



**higher education  
& training**

Department:  
Higher Education and Training  
**REPUBLIC OF SOUTH AFRICA**

# **MARKING GUIDELINE**

**NATIONAL CERTIFICATE**

**CHEMICAL PLANT OPERATION N5**

**15 April 2021**

**This marking guideline consists of 5 pages.**

**QUESTION 1**

- 1.1 Pressure  
 1.2 Parallel  
 1.3 Blades  
 1.4 Air  
 1.5 Temperature

(5 × 1)

**[5]****QUESTION 2**

- 2.1
- Identify the type of problem.
  - Draw a flow sheet.
  - Select basis for a calculation.
  - Construct an input-output table.
  - Formulate the balances needed for the solution.
- (5)
- 2.2
- 2.2.1  $4\text{NH}_3 + 3\text{O}_2 \rightarrow 2\text{N}_2\checkmark + 6\text{H}_2\text{O}\checkmark$
- 2.2.2  $\text{NaNO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{NaHSO}_4\checkmark + \text{HNO}_3\checkmark$
- (2 × 2) (4)
- 2.3
- Change-can:✓ Blend viscous liquids or light pastes as in food processing or paint manufacturing.✓
  - Two-arm kneader:✓ Suspensions, pastes and light plastic masses.✓
  - Banbury:✓ Heavy, stiff or gummy materials.✓
  - Muller:✓ Batches of heavy solids and pastes, coating of particles.✓
  - Ribbon:✓ Dry powders and thin pastes.✓
  - Tumbler:✓ Dense solids in liquids and heavy dry powders.✓
  - Internal screw:✓ Free flowing grains and light solids. ✓
  - Impact wheels:✓ Fine, light powders such as insecticides. ✓ (Any 6 × 2) (12)
- 2.4
- Advantages: The working agent remains free from pollution by the products of combustion and hence the interior of the plant remains clean.
  - Disadvantages: Large, costly heating and cooling surfaces are needed, and air must be pumped into the system to make up for leakage. (2 × 2) (4)

**[25]****QUESTION 3**

- 3.1 3.1.1
- In a reaction turbine, only part of the pressure drop occurs in the nozzle.✓
  - The remainder occurs during the passage of the steam through the blades.✓
  - The blade passages are nozzle shaped so that the acceleration of the steam occurs partly in the blade.✓
  - The force of reaction is added to the force resulting from redirection of the steam to make the total propulsive force on the blade.✓
- (4)

- 3.1.2
- In an impulse turbine, the entire available pressure drop from supply to exhaust occurs across the nozzle.✓
  - The steam carries out its full expansion in the nozzle and emerges with high velocity.✓
  - The nozzle directed the steam onto the blades,✓ which are so shaped that the direction of flow of steam is changed and thereby a force is exerted on the blades.✓
- (4)

- 3.1.3
- The shape of the nozzle must be such that the conversion from internal energy to kinetic energy is carried out with greatest efficiency.
  - Nozzles are either converging or converging-diverging.
  - The minimum section of a nozzle is called a 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.
- (9)

- 3.2
- Particle size and cyclone diameter.✓
  - Efficiency decrease with increased temperature.✓
  - Efficiency increases with particle density.✓
  - Separation is more efficient if the particles are larger, because small particles can agglomerate.✓
  - Larger diameter cyclones tend to be less efficient because of a loss in centrifugal force, and this effect is offset by the increased surface area.✓
- (5)  
[22]

#### QUESTION 4

- 4.1 Immiscible liquids are separated industrially in centrifugal decanters.✓ Their operation is similar to that of gravity decanters,✓ except that the separating is much larger than that of gravity✓ and it acts in the direction away from the axis of rotation instead of downwards towards the earth's surface.✓ The main types of centrifugal decanters are tubular centrifuges and disk centrifuges.✓
- (5)

- 4.2 4.2.1 Input = Output ✓
- $$\begin{aligned} \text{Input} &= \text{mass of A entering} + \text{mass of B entering} \checkmark \\ &= 250 \text{ kg} \checkmark + 150 \text{ kg} \checkmark \\ &= 400 \text{ kg} \checkmark \\ \therefore \text{Output} &= 400 \text{ kg} \checkmark \end{aligned}$$
- (6)