higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

PLANT OPERATION THEORY N2

1 AUGUST 2018

This marking guideline consists of 6 pages.

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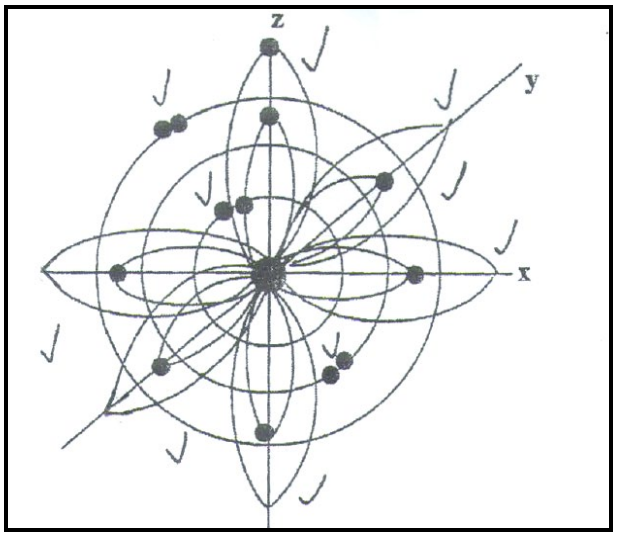
QUESTION 1: CHEMISTRY

1.1 1.1.1 C
1.1.2 E
1.1.3 A
1.1.4 B
1.1.5 D

(5 × 1) (5)

1.2 Aluminium atom : $_{13}Al$: $1s^2, 2s^2 2p^6, 3s^2 3p^1$



(½ mark per correct answer) (10 × ½) (5)

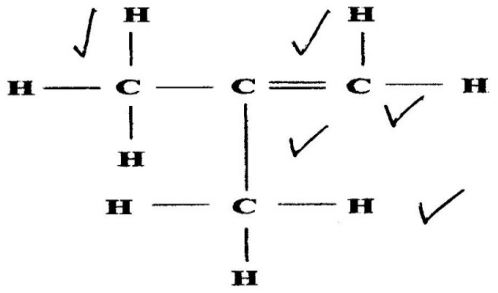
1.3 Paraffin = Alkane - C_nH_{2n+2}
Acetylene = Alkyne - C_nH_{2n-2} (2 × 2) (4)

1.4
- Change oil into fats e.g. vegetable oil to become fats to form margarine
- Extraction of petrol and oil from coal
- In the Haber process hydrogen is used in the manufacturing of synthetic ammonia (Manufacture of fertilizers)
- Releasing of weather balloon
- Manufacture of hydrochloric acid
- To obtain metals from ore by reduction
- Used as liquid fuel for rockets (Any 4 × 1) (4)

1.5 1.5.1 MgO
1.5.2 $(NH_4)_2SO_4$

(2 × 1) (2)

1.6



Isobutylene C_4H_8
Isocompounds

(5)
[25]

QUESTION 2: ENERGY AND FLUID FLOW

2.1 2.1.1 It is the energy of an object due to its state of movement or velocity✓ measured in joule.✓ (2)

2.1.2 It is the property of a fluid that resists flow.✓ The higher a fluid's resistance✓ against flow, the higher the viscosity of the fluid. A low viscosity will indicate a fluid that will flow easily.✓ (3)

2.2 Heat required to change the state of a liquid✓ at constant temperature✓. It is measured in J/kg✓.
Any ONE RELEVANT Example:
- The vaporisation of a stream in a reboiler of a fractionation column✓

OR
- Conversion of water to steam in a boiler✓ (4)

2.3 2.3.1 Power = Work done ÷ Time✓

= $12 \times 10^6 \div 6 \times 60$sec ✓

= 33333.33 W ✓

= 33, 3 kW✓ (4)

2.3.2 Input = Output ÷ Efficiency

= 33, 33 ÷ 85%✓

= 39, 2 KW ✓ (2)

2.4 $Q = Av$
$= (3,142 \times 0,04^2 \div 4) \times 3,5 \times 1\ 000$✓✓
$= 4,399$ litres/s✓ (3)

2.5 $V = Q/A$
$= (0,004399 \times 4) \div (3,142 \times 0,06^2)$ ✓✓
$= 1,55$ m/s✓ (3)

2.6 $Q_1 = k (h)^{½}$
$k = 10 \div (25)^{½}$ ✓
$= 2$✓
$h_2 = (15 \div 2)^2$✓
$= 56,25$ kPa ✓
(4)
[25]

QUESTION 3: DISTILLATION AND FRACTIONATION

3.1 3.1.1
- This is the part below the feed inlet, with smaller strippers on the side responsible for stripping higher up in the tower.
- In the absence of smaller strippers, the tower has to be higher with the plates to carry out this whole action between the fractions. (2)

3.1.2
- Rectification/absorption takes place above the feed inlet
- and the fractions are drawn down to places where the composition complies with required specifications.
- Rectification indicates the rectification of each fraction by means of absorption. (3)

3.2
A- Heavy Fuel Oil
B- Steam Supply
C- Boiler Light Fuel Oil
D- Boiler Paraffin
E- Stripper
F- Petrol
G- Water
H- Gas
I- Vapours
J- Back flow
K- Furnace

(11 × 1) (11)

3.3 3.3.1 When a mixture of light and heavy fluid is heated ✓and the amount of evaporation is controlled, it is called partial evaporation. ✓

3.3.2 When a vapour mixture is cooled and only a part is condensed✓ so that condensation contains a greater quantity of the fluid, it is called partial condensation. ✓

(2 × 2) (4)

3.4 Pressure causes vapour to condense,✓ causing the boiling point of the fluid in the column to rise.✓ To maintain the previous rates of condensation and evaporation,✓ the pressure must be reduced✓ or the temperature increased.✓ (5)
[25]

QUESTION 4: INSTRUMENTATION

4.1 4.1.1 True
4.1.2 True
4.1.3 False
4.1.4 False
4.1.5 True

(5 × 1) (5)

4.2
- Pressure control points are fitted on fractionating towers because a variation in pressure gives fractions of specifications.
- Variation in pressure disturbs the energy balance of the tower.
- With vacuum distillation the pressure inside the tower is lower than the atmospheric pressure and condensation of the steam causes marked reductions in pressure, which must be controlled.
- A pressure controller is fitted at the bottom of the tower to control the flow of steam through the boiler.
- This also controls the bottom temperature, which in turn controls the vapour pressure of the bottom products.
- Placing of pressure control points are determined by the type of fractionation to be carried out and the material to be handled. (6)

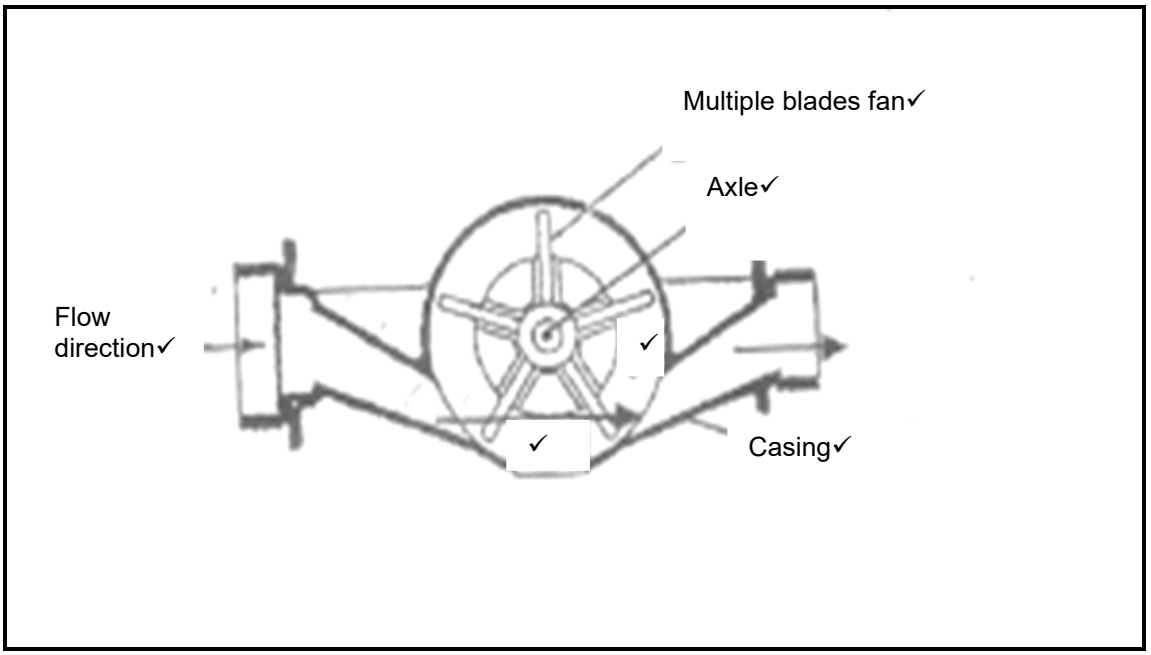
4.3 4.3.1
- Heat is the result of molecular movement and therefore is a form of energy.
- Heat is measured in joule.

4.3.2
- Temperature is an energy condition
- It indicates the degree of heat of a substance in degrees Celsius or kelvin.

(2 × 2) (4)

4.4
- Mercury type U-tube
- Dead mass tester (2)

4.5



ROTATING VANE FLOWMETER (6)

4.6
- Orifice plate
- Venturi tube
- Pitot tube

(Any 2 × 1) (2)
[25]

TOTAL: 100

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