



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

CHEMICAL PLANT OPERATION N5

24 November 2022

This marking guideline consists of 5 pages.

QUESTION 1

- 1.1 B
 1.2 G
 1.3 D
 1.4 E
 1.5 A

(5 × 1) [5]

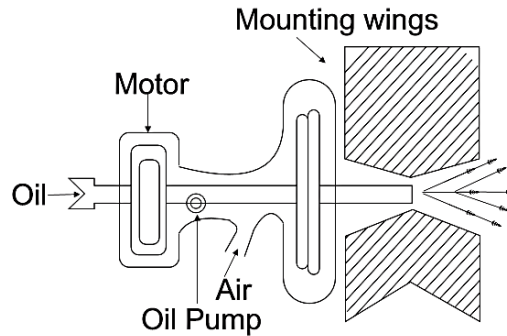
QUESTION 2

- 2.1 2.1.1 The heat of reaction is the difference in energy between the products of the reaction and the reactants. (2)
- 2.1.2 The heat of reaction equals the sum of the heat of formation of the products minus the sum of the heat of formation of the reactants. (3)
- 2.1.3 Kinetic energy is created due to the motion (velocity) of an object. (2)
- 2.2 $\Delta H = n_{CP} (T_F - 25 \text{ }^\circ\text{C}) - n_{CP} (T_I - 25 \text{ }^\circ\text{C})\checkmark$
 $= 10 \times 31,27(1\ 100 - 25)\checkmark - 10 \times 29,69(600 - 25)\checkmark$
 $= 336\ 152,5 - 170\ 717,5\checkmark$
 $= 165\ 435\ \text{cal}\checkmark$ (5)
- 2.3
- Identical casing and moving blades
 - Height of the blades
 - Area through which the steam flows
- (3)

[15]**QUESTION 3**

- 3.1 $\text{CCl}_4 + 2\text{H}_2\text{O}\checkmark \rightarrow \text{CO}_2\checkmark + 4\text{HCl}\checkmark$ (3)
- 3.2 Advantage: The working agent remains free from pollution \checkmark by the products of combustion \checkmark and hence the interior of the plant remains clean. \checkmark
- Disadvantage: Large and costly heating \checkmark and cooling surfaces are needed \checkmark and air has to be pumped into the system to make up for leakage. \checkmark (3 + 3) (6)

3.3



(4 for correct labels + 1 for the correct drawing) (5)

3.4

- The common stigma blade✓ is used for general-purpose kneading.✓
- The double-naben or fish tale blade✓ is particularly effective with heavy plastic material.✓
- The dispersion blade✓ develops the high shear forces needed to disperse powders and liquid into plastic or rubbery masses.✓

(3 × 2) (6)

[20]**QUESTION 4**

4.1

- Weight cylinder
- Floating weight
- Feed hopper door
- Extended neck
- Drilled sides
- Discharge door
- Door support
- Door latch

(Any 4 × 1) (4)

4.2

4.2.1

Steam flows from the centre outwards or from the outside towards the centre.✓ Pressure drops during the passage of steam through the nozzles✓ and then remains constant.✓ Velocity increases due to the pressure drop in the nozzles.✓ Velocity decreases as kinetic energy is given to the moving blades.✓

(5)

4.2.2

The shape of the nozzle must be such that the conversion from internal energy to kinetic energy is carried out with the greatest efficiency.✓ Nozzles are either converging or converging-diverging.✓ The minimum section of the nozzles is called the throat.✓ The corresponding pressure at the throat is called critical pressure.✓ If the discharge pressure is greater than the critical pressure,✓ converging nozzles are required.✓ If the discharge pressure is less than the critical pressure,✓ converging-diverging nozzles are required.✓

(8)

4.3

The nozzle converts the internal energy✓ of high-pressure steam into kinetic energy✓ so that the steam issues from the nozzles with high velocity.✓

(3)

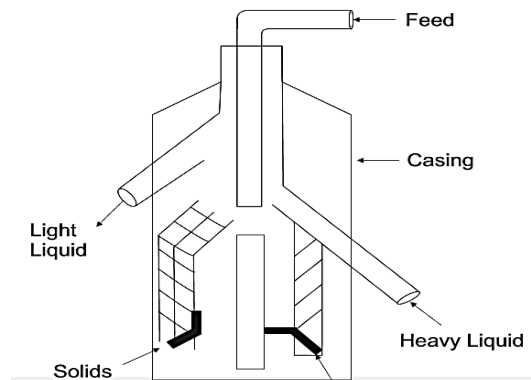
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QUESTION 5

- 5.1 Mulling is a smearing rubbing action similar to that in a mortar and pestle.✓ In large-scale processing this action is given by the wide, heavy wheel of the mixer.✓ In the particular design of a muller, the pan is stationary✓ and the central vertical shafts are driven causing the muller heels to roll in a circular path over the layer of solids on the pan floor.✓ The rubbing action results from the slips of the heels on the solids.✓ Plows guide the solids under the muller heels✓ or to an opening in the pan floor at the end of the cycle when the mixer is being discharged.✓

(7)

5.2



(1 for correct drawing + 4 for correct labels)

A short, wide bowl turns on a vertical axis.✓ Feed enters from above through a stationary pipe set into the neck of the bowl.✓ Two liquid layers are formed as in a tubular centrifuge that flows over adjustable dams into separate discharge spouts.✓ Inside the bowl and rotating with it are closely spaced disks which are actually cones of sheet metal set one above the other.✓ Heavier liquid is thrown outward, displacing lighter liquid toward the centre of the bowl.✓

(10)

- 5.3 5.3.1 The diameter for which one half of the inlet particles by mass are separated and the other half retained by air (2)
- 5.3.2 The efficiency of the cyclone (1)

[20]

QUESTION 6

- 6.1
- Manufacture of sulphate
 - Manufacture of fertiliser
 - Manufacture of tin blades
 - Manufacture of leather
 - Refining of petroleum
 - Dying fabric
 - Synthetic detergents
 - Explosives
 - Drugs
- (Any relevant 4 × 1) (4)



- 6.3
- Anhydrous ammonia is evaporated continuously \checkmark and uniformly in an evaporator using swing to supply the necessary heat of evaporation. \checkmark
 - Air from a reaction is compressed in a steam-driven compressor \checkmark and passed through heat exchangers and filters. \checkmark
 - Ammonia gas is oxidised with air to NO. \checkmark
 - The NO with excess air necessary for the oxidising is then cooled. \checkmark
 - Oxidation \checkmark and hydration of the NO are carried out. \checkmark
 - The acid HNO₃ is drawn off. \checkmark

(1 mark if the student got all points correct.)

OR

- Anhydrous NH₃ is evaporated.
- Air for the reaction is compressed and passed through a heat exchanger and air filters.
- NH₃ gas is oxidised to NO by air.
- NO with excess air is cooled and conducted to the bottom of the absorption tower.
- Successive oxidations and hydrations of NO are carried out to form HNO₃.
- The acid is drawn off through an acid trap.
- Waste gas is released.

(10)
[20]

TOTAL: 100