higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE (VOCATIONAL)

PROCESS TECHNOLOGY
NQF LEVEL 3

04 November 2022

This marking guideline consists of 6 pages.

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QUESTION 1

1.1 B
1.2 A
1.3 C
1.4 D
1.5 A

(5 × 1) **[5]**

QUESTION 2

2.1 True
2.2 False
2.3 True
2.4 False
2.5 False

(5 × 1) **[5]**

QUESTION 3

3.1 3.1.1 Absorption is the process or action by which one thing soaks up or is soaked up by another.✓✓ OR a process where molecules are sucked into the material but do not physically bond to the surface.✓✓ (2)

3.1.2 Combustion is the process of burning something.✓ OR a chemical reaction taking place between air and oxygen✓ (1)

3.2 Using water to suspend solid materials is an efficient method to transfer solid materials from one place to another by using pumps.✓ Earthmoving machinery like front loaders are used for the same purpose✓ and in mining industries sand, grit or rock slurries are made to pump solid materials for processing, recovery or dumping✓ (3)

3.3 Mixing time will determine the type of process to be used during the mixing process,✓ it might either be batch or continuous mixing.✓ (2)

3.4
- The sample container should be flushed to remove all traces of other gases present.
- The sampling techniques should not change the properties of the gas.
- The sample containers should not affect the physical and chemical properties of the sample.
- Some gases may create safety hazards if sufficient quantities are released into the atmosphere.
- Do not expose samples to flames, fire, sparks, heat, or static electricity that may cause gases to ignite.
- The sampled material may need to be kept at a specific temperature or pressure to preserve its condition. (Any 4 × 1) (4)

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3.5 3.5.1 $V_{(H2O)} = V_{total} - V_{acetic\ acid}$
$= 250\ m^3 - 50\ m^3$✓
$= 200\ m^3$ ✓ (2)

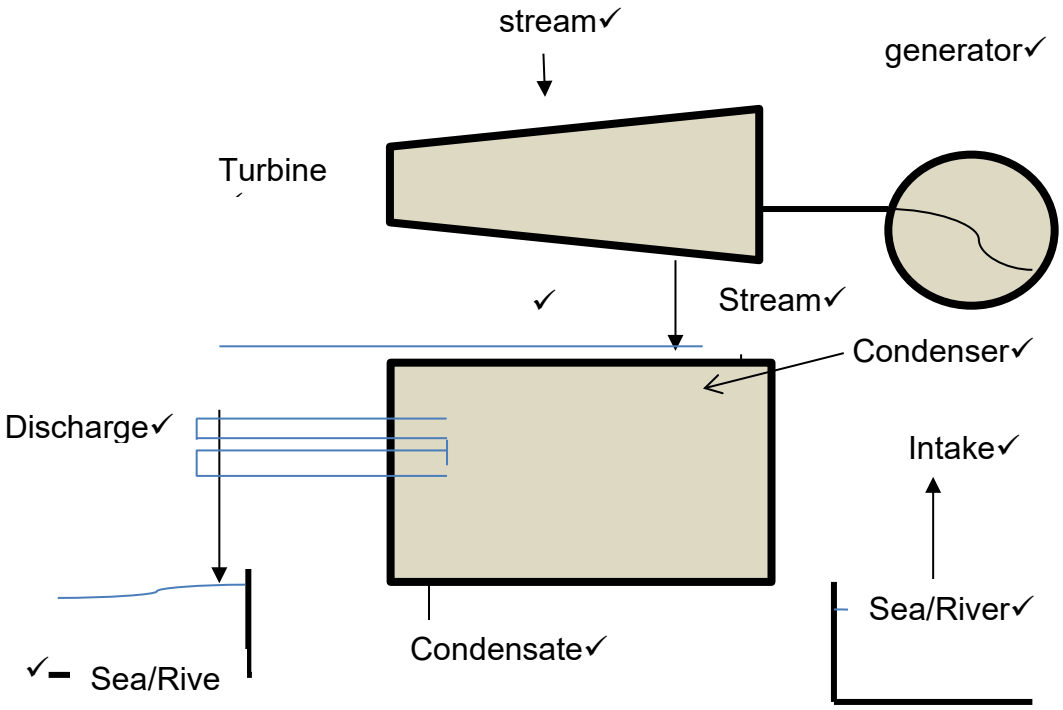
3.5.2 $V(\%) = \frac{V_{solute}}{V_{total\ solution}} \times 100\%$✓
$V(\%) = \frac{V_{acetic\ acid}}{V_{total}} \times 100\%$✓
$= \frac{50\ m^3}{250\ m^3} \times 100$ ✓
$\therefore V(\%) = 20\ \%$✓ (4)
[18]

QUESTION 4

4.1 4.1.1 C
4.1.2 D
4.1.3 E
4.1.4 D
4.1.5 A
(5 × 1) (5)

4.2
- Fouling decreases the heat transfer coefficient
- Needs to be cleaned regularly due to scaling and is likely to corrode
- Corrosive, reactive materials cause problems such as contamination and leakage
- Larger tube diameters cause a decrease in heat exchange
- Long tube length causes longitudinal expansion
- Long multi-pass exchangers induce thermal stresses causing mechanical deformation (Any 5 × 1) (5)

4.3



Water is pumped from the water source to condensers.✓ The used water is discharged at a point away from the intake.✓
(ONE mark for a correct diagram, ½ mark for labelling and TWO marks for operation). (8)

4.4
- Wet cooling towers
- Dry cooling towers
- Hybrid cooling towers (3)

4.5
- Radiation
- Conduction
- Convection (3)

4.6
- Primary air✓ it is the air used to control the rate of combustion✓
- Secondary air✓ this is used to change the efficiency of the combustion process, or in other words, how complete all the fuel is burned up.✓
- Excess air✓ the amount of air given to the burner that exceeds the theoretical amount needed for full combustion.✓ (6)

4.7 Fuel gas (1)

4.8 Nitrogen oxide and carbon dioxide are formed✓ where nitrogen oxide forms as a result of the high burning temperature related to natural gas burners, which cause nitrogen to burn in oxygen.✓ (2)

4.9
- Fatigue cracking at the rolled tubes ends
- Low-temperature corrosion and problems from gas side deposits
- Sliding and leaking expansion joints at the casing, that may allow accumulation of soot with severe acid attack (3)

[36]

QUESTION 5

5.1 5.1.1 Ion-exchanger is the process in which ions are exchanged✓ between a solution and an insoluble solid, usually a resin.✓

5.1.2 Catalysis is the change✓ in the rate of a chemical reaction.✓

5.1.3 Backwash is when some unwanted particles are removed from the resin by flushing the resin with water in a separate procedure from the normal operation.

(3 × 2) (6)

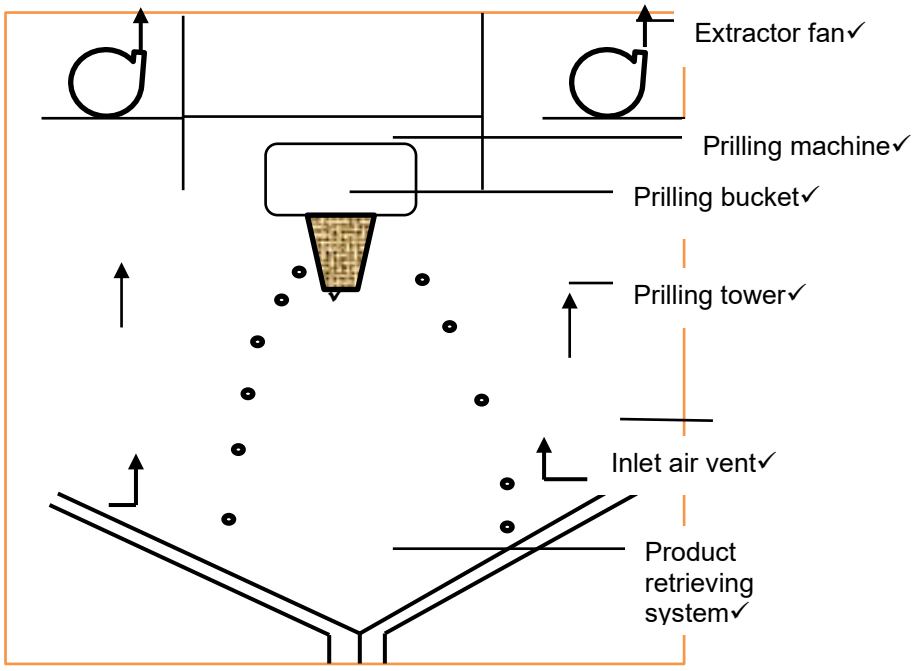
5.2 5.2.1

- A dry product is lighter than a wet product, making it less expensive and easier to handle and transport
- Dry products can be preserved longer than wet products
- Product yields and assays can be calculated from a sample of dry product
- Drying is often needed to make a product compatible with downstream processes, sometimes, the liquid from one process cannot be carried over to another process (Any 3 × 1) (3)

5.2.2

- Tray dryer
- Spray dryer
- Paddle dryer
- Flash dryer
- Rotary dryer
- Fluidised bed dryer
- Except drum dryer (Any 3 × 1) (3)

5.2.3



(ONE mark for correct drawing and ½ mark for each labelling) (4)

5.3
- Heat-sensitive materials can safely be dried as the drying time in a spray dryer is very short.
- There is no build-up of material on the walls of the chamber as the material is dried before it comes into contact with the walls.
- The dried product is usually in powder form which can easily be dissolved in a suitable solvent.
- The particle size of some products can be varied by adjusting the atomising conditions.
- Continuous operation allows for high loads of material to be dried.
- Cleaning is fairly easy and simple in most cases (Any 5 × 1) (5)

5.4
- Spraying of a liquid mixture
- Addition of heated air or nitrogen (2)

5.5
- Oxygen from air
- Drying of gases
- Removing water from azeotropes
- Sweeting sour gases and liquids
- Purification of hydrogen
- Separation of ammonia and hydrogen
- Recovery of carbon dioxide
- Separation of oxygen and argon
- Removal of acetylene, propane, and butane from air
- Separation of xylenes and ethyl benzene
- Separation of normal from branched paraffin
- Separation of olefins and aromatics from paraffin
- Recovery of carbon monoxide from methane and hydrogen
- Purification of nuclear off-gases
- Separation of cresols
- Drying of refrigerants and organic liquids
- Separation of solvent systems
- Purification of silanes
- Pollution control, including removal of hg, no_x and so_x (Any 5 × 1) (5)

5.6
- Chemical adsorption or chemisorption✓ – this is where the adsorbent reacts with the adsorbate. The result is a chemical bond between the two with an exchange of electrons✓
- Physical adsorption or physisorption✓ – this probably is the most common type of adsorption. With physisorption, there is no transfer of electrons and the molecules do not react.✓
- Electrostatic adsorption✓ – this is where oppositely charged ions and functional groups bond due to the electrical charge differences between them. This is often called ion exchange.✓ (3 × 2) (6)

5.7 In size exclusion, the membrane has specific pores or hole sizes that do not allow certain substances to pass through.✓ This means that certain substances are too big to pass through✓ (2)

[36]

TOTAL: 100

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