type of liquid, any type of metal can be used.

Disadvantage
- The pipe blocks up easily if the liquid contains solids.
- The high pressure tube must be placed exactly in the pipe otherwise it will affect the reading. (4 + 2) (6)

5.4 Flow rate meters indicate both the amount of fluid as well as the time taken for the fluid to flow through the meter.✓ The flow rate is proportional to the linear velocity of the fluid through the pipe,✓ the difference in pressure over a structure in the pipe✓ and the square root of the difference in pressure.✓ When liquid flows in a pipe and the cross section changes, the velocity of the liquid changes the pressure of the liquid changes✓ accordingly. The meter that causes the difference in pressure is called the primary flowmeter or primary element.✓ The meter used to measure the difference in pressure over the primary element is called the secondary flowmeter or element.✓ Both these elements must be used together to measure flow rate and cannot be used separately for this purpose.✓ (8)

[22]

TOTAL: 100

Copyright reserved