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higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

CHEMICAL PLANT OPERATION N5

6 AUGUST 2019

This marking guideline consists of 6 pages.

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QUESTION 1

1.1 True
1.2 True
1.3 True
1.4 False
1.5 False

(5 × 1) **[5]**

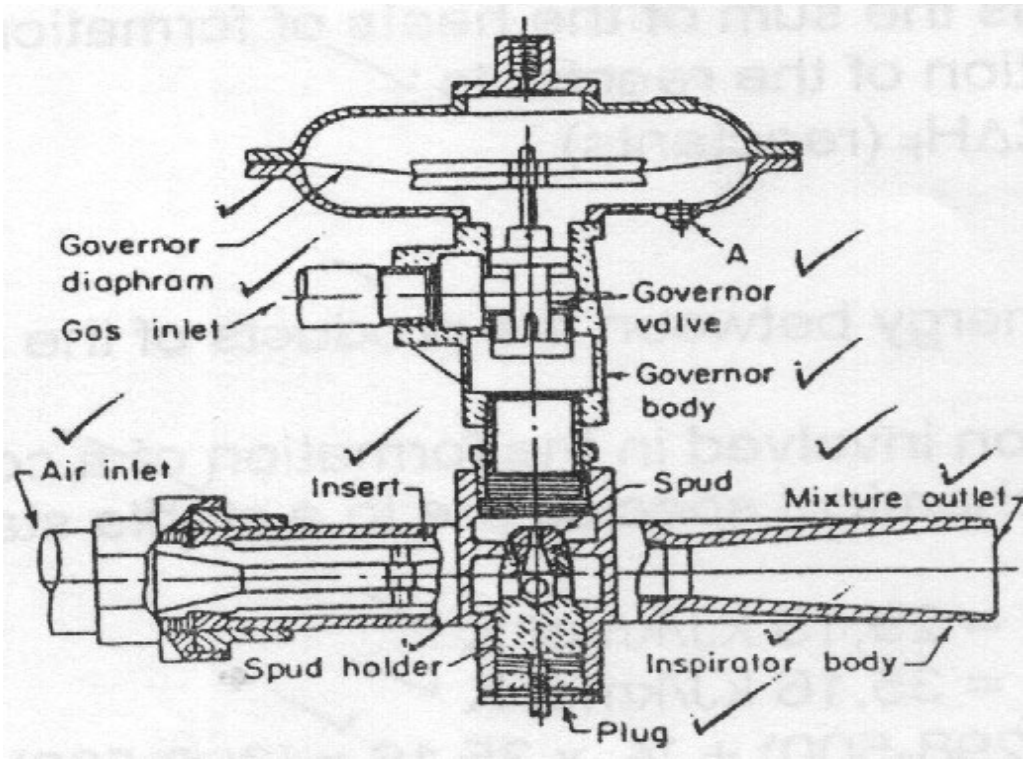
QUESTION 2

2.1

AXIAL-FLOW TURBINE	RADIAL-FLOW TURBINE
• The steam flow is parallel to the turbine axis.	• Steam flows from the centre outwards or from the outside to the centre.
• Total pressure drop takes place in one set of nozzles only.	• Pressure drop takes place in all the nozzles.
• Steam enters the row of moving blades at a high velocity and is directed in moving blades.	• Velocity of the steam increases due to pressure drop.
• It transfers most of its velocity to the moving wheel.	• Velocity decreases as kinetic energy is given off to move the blades.

(8)

2.2



(One mark for each correct label) (11 × 1) (11)
(One mark for correct sketch) (1)
[20]

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QUESTION 3

3.1 3.1.1

- The fuel spray from a nozzle under pressure atomises it with air or steam under pressure.
- Combustion air surrounds the fuel nozzle
- and it is blown into the furnace with the fuel spray.
- Vanes and baffles are built into the air stream to assure proper air-fuel mixing.
- Oil spray usually enters the furnace through an ignition tile which surrounds the burner.

3.1.2

- Open-circuit gas turbine plants are internal combustion engines of the rotary type in which oxygen for combustion of the fuel is supplied by the air entering from the atmosphere.
- This turbine operates on a continuous combustion cycle and the working agent flows through the plant at a steady rate.
- Air from the atmosphere is compressed in an axial-flow compressor and delivered to the combustion chamber into which fuel is injected through the burners or nozzle. Combustion is continuous.
- The flame is situated within the main casing of the combustion chamber.
- The secondary air flows between this tube and the outer casing of the combustion chamber and mixes with the product of the combustion to reduce the resultant gas temperature.

(2 × 5) (10)

3.2 3.2.1

Input = Output
= mass of A entering + mass of B entering✓
= 280 kg + 120 kg✓
= 400 kg✓
Output = 400 kg/min✓ (4)

3.2.2

Input of C_6 's = Amount of C_6 's in A + amount of C_6 's in B
= 280 × 0,65 + 120 × 0,55✓✓
= 182 + 66✓
= **248 kg✓**

Input of C_8 's = Amount of C_8 's in A + amount of C_8 's in B
= 280 × 0,35 + 120 × 0,45✓
= 98 + 54✓
= **152 kg✓**

Percentage composition of C_6 and C_8 in the product:

$\%C_6$ = 248/400 × 100 = 62%✓✓

$\%C_8$ = 152/400 × 100 = 38%✓✓

(11)
[25]

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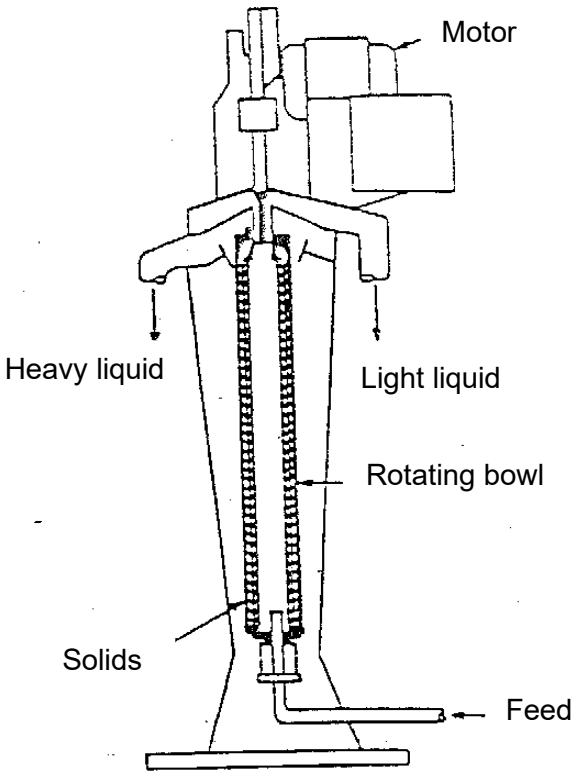
QUESTION 4

4.1



TUBULAR CENTRIFUGE

(One mark for each correct label) (6 × 1) (6)

- The bowl is tall and narrow and turns in a stationary casing at about 15 000 r/min.
- Feed enters from a stationary nozzle inserted through an opening in the bottom of the bowl.
- It divides into two concentric layers of liquid inside the bowl. The inner or lighter layer spills over a weir at the top of the bowl, which is thrown outward into a spout.
- Heavy liquid flows over another weir into a separate cover and discharges through a spout. (4)

4.2

- Mulling is a smearing, rubbing action similar to that in a mortar and pestle.
- In large-scale processing this action is performed by the wide, heavy wheels of a mixer.
- In this particular design of the Muller mixer, the pan is stationary and the central vertical shaft is driven.
- Causing the Muller wheels to roll in a circular path over a layer of solids on the pan floor.
- The rubbing action results from the slip of the wheels on the solids.
- Plows guide the solids under the Muller wheels onto an opening in the pan floor at the end of the cycle.
- When the mixer is being discharged. (7)

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4.3
- It is the heat of a reaction involved in the formation of a compound from its constituent elements
- when all chemical species are in a stable state
- at 25 °C and 1 atm. (3)

4.4
- Immiscible liquids are separated industrially in centrifugal decanters.
- Their operation is similar to that of the gravity decanters, except that the separating force is much larger than that of gravity
- and it acts in the direction away from the axis of rotation instead of downward towards the earth's surface.
- The main types of centrifugal decanters are tubular centrifuges
- and disk centrifuges. (5)

[25]

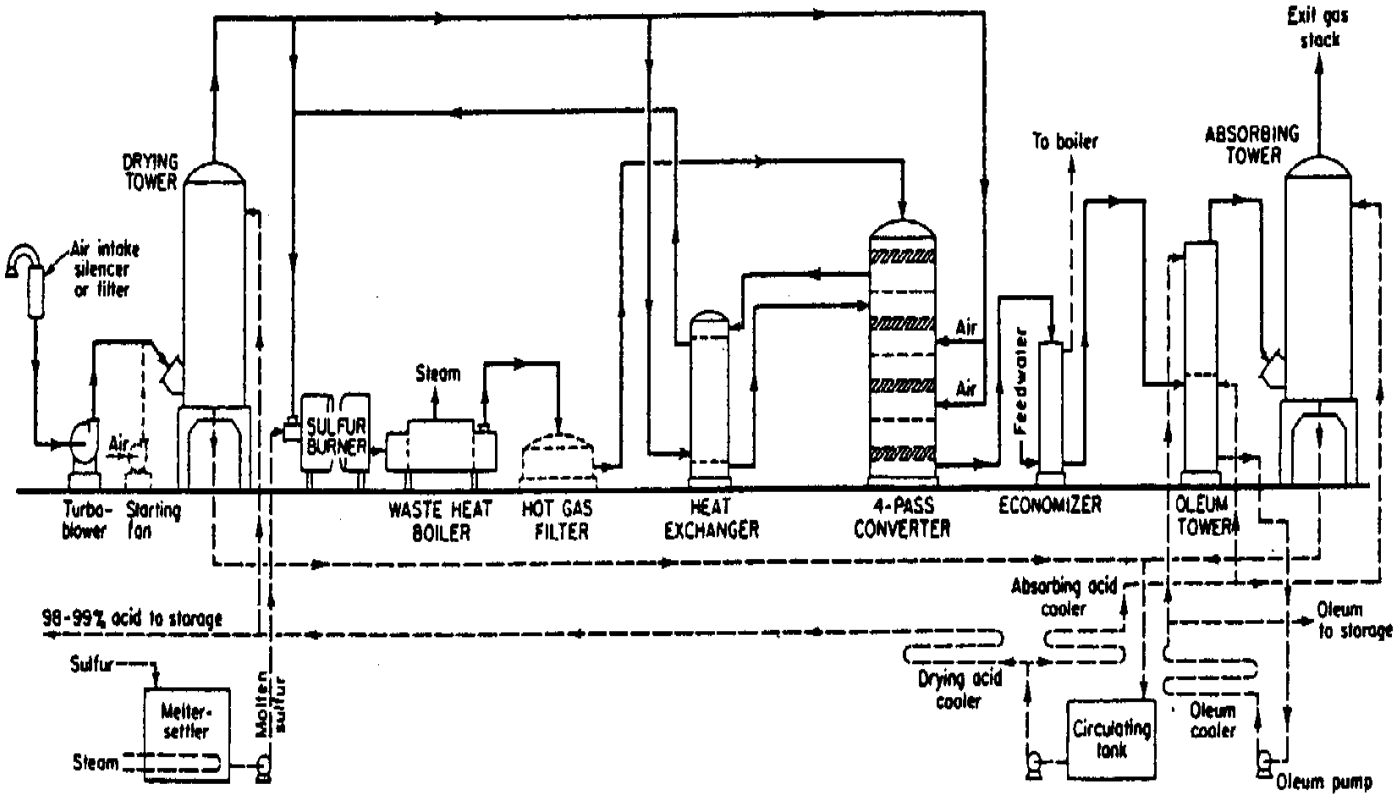
QUESTION 5

5.1 $S + O_2 \longrightarrow SO_2$

$SO_2 + {}^1/_2O_2 \longleftrightarrow SO_3$

$SO_3 + H_2O \longrightarrow H_2SO_4$ (3 × 2) (6)

5.2



(One mark each for any 12 correct labels) (12 × 1) (12)

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5.3
- Ammonia
- Air
- Water
- 10% rhodium-platinum catalyst gauze (4)

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

[25]

TOTAL: 100

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