



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

CHEMICAL PLANT OPERATION N6

8 April 2021

This marking guideline consists of 5 pages.

QUESTION 1

- 1.1 True
 1.2 True
 1.3 True
 1.4 False
 1.5 True

(5 × 1) [5]

QUESTION 2

- 2.1 E
 2.2 D
 2.3 G
 2.4 A
 2.5 F

(5 × 1) [5]

QUESTION 3

- 3.1 3.1.1
- Overall efficiency
 - Murphree plate efficiency
 - Local efficiency
- (3)
- 3.1.2
- Foaming/Entrainment
 - Poor vapour distribution
 - Short-circuiting
 - Weeping
 - Dumping of liquid
- (Any 2 × 1) (2)
- 3.2 Total heat needed to vaporise 1 mole of feed✓ divided by heat required to vaporise 1 mole of liquid✓ at boiling point✓ (3)
- 3.3 3.3.1 Usually made of sheet metal of special alloys if necessary,✓ thickness governed by anticipated corrosion rate.✓ Tray must be stiffened, supported and fastened to shell to prevent movement with gas surges.✓ Installed to level within 6 mm to promote good liquid distribution.✓ Large tray must be fitted with manways to enable climbing from one tray to another during repair and cleaning.✓ (5)
- 3.3.2 Series of plates✓ with number of openings in each plate through which vapours rise.✓ Each opening has an elevated cap so that vapours can be deflected.✓ The vapours bubble through liquid on plate where condensation and vaporisation occur.✓ (4)

- 3.4
- Recovery of vapours from diluted mixtures with gases
 - Solute recovery
 - Removal of contaminants from solution
 - Fractionation of gas and liquid mixture

(Any 3 × 1)

(3)
[20]

QUESTION 4

- 4.1
- Bauxite is ground and conveyed to storage bins✓
 - Reaction occurs in lead-lined steel tanks,✓ where reactants are thoroughly mixed and heated with the aid of agitators and live steam.✓ These reactors are operated in series✓
 - Barium sulphide is added to last reactor in form of black ash to reduce ferric sulphate to ferrous state and to precipitate iron✓
 - Mixture from reactors sent through series of thickeners,✓ which remove undissolved matter so that it contains practically no alum✓
 - Clarified aluminium sulphate is concentrated and poured into flat pans for cooling and solidifying.✓

(8)

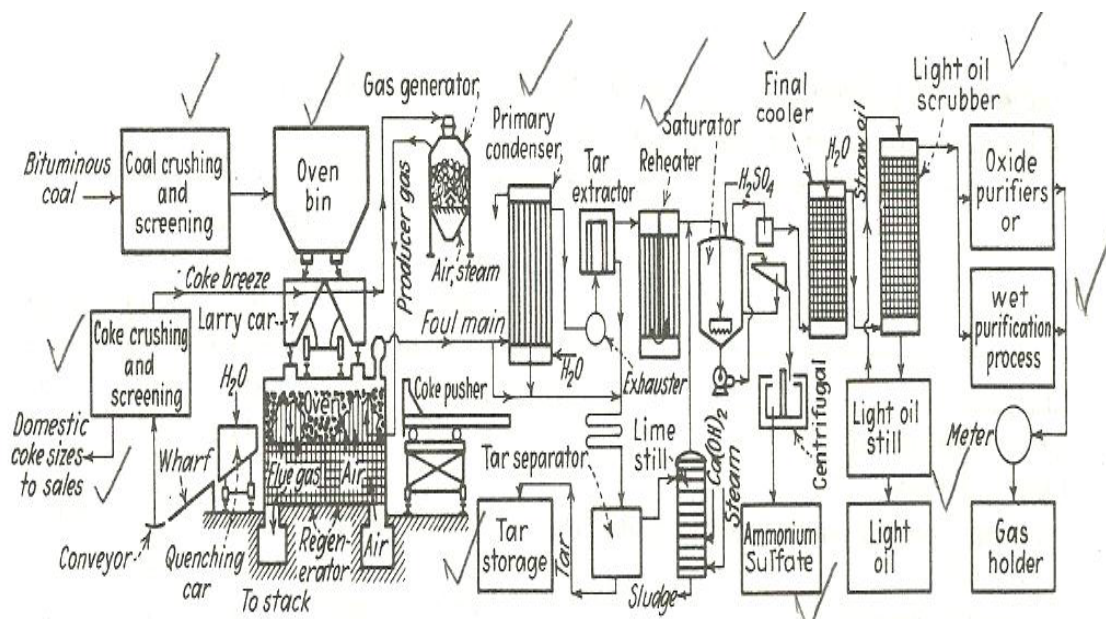
4.2.1 Alteration of arrangement of atoms✓ in molecule✓ without changing number of atoms✓

4.2.2 Breaking down large hydrocarbon molecules✓ into smaller molecules✓ by heat or catalytic action✓

(2 × 3)

(6)

4.3



(11 marks for any correct labelling)

(11)
[25]

QUESTION 5

- 5.1 5.1.1 Removal of wax from wax distillates.✓ Mixture of wax and adhering oil obtained from press is frozen✓ and allowed to warm slowly so that oil drains (sweat) from cake,✓ thus further purifying wax. Contact filtration involving use of clay is common method of purification of oils; decolourisation takes place at same time✓ (4)
- 5.1.2 Removal of components from liquid by means of selective solvent action of another liquid.✓ Procedure of selective extraction by solvent is important in further refining of lubricating oil.✓ Used to remove low viscosity material.✓ Adequate mixing followed by clean and rapid separation of two liquid layers.✓ Another example is the production of benzene, toluene and xylene by extraction from specially processed petroleum.✓ (5)
- 5.1.3 Wax removed from crude oil or lubricating oil by crystallisation✓ to yield crystalline✓ and microcrystalline of low oil content✓ (3)
- 5.2 5.2.1 Gas compressor✓ followed by cooling system✓ to remove water vapour by condensation✓ (3)
- 5.2.2 Agents employed are activated alumina, bauxite, silica gel, sulphuric acid, glycerine✓ and concentrated solution of calcium chloride and sodium thiocyanate.✓ Requires packed tower for counter-current treatment of gas with reagent✓ (3)
- 5.2.3 Gas is dehydrated by passing it over refrigeration coils. (1)
- 5.3
- High corrosion may occur in transmission line
 - Water may result from formation of hydrates causing line stoppage
 - May cause freezing of valves and regulators in cold weather. (3)
- [22]**

QUESTION 6

- 6.1 Hot chlorine evolving from anode carries much water vapour.✓ It is first cooled to condense most vapour✓ and then dried with sulphuric acid in scrubber.✓ (3)
- 6.1 Diaphragm box suspended in tank well above sediment level.✓ When level of liquid in tank rises,✓ pressure on diaphragm increases✓ and diaphragm moves.✓ This compresses air within closed system.✓ Increased air pressure transmitted by capillary tube✓ to pressure-measuring portion of instrument which may be indicator or recorder.✓ (7)

[10]**QUESTION 7**

- 7.1
- Reciprocating piston-type
 - Rotating or oscillation piston-type
 - Nutating disc-type
 - Fluted spiral rotor-type
 - Sliding vane -type
 - Rotating vane-type
 - Oval gear-type
- (Any 5 × 1) (5)
- 7.2 Level of the measured liquid is held constant in an overflow tube.✓ Glass hydrometer either rises or falls in liquid as specific gravity varies.✓ Lower end of the hydrometer supports an armature inductance coil.✓ Movement of this armature is duplicated by similar coil in recording instrument.✓ Temperature of liquid usually recorded with value of specific gravity, so that corrections can be made✓ (5)
- 7.3
- Reaumur scale
 - Celsius scale
 - Kelvin scale
 - Rankine scale
- (Any 3 × 1) (3)

[13]**TOTAL: 100**