



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

CHEMICAL PLANT OPERATION N6

XX AUGUST 2019

This marking guideline consists of 6 pages.

QUESTION 1

- 1.1 True
1.2 False
1.3 True
1.4 True
1.5 False

(5 × 1) [5]

QUESTION 2

- 2.1 2.1.1
- An adsorbent for solvent vapour at low pressure
 - A rotating fixed-bed adsorbent
 - A fixed-bed adsorbent for vapour at high pressure
- (3)
- 2.1.2 An adsorbent is a solid substance that attracts other molecules to its surface.
- An adsorbate is a substance that adheres to a surface of another substance.
- (2)
- 2.2 2.2.1 Raoult's law is a liquid law✓ and must be expressed as applying only to the liquid solution✓ and to vapour in equilibrium with the liquid solution.✓
- (3)
- 2.2.2 In an operation of this type, the unit can be brought to steady operating conditions✓ where the amount of feed exactly✓ equals✓ the amount of material removed,✓ such that vapour and liquid concentrations✓ at any point in the unit remain constant.✓
- (6)
- 2.2.3 The efficiencies of individual plates in a distillation tower✓ may be reported as Murphree plate efficiency.✓ This efficiency is defined as the actual vapour enrichment over one plate✓ divided by the theoretical vapour enrichment✓ which would have been obtained if the liquid on the plate✓ and the vapour leaving the plate had reached equilibrium.✓
- (6)
- [20]

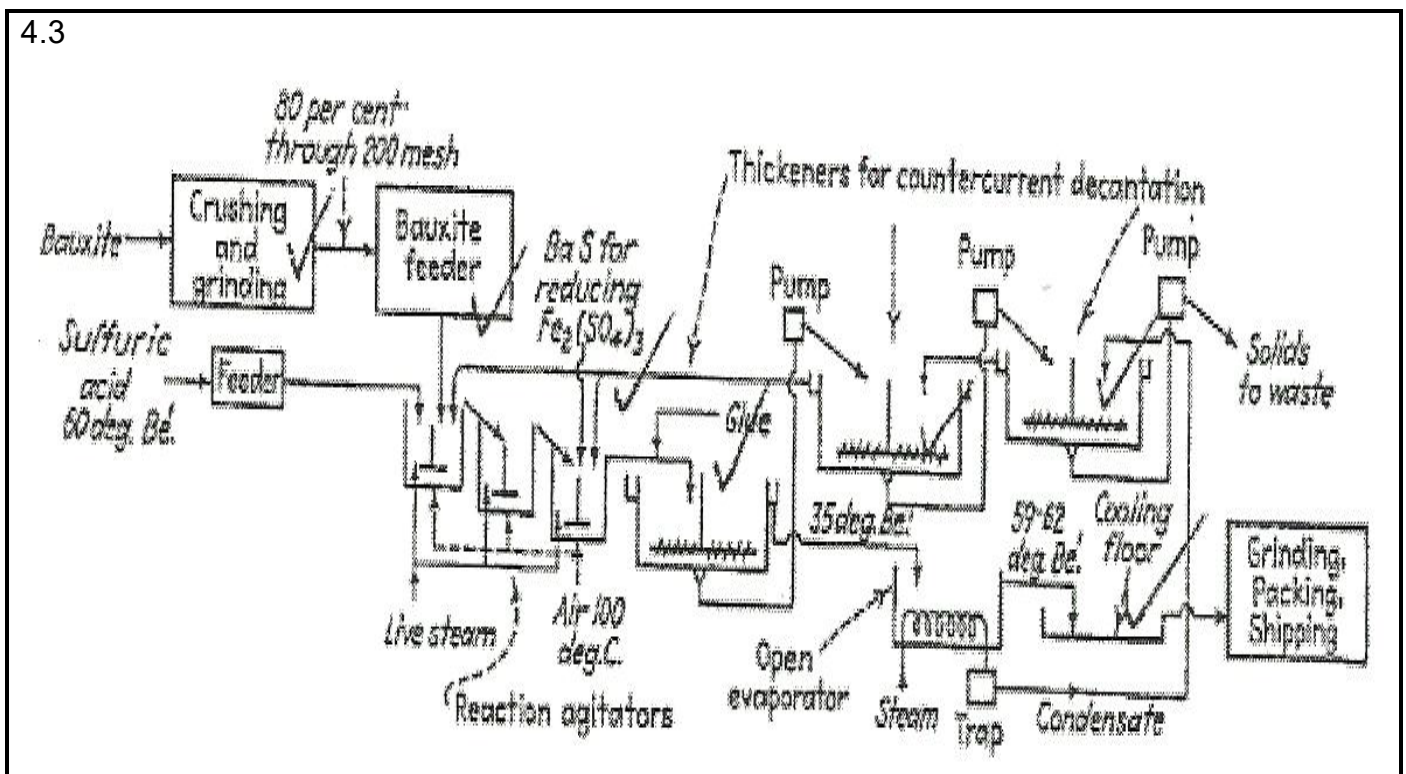
QUESTION 3

- 3.1 3.1.1 These plate/tray resembling devices differ from conventional trays in that these are not ordinary down-spouts.✓ The liquid and vapour flow counter-currently✓ through the same openings.✓ Trays like turbo, kitler, ripple and leva trays are used.✓ (4)
- 3.1.2 This type of distillation column consists of a series of plates.✓ There are a number of openings in each plate through which the vapours rise.✓ Each of the openings has an elevated cap on it✓ so that the vapours are deflected by the cap✓ into the liquid on the plate.✓ The vapours are bubbled through the liquid where condensation and vaporisation occur.✓ (6)
- 3.2 3.2.1 It is the breaking down of larger hydrocarbon molecules✓ into smaller molecules✓ by heat or catalytic action.✓ (3)
- 3.2.2 It is the conversion of naphthas✓ to obtain products with a higher octane number.✓ (2)
- 3.3 3.3.1
- To prevent corrosion
 - To prevent formation of hydrates
 - To prevent freezing of valves and regulators
- (3)
- 3.3.2
- Compression
 - Treatment with a drying substance
 - Absorption
 - Refrigeration
- (4)
- 3.4 3.4.1 These crudes consist of open chain compounds✓ and furnish low-octane number straight-run gasoline.✓ They are excellent but waxy lubricating oil stocks.✓ (3)
- 3.4.2 These crudes contain large quantities of paraffinic (alkanes)✓ and naphthenic compounds.✓ They furnish medium-grade straight-run gasoline✓ and lubricating oils.✓ Both wax and asphalt are found in these oils.✓ (5)
- [30]**

QUESTION 4

- 4.1
- Hydrogen
 - Methane
 - Ethylene
 - Carbon monoxide
 - Carbon dioxide
 - Hydrogen sulphide
 - Ammonia
 - Nitrogen
- (Any 3 × 1) (3)
- 4.2
- Coal is transferred, crushed and screened.
 - Coal is charged to a hot, empty oven.
 - Coal is chemically transformed to coke and volatilities by pyrolysis.
 - Hot coke is pushed out of the oven, quenched and transported.
 - A condensable product of distillation is liquefied and collected in the hydraulic main.
 - Foul gas is cooled and tar extracted.
 - Ammonia is removed from gas as ammonia sulphate.
 - Gas is cooled and subjected to benzol and toluol removal by absorption.
 - Hydrogen sulphide is remove.
 - Purified gas is metered and transferred to consumers.
 - The tar separated from the collecting main and tar extractor is settled from ammonia liquor and with light oil, subjected to the next sequences.
- (11)

4.3

(6)
[20]

QUESTION 5

5.1 5.1.1 Impurities in caustic soda (NaClO_3 , NaCl and iron) are removed by treating caustic with 1% calcium carbonate ✓ and filtering the mixture through a Vallez filter. ✓ The content of caustic soda is cooled to 20°C to reduce the salt. ✓ (3)

5.1.2

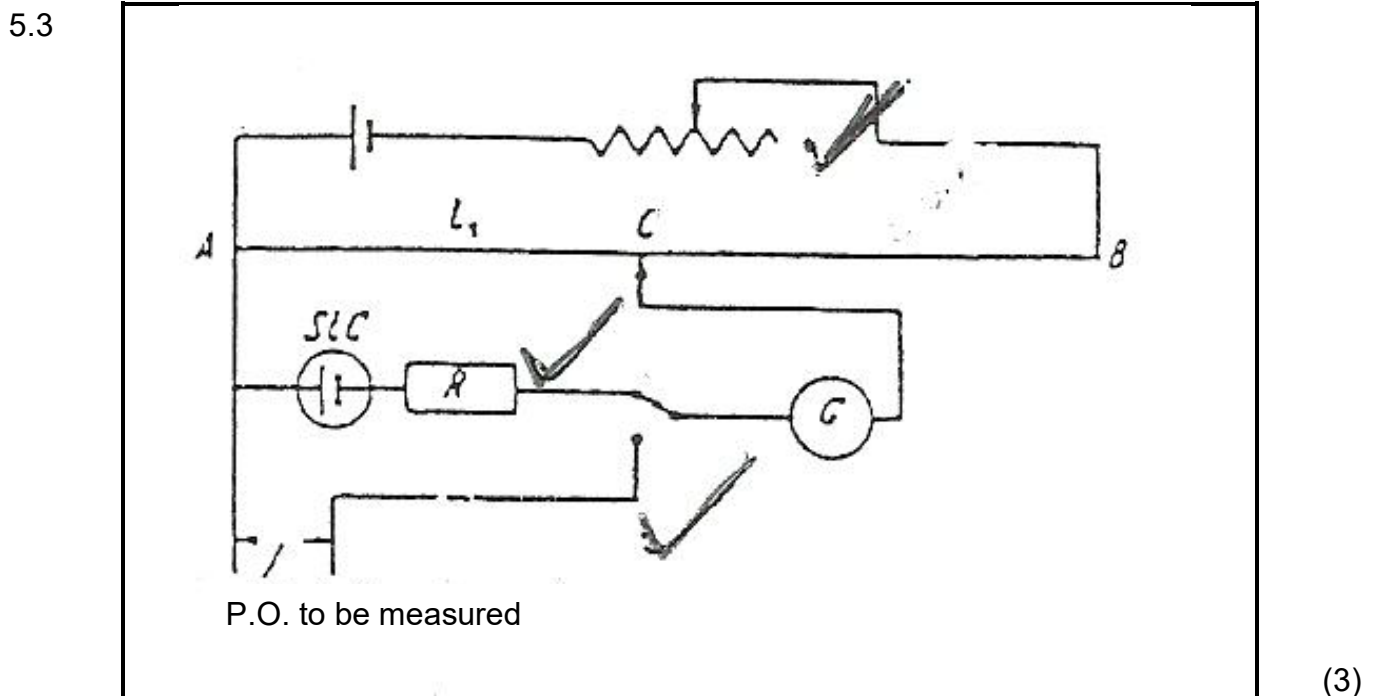
- Cooled and settled purified caustic soda is concentrated in a single-effect final or high evaporator.
- Very strong caustic must be handed in steam-jacketed pipes to prevent solidification.

(2)

5.2

- Celsius scale
- Kelvin scale
- Rankine scale
- Reaumur scale

(4)



The potentiometer consists of a length of uniform wire, AB. The resistance per unit length of the wire may be regarded as being constant so that when a current flows, the voltage drop along the wire is uniform. ✓ The wire is connected with an accumulator. ✓ If a standard cell is connected in series with a larger resistance and galvanometer at point C (found in AB) such that no current flows through the galvanometer when it is connected to C, the high resistance R, is for the protection of the standard cell. ✓ When the point C has been found, it is known that the potential drop between A and C is equal to the EMF or electromotive force of the standard cell (E). ✓ (4)

- 5.4
- The bulb size may be too large to fit the available space.
 - The performance characteristics vary considerable with the type of filling fluid and the user must be make sure not to misapply a particular type of system.
 - The maximum temperature is more limited than that in some electrical measuring systems.
 - In case of system failure, the entire unit must be replaced or repaired.
 - Separation of sensing and indicating elements may be limited, depending on other characteristics, such as filling liquid and accuracy requirements. (5)

5.5 Strong acids ionise almost completely in solution✓ and form a high concentration of hydrogen ions (H^+ or H_3O^+).✓

Weak acids ionise only partially in solution✓ and form a low concentration of hydrogen ions (H^+ or H_3O^+).✓

(4)
[25]

TOTAL: 100