higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

PLANT OPERATION THEORY N2

6 AUGUST 2019

This marking guideline consists of 5 pages.

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QUESTION 1: CHEMISTRY

1.1 1.1.1 B
1.1.2 B
1.1.3 B
1.1.4 C
1.1.5 A

(5 × 1) (5)

1.2 Isotopes are atoms of the same kind of element✓ that differ with regard to the mass of each atom.✓ The mass will differ because of the number of neutrons in the nucleus,✓ e.g. $^{16}O_8$✓ and $^{17}O_8$.✓ (5)

1.3 1.3.1 The energy levels of these elements are filled with electrons having no valence,✓✓ therefore they are chemically inactive or inert. (2)

1.3.2
- Helium (He)
- Neon (Ne)
- Argon (Ar)

(Any 1 × 1) (1)

1.4 Mg: 1 × 24 = 24✓
S: 1 × 32 = 32✓
O: 4 × 16 = 64✓
TOTAL = 120 amu✓ (4)

1.5
- Rocket fuel
- Gas for hydrogen welding flame
- Purify metals
- Convert animal and plant fats into margarine or lubricants
- Hydrogenation of hydrocarbon
- Create water
- Hydrogen gas can be used for metallic ore reduction
- Electrical generators use the gas as a rotor coolant

(Any 6 × 1) (6)

1.6 1.6.1 Potassium hydroxide
1.6.2 Sulphuric acid

(2 × 1) (2)
[25]

QUESTION 2: ENERGY AND FLUID FLOW

2.1 2.1.1 This is the mass of the liquid per unit volume thereof. More energy is needed to displace a fluid with a high density than a fluid with a low density during the same time lapse.✓ The higher the density of the fluid, the greater the loss of pressure in the pipe.✓ (2)

2.1.2 This is the property of a fluid that will resist flow.✓ The higher the fluid resistance against flow, the higher the viscosity of that fluid. A low viscosity will indicate a fluid that will flow easily.✓ (2)

2.2 Energy cannot be created nor destroyed but can be changed from one form to another. (3)

2.3 $P = V \times p \times g \times h$✓
$= 150 \times 1\,000 \times 9{,}81 \times 75/1$ sec✓
$= 110\,250\,000$ W✓
$= 110{,}3$ kW✓ (4)

2.4 $Q = A \times V$✓
$d = 4Q/3{,}142 \times 5 \times 3\,600$✓
$= 0{,}038$ m✓
$= 37{,}6$ mm✓ (4)

2.5 Electricity is generated from mechanical energy produced from water flow.✓ A hydroelectricity power station is normally built at the wall of a dam.✓ The water flows through a pipe system to a turbine pump✓ which turns a generator which produces the electricity.✓ Basically the water force, i.e. potential energy, is converted to kinetic energy✓ in the form of mechanical energy used to produce electricity.✓ (6)

2.6 Tidal force is the energy of water in motion,✓ which is utilised to generate electricity.✓ The energy of the water in motion due to tidal changes of the sea is used.✓ An important requirement is that the tidal height between high and low tide must be significant.✓ (4)

[25]

QUESTION 3: DISTILLATION AND FRACTIONATION

3.1 Fractionation is the separation✓ of mixture into various components✓, while distillation is the separation✓ of a mixture into an overhead and bottom product✓. (4)

3.2 The effective temperature gradient of a distillation tower will be determined by the heat balance and the composition of the feed.✓ The temperature gradient refers to the difference between the top and bottom temperature of the tower.✓ To produce (refine) the purist top and bottom product it is of great importance that:✓

- The maximum heat input through the reboiler apply✓
- The maximum reflux is maintained without over flowing of the tower✓ (5)

3.3 3.3.1
- Before the tower can be dismantled the packing material has to be removed
- Packing can break during installation, or due to thermal expansion.
- Not cost efficient for high liquid flow rates.
- Contact efficiencies are decreased when the liquid flow rate is too low.

(Any applicable 2 × 1) (2)

3.3.2
- Raschig (porcelain) rings
- Charcoal
- Grit
- Wood
- Woven gauge
- Ceramics
- Clay
- Metal
- Graphite

(Any applicable 2 × 1) (2)

3.4
- Cooling water in
- Condenser
- Cooling water out
- Backflow
- Accumulator
- Light liquid product
- Feed
- By-product
- Absorptive section
- Stripping section
- Heater
- Residue

(12)
[25]

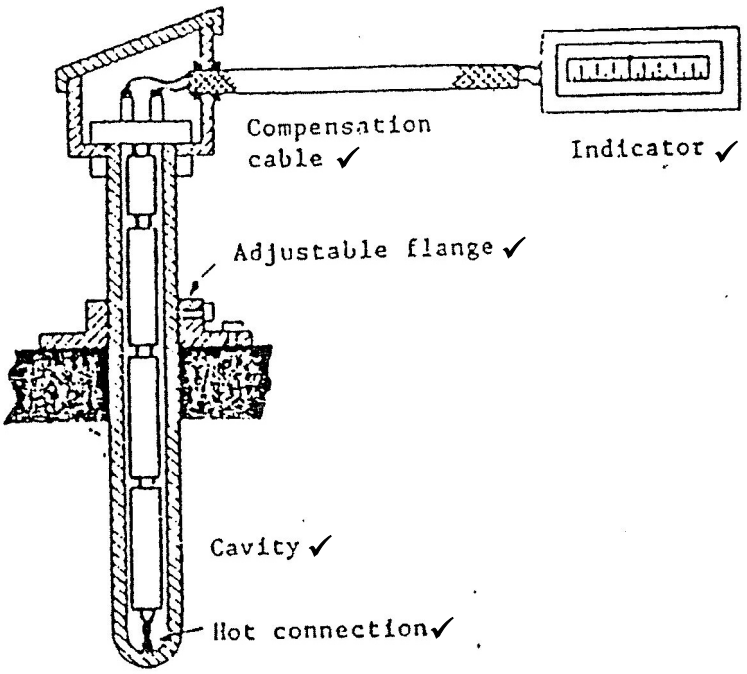
QUESTION 4: INSTRUMENTATION

4.1
4.1.1 True
4.1.2 False
4.1.3 False
4.1.4 False
4.1.5 True

(5 × 1) (5)

4.2
- Primary measuring element or sensory✓, e.g. pH electrode✓ or thermometer ball
- Transfer element✓, e.g. small tube or electrical wire ✓
- Indicating element✓, e.g. manometer or potentiometer✓ (3 × 2) (6)

4.3



Thermocouple

Conductor material: Iron,✓ copper✓ or rhodium (7)

4.4 P = p × g × h✓
= 13 600 × 9,81 × 0,915✓
= 122 075,64 Pa
= 122,08 kPa✓ (3)

4.5
- Bimetal thermometer
- Liquid-in-glass thermometer
- Pressure-type thermometer
- Thermocouple (4)

[25]

TOTAL: 100

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