higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

PLANT OPERATION THEORY N1

22 November 2022

This marking guideline consists of 6 pages.

Copyright reserved

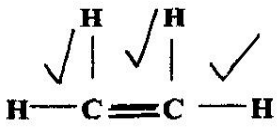
QUESTION 1: CHEMISTRY

1.1
- Acidic taste
- Turns blue litmus red
- Conducts electricity when dissolved in water due to ions in the solution
- Liberates hydrogen when reacting with metal
- Sour taste
- Conducts electric current
- Destroys the chemical properties of bases
- Forms a salt plus water when reacting with an alkali or basis when diluted (neutralisation)
- Liberates carbon dioxide gas from carbonates and bicarbonates

(Any 3 × 1) (3)

1.2
- Solid at room temperature with the exception of mercury
- High melting and boiling points
- High density
- Opaque
- Good conductors of heat and electricity
- Strong and hard
- Can be drawn into wires
- Tends lose electrons and form cations
- Normally do not accept electrons
- Metallic lustre (shine) when pure
- Tends to lose electrons to gain an octet structure (Any 3 × 1) (3)

1.3



Ethylene C_2H_4

(3)

1.4 A molecule is the smallest particle of a compound which consists of two or more atoms of the same or various types, e.g. H_2 which refers to a hydrogen molecule. An atom is the smallest particle of an element and consists of protons and neutrons in the nucleus with electrons spinning around the nucleus, e.g. H which refers to a hydrogen atom. An atom is the smallest indivisible particle of an element that reacts to form a molecule. (Any relevant 3 + any relevant 3) (6)

1.5
1.5.1 Si: 4
1.5.2 P: 5
1.5.3 S: 6
1.5.4 Na: 1
1.5.5 K: 1

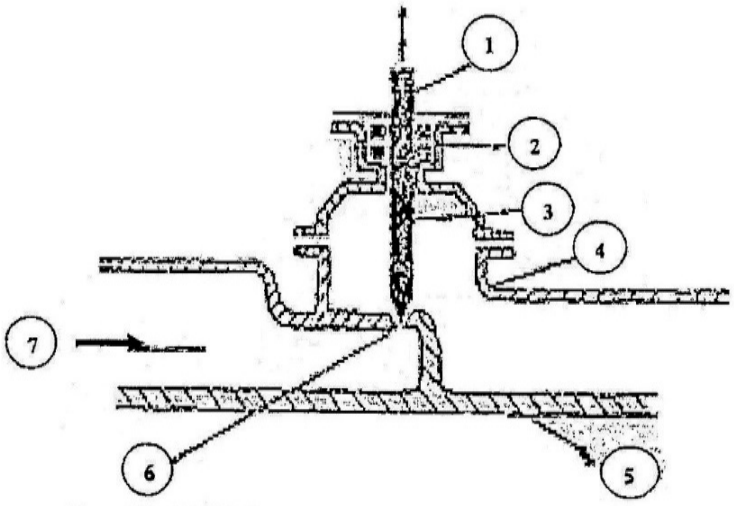
(½ for correct symbol and ½ for valence electron) (5 × 1) (5)

[20]

QUESTION 2: VALVES AND PIPES

2.1

NEATNESS ✔



1. Rod
2. Packing
3. Needle
4. Cap
5. Cover body
6. Seating
7. Flow

(7 for labels + 1 for neatness) (8)

2.2
- Cross valve
- Globe valve
- Angle valve
- Gate valve
- Check valve
- 90° elbow
- 45° elbow
- Coupling
- Reducing coupling
- Straight T
- Union
- Cap
- Cross
- Plug

(Any 4 × 1) (4)

2.3
- Gate valve: These valves are used in pipes and got its name from sluices used in canals as it operates on the same principle.
- Plug valve: These valves have a quick action and are very suitable to let flow through or to stop it. It is sometimes used as regulators.
- Globe valve: Regulating valves are most commonly of this type and used to regulate flow.

(3 × 2) (6)

2.4 A valve is a device used in pipelines to regulate flow. (2)

[20]

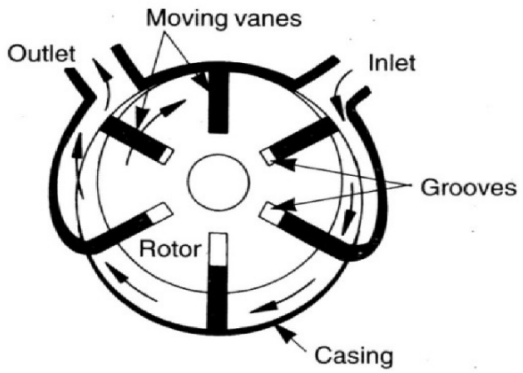
QUESTION 3: PUMPS AND INSTRUMENTATION

3.1
3.1.1 True
3.1.2 False
3.1.3 True
3.1.4 False
3.1.5 False

(5 × 1) (5)

3.2
- Centrifugal pumps (both single and multistage)
- Rotary pumps (gear pump, helical screw gear pump, vane pump, flexible impeller pump)
- Reciprocating pumps (3)

3.3



(6 for labels + 1 for neatness) (7)

3.4
- Handles thin liquids at relatively higher pressure
- Compensates for wear through vane extension
- Sometimes preferred for solvents like LPG
- Can run dry for short periods
- Can have one seal or stuffing box (5)

[20]

QUESTION 4: DISTILLATION WATER TREATMENT

4.1 4.1.1 Distillation is the separation of components of a liquid mixture through stages of heating and cooling until a pure light product is obtained towards the top of the plant and a pure heavy product at the bottom.

4.1.2 Evaporation takes place as the result of heating, which provides the liquid with greater molecular movement. The movement increases until the mutual force of attraction between the molecules and the pressure on the liquid are overcome simultaneously and the molecules break away from the mass.

4.1.3 Condensation is the opposite of evaporation. The movement of the molecules of the vapour decreases as a result of cooling. The molecules move closer to each other and the force of attraction between the molecules becomes stronger with cooling.

(3 × 2) (6)

4.2
- By-product
- Absorption section
- Stripping section
- Heater
- Feed
- Condenser
- Cooling water out
- Cooling water in
- Back flow
- Accumulator
- Light liquid product
- Residue

(Any 10 × 1) (10)

4.3
- Bicarbonates
- Calcium
- Magnesium
- Limestone

(4)
[20]

QUESTION 5: SAFETY AND STORAGE

5.1 5.1.1 True
5.1.2 False
5.1.3 False
5.1.4 True
5.1.5 False

(5 × 1) (5)

5.2 Class A: Solid materials, e.g. burning wood extinguished with water
Class B: Gases and fumes of liquids,✓ e.g. oil extinguished by smothering

(2 + 2) (4)

5.3 Sphere volume = $4/3\pi r^3$ × %
= 1,33 × 3,14 × $(5 \div 2)^3$ × 75%✓
= 4,187 × 15,625 × 0,75✓
= 48,94 m^3✓ (3)

5.4
- Dome roof: Necessary to blend radial grinders
- Umbrella roof: Dome roof without steel rings
- Hanging roof
- Cone roof
- Fixed roofs (domed or cone) with internal floating (Any 4 × 1) (4)

5.5
- Decreased level of evaporation of stored product
- Lower risk of fire
- Light aluminium which increases storage capacity
- Protected from ambient climatic conditions for use in various regions
- Roof drain not necessary (Any 4 × 1) (4)

[20]

TOTAL: 100

Copyright reserved