higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

PLANT OPERATION THEORY N2

6 APRIL 2018

This marking guideline consists of 5 pages.

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QUESTION 1: CHEMISTRY

1.1 1.1.1 False
1.1.2 True
1.1.3 True
1.1.4 True
1.1.5 True

(5 × 1) (5)

1.2 1.2.1 Al = 3

1.2.2 Ar = 0

(2 × 2) (4)

1.3 1.3.1 Isomers are hydrocarbons having the same molecular formulae✓ but are different in structural formulae.✓

1.3.2 Di-olefines are molecules having more than one double bond✓ between carbon atoms.✓

(2 × 2) (4)

1.4
- Fuel for heating
- As a reducing agent it is used to extract nickel and other metals
- To produce organic acids
- Synthesis of hydrocarbons
- Manufacture of catalysts
- Manufacture of carbonyl (6 × 1) (6)

1.5 A metal removes hydrogen from an acid when it reacts.✓ For example, through a small portion of iron fillings in a flask.✓ Slowly, drop by drop, add diluted acid (H_2SO_4) on it; this catches the gas that forms by the downward displacement of the air.✓

Reaction: $Fe + H_2SO_4 \rightarrow FeSO_4 + H_{2(\text{ gas })}$ ✓✓✓

(Any other relevant answer is acceptable.) (6)
[25]

QUESTION 2: ENERGY AND FLUID FLOW

2.1 2.1.1 Pascal's law: When a pressure is applied to an enclosed liquid,✓ the pressure will be transferred proportionally✓ in all directions by the liquid.✓ (3)

2.1.2 One joule: It refers to work done✓ when one Newton is displaced one metre.✓ (2)

2.1.3 Internal energy: The amount of energy due to the temperature level✓ and the state it acquires and is measured in J/kg.✓ (2)

2.2
- Continuous flow
- Turbulent flow (2)

2.3 A ball with a specific mass is dropped✓ in a glass tube filled with liquid.
The time taken for the ball to reach the bottom✓ of the tube is measured.
This is then the viscosity of the liquid, in other words the longer the time taken the higher the viscosity.✓
Viscosity is measured in poise or stokes.✓ ✓ (5)

2.4 P = $\rho gh + P_{(atm)}$
= (1000 × 9,8 × 1,62) + 101 300 ✓✓
= 15876 + 101 300 ✓
= 117176 Pa
= 117,176 kPa ✓ (4)

2.5 Delivery pressure = $pg\ (h_1+h_2) \div 2$
= 998 x 9,8 x [(15-3)+15] ÷ 2 ✓✓
= 132 035,4 Pa ✓
= 132,04 kPa ✓ (4)

2.6 $\widehat{Q} = \frac{\pi\,(d)^2}{4} \times v$

$15 = \frac{\pi\,(0{,}19)^2}{4} \times v$ ✓

$v = \frac{4 \text{ x}15}{\pi\,(0{,}19)^2}$ ✓

= 528,83 m/min ✓
= 8,814 m/s ✓ (3)

[25]

QUESTION 3: DISTILLATION AND FRACTIONATION

3.1 The distillate removed from the condenser✓ flows into a level controlled accumulator part of the top of the tower and because its temperature is lower than the top plate✓, it will cool down the top plate and any heavy vapours✓ still left will be condensed and will flow downward with the product from each plate.✓ (4)

3.2 If the pressure on the liquid is increased,✓ the molecules of the vapour will move closer✓ to one another and it will condense more readily. Then evaporation takes place.
If the pressure decreases,✓ the reverse will happen with an increase in temperature; evaporation will increase✓ but condensation in the tray will decrease. (4)

3.3 3.3.1 Distillation tower (1)

3.3.2 A. Bi-product
B. Absorptive section
C. Stripping section
D. Heater
E. Feed
F. Light liquid product
G. Accumulator
H. Back flow
I. Cooling water out
J. Condenser
K. Cooling water in
L. Residue (12 × 1) (12)

3.4
- Overloading
- Poor control of column temperature
- Incorrect quantity of supply
- Incorrect supply/inlet position
- Variation/fluctuation of supply temperature
- Poor maintenance (Any 4 × 1) (4)

[25]

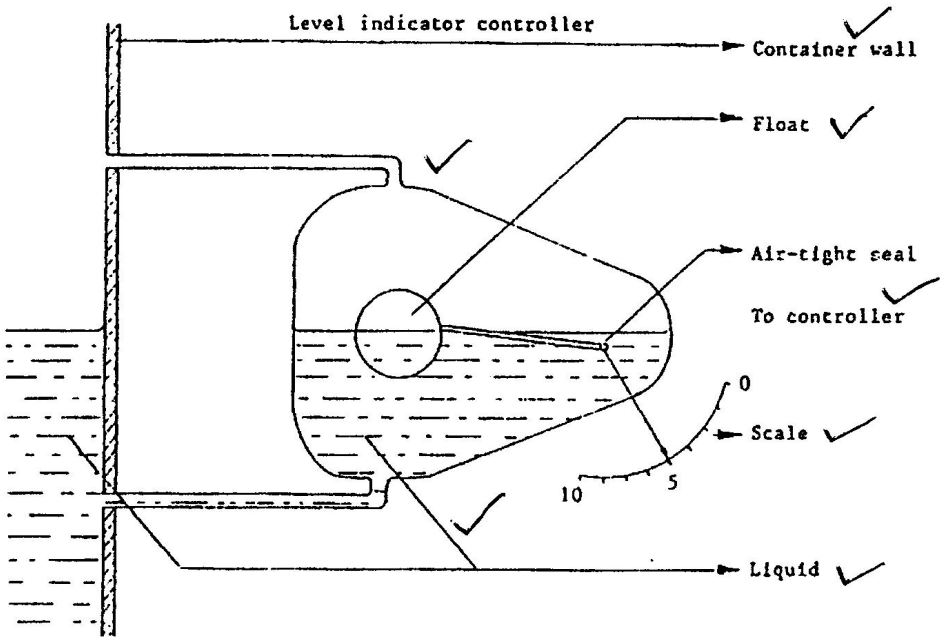
QUESTION 4: INSTRUMENTATION

4.1 Advantages
- As a result of the slanted shape which allows solids through more easily, the tube does not easily become blocked.✓
- No special provision has to be made.✓
- The pressure loss across the meter is less than the orifice plate.✓
- If accurately manufactured, it gives accurate readings.✓

Disadvantages

- As a result of its size and shape, it is more difficult to install than the orifice.✓
- Accurate machining is essential and the characteristics of each of the tubes have to be determined experimentally.✓ (7)
- The cost of the tube is higher than that of the orifice plate.✓ (7 × 1)

4.2



FLOAT LEVEL INDICATOR CONTROLLER (7)

4.3 4.3.1

A. Spigot
B. Screwed connection
C. Block
D. Shoulder screw
E. Connecting link
F. Adjustment screw
G. End piece
H. Bourdon tube

(8 × 1) (8)

4.3.2

- Pressure thermometer
- Liquid pressure thermometer
- Vapour pressure thermometer (3)

[25]

TOTAL: 100

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