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higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

CHEMICAL PLANT OPERATION N5

1 AUGUST 2018

This marking guideline consists of 5 pages.

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QUESTION 1

1.1 True
1.2 True
1.3 False
1.4 True
1.5 False

(5 × 1) **[5]**

QUESTION 2

2.1

Substance	Mass/mol	Mol	Mol%
Na_2SO_4	$\frac{18}{2(23)+32+4(16)}$	0,127✓	$\frac{0,127}{1.645}$ × 100 = 7,7%✓
NaOH	$\frac{36,5}{23+16+1}$	0,913✓	$\frac{0,913}{1,645}$ × 100 = 55,5%✓
Na_2CO_3	$\frac{22,5}{2(23)+12+3(16)}$	0,212✓	$\frac{0,212}{1,645}$ × 100 = 12,9%✓
NaCl	$\frac{23}{23+35,5}$	0,93✓	$\frac{0,393}{1,645}$ × 100 = 23,9%✓
Total		1,645✓✓	

(10)

2.2.1 The incoming dust-laden air receives a rotating motion on entrance to the cylinder.✓ The vortex so formed develops centrifugal force, which act to throw the particles radially towards the wall.✓ The path of the air in a cyclone follows a downward vortex or spiral adjacent to the wall and reaching to the bottom of the cone.✓ Particles then leave the cyclone at the bottom.✓ The air stream then moves upward in a tighter spiral, concentric with the first and leaves through the outlet pipe still whirling.✓ (5)

2.2.2 Two counteracting ribbons are mounted on the same shaft,✓ one moving slowly in one direction and the other quickly in the other direction,✓ mixing results from the turbulence induced by the agitators.✓ Solids are fed into one end of the trough and discharged from the other.✓ Some ribbon blenders operate batch wise while others mix continuously.✓ They are effective mixers for thin pastes and powders that do not flow readily. (5)

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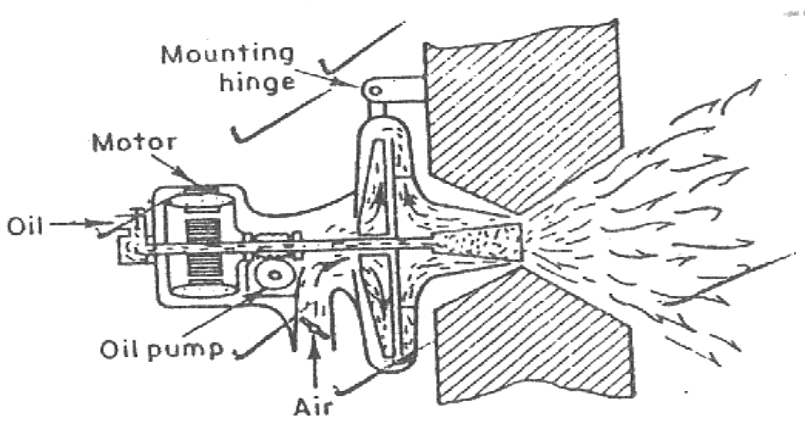
2.3



(1 mark for each correct labelling) (5)
[25]

QUESTION 3

3.1 C
3.2 H
3.3 A
3.4 B
3.5 F

(5 × 1) **[5]**

QUESTION 4

4.1 4.1.1

- Steam flows from the centre outwards or from the outside to the centre.
- Pressure drops in the nozzles.
- Velocity increases due to the pressure drop.
- Velocity decreases as kinetic energy is given to moving blades.

4.1.2

- The steam flow is parallel to the turbine axis.
- Total pressure drop takes place in one set of nozzles only.
- The steam enters the row of moving blades at a high velocity, which is directed at the moving blades.
- The steam transfers most of its velocity to the moving wheel.

(2 × 4) (8)

4.2 4.2.1 Weight fraction: $\frac{20}{(100+20)}$ ✓ ✓

= 0,167✓

∴% weight = 0.167 x 100

= 16,7%✓

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4.2.2 Moles of water = $\frac{100}{2(1)+16}$ = 5,56✓

Moles of salt = $\frac{20}{23+35,5}$ = 0,34✓

∴Mole fraction of salt = $\frac{0.34}{(5,56+0,34)}$✓

= 0,058✓ (2 × 4) (8)

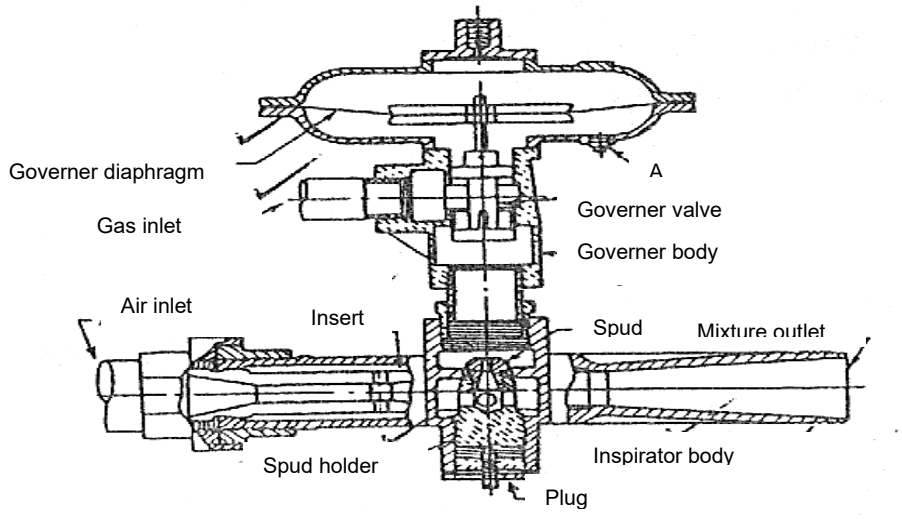
4.3 A short, wide bowl turns on a vertical axis. The bowl has a flat bottom and conical top. Feed enters from above through a stationary pipe set into the neck of the bowl.✓ Two liquid layers are formed as in a tubular centrifuge, which flow over adjustable dams into separate discharge spouts.✓ Inside the bowl and rotating with it are closely spaced disks which are actually cones of sheet metal set one above the other.✓ There are matching holes in the disks about halfway between the axis and the wall of the bowl from channels through which the liquid passes.✓ In operation feed liquid enters the bowl at the bottom, flows into the channels, and upward passes the disk.✓ Heavier liquid is thrown outward, displacing lighter liquid toward the centre of the bowl.✓ In its travel the heavy liquid very soon strikes the underside of a disk and flows beneath in to the periphery of the bowl without encountering any more light liquid.✓ Light liquid similarly flows inward and upward over the upper surfaces of the disks.✓ (8)

[24]

QUESTION 5

5.1
- It consists of a large construction.
- Costly heating and cooling apparatus are needed.
- Air under pressure must be pumped into the system to make up for leakages. (3)

5.2



(1mark for each correct labelling) (11)

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5.3 In this application heat from the flame continually converts liquid fuel✓ into vapour in the combustion air,✓ thus sustaining the flame.✓ This principle is used in blowtorches, kerosene lamps, cigarette lighters, et cetera✓ (4)

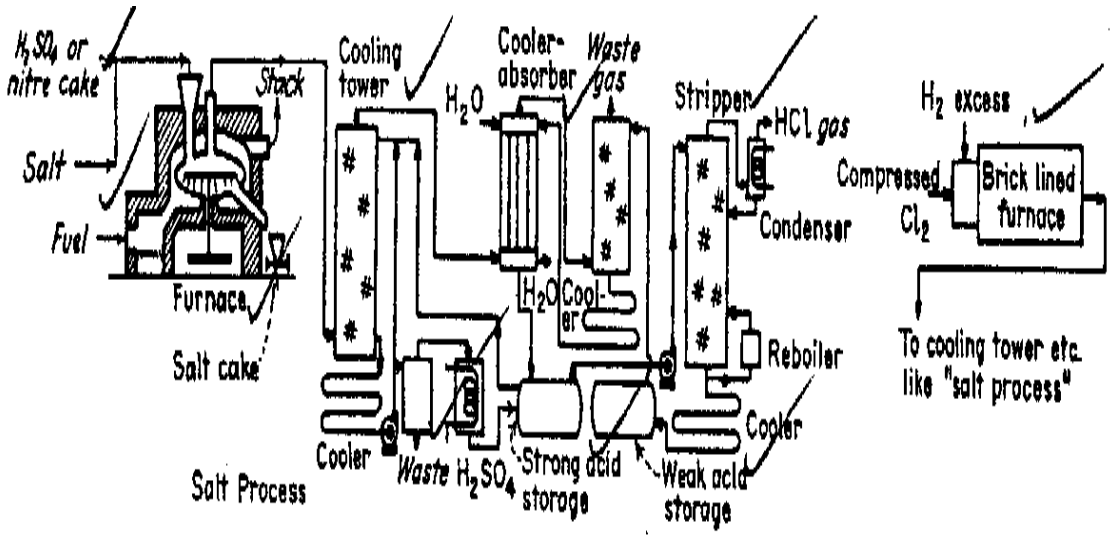
5.4
- Distillation of salt rock with sulphuric acid
- By lightning
- Burning of ammonia in air (3)

[21]

QUESTION 6

6.1
- A kneader handles suspensions, pastes and light plastic masses.
- A dispenser is heavier in construction and draws more power than a kneader, it makes additives and colour agents into stiff materials.
- A masticator draws even more power. It can disintegrate scrap rubber and compound the toughest plastic masses. (3 × 2) (6)

6.2
- Sulphuric acid and salt are roasted in a furnace to form hydrogen chloride and sodium sulphate.
- Passing it through coolers cooled externally by water, the hot hydrogen chloride is contaminated with droplets of sulphuric acid and particles of salt cake.
- The cooled gas is then passed through a coke tower to remove suspended foreign materials.
- Purified hydrogen chloride from the top of the coke tower is absorbed in water in a tantalum of carbide absorber.
- Finished hydrochloric acid is withdrawn from the bottom of the absorber. (5)



(9)

[20]

TOTAL: 100

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