higher education & training

Department:
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REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

CHEMICAL TECHNOLOGY N6

(15040106)

25 August 2019 (X-Paper)
09:00–12:00

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
CHEMICAL TECHNOLOGY N6
TIME: 3 HOURS
MARKS: 200

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. Sketches must be large, neat and fully labelled.
5. Keep the subsections of questions together.
6. Start each calculation with the formula and the substituted values.
7. Round off all final answers to THREE decimal places.
8. Write neatly and legibly.

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QUESTION 1

Give ONE term for each of the following descriptions. Write only the term next to the question number (1.1.1–1.1.5) in the ANSWER BOOK.

1.1 1.1.1 The amount of water that can be removed from wet solid under any given condition of air humidity and temperature

1.1.2 The formation of solid particles within a homogenous phase

1.1.3 When liquid changes from liquid state to a vapour state

1.1.4 Separation of the component of the liquid mixture by using partial vaporisation

1.1.5 The number of new particles produced in magma or mother liquor per unit time

(5 × 2) (10)

1.2 Write notes on the boiling point rise due to material. (10)

1.3 Complete the following paragraph by filling in the missing words. Write only the words next to the question number (1.3.1–1.3.10) in the ANSWER BOOK.

The wet material enters one end of the (1.3.1) … and (1.3.2) … may be forced into the other end. The (1.3.3) … lifts through the (1.3.4) … and permit it to drop through the hot gas, thus bringing about a rapid rate of drying. The (1.3.5) … exit end of the cylinder is slightly lower than the entrance end to permit the feed to move through the dryer by (1.3.6) … The movement of the feed is often aided by the presence of a stationary (1.3.7) … located inside the cylinder. The (1.3.8) … of the blades is set to force the solid material towards the exit. These blades also serve to keep (1.3.9) … from building up on the (1.3.10) … (10 × 1) (10)

1.4 Differentiate between *equilibrium moisture content* and *critical free moisture content*. (5)

1.5 Write down FOUR sequential stages in the evolution of crystals. (4)

1.6 Study the dryer in DIAGRAM 1 below and answer the questions.

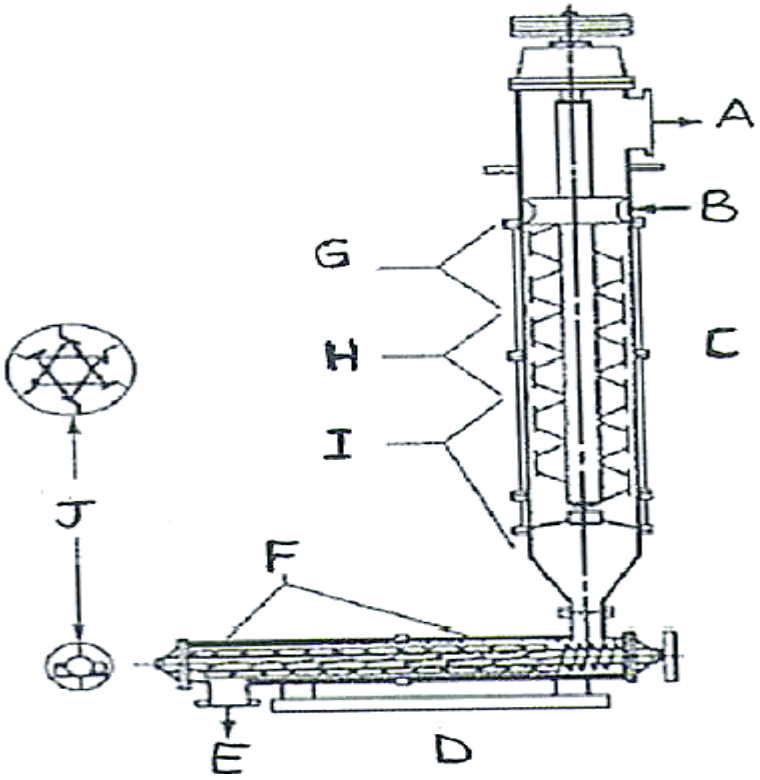


DIAGRAM 1

1.6.1 Name the dryer in DIAGRAM 1. (1)

1.6.2 Complete DIAGRAM 1 by filling in the labels. Write only the answer next to the letter (A–J) in the ANSWER BOOK. (10)
[50]

QUESTION 2

2.1 Write brief notes on each of the following:

2.1.1 Radiation (5)

2.1.2 Needle breeding (5)

2.2 Study DIAGRAM 2 below and answer the questions.

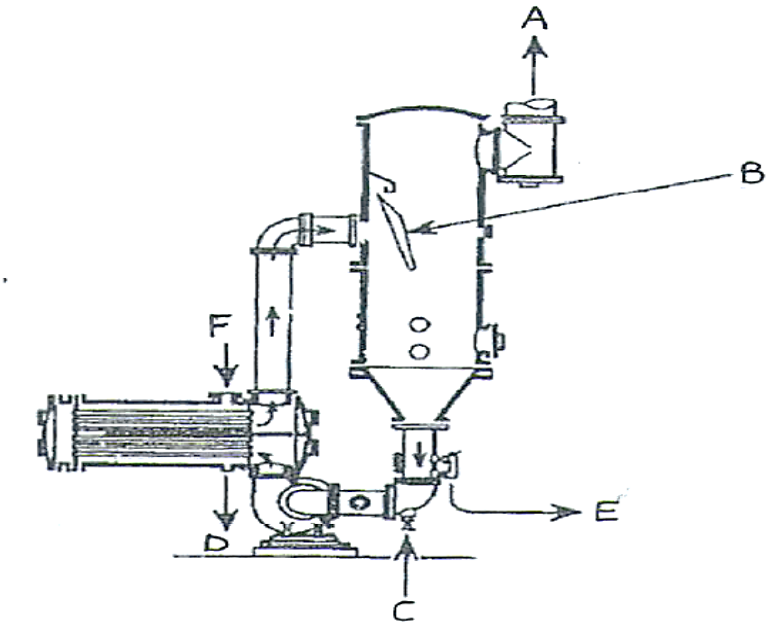


DIAGRAM 2

2.2.1 Name the evaporator in DIAGRAM 2. (1)

2.2.2 Complete DIAGRAM 2 by filling in the labels. Write only the answer next to the letter (A–F) in the ANSWER BOOK. (6)

2.2.3 Discuss the operation of the evaporator mentioned in QUESTION 2.2.2. (10)

2.2.4 State TWO disadvantages of this evaporator. (2)

2.2.5 Give THREE uses of this evaporator. (3)

2.3 Discuss THREE methods of preventing initial breeding. (3 × 2) (6)

2.4 In a chemical process plant, benzene is used as a solvent to vaporise nitrogen gas. The mixture has a temperature of 287 K, a pressure of 101,325 KPa and a relative humidity of 72%. The vapour pressure of benzene at 287 K is 13,2 KPa.

Given: The molecular weight of benzene and nitrogen is 79 g/mol and 28 g/mol respectively.

Determine the following:

2.4.1 Actual pressure of the mixture (3)

2.4.2 Humidity of the mixture (6)

2.5 List THREE types of long-tube vertical evaporators. (3)
[50]

QUESTION 3

3.1 Write notes on the boiling point rise due to hydrostatic head. (8)

3.2 Differentiate between *absorptivity* and *emissivity*. (6)

3.3 A long-tube vertical evaporator has three essential parts.

Indicate the main function of each of the following parts:

3.3.1 Tubular exchange

3.3.2 Separator or vapour space

3.3.3 Circulation unit

(3 × 2) (6)

3.4 Define each of the following terms:

3.4.1 Temperature difference driving force (6)

3.4.2 Apparent temperature difference (4)

3.4.3 Critical temperature difference (4)

3.5 List FIVE types of heat exchangers in the industry. (5)

3.6 Write brief notes on the Stefan-Boltzmann law. (5)

3.7 Write brief notes on the natural convection of gases. (6)
[50]

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QUESTION 4

4.1 Define the following terms:

4.1.1 Humidity

4.1.2 Humidity heat line

4.1.3 Adiabatic humidification line

4.1.4 Saturation volume

(4 × 3) (12)

4.2 Write brief notes on the enthalpy balance. (10)

4.3 Draw a diagram of each of the following cooling towers:

4.3.1 Wet tray tower (5)

4.3.2 Natural draft (4)

4.4 A mixture of air and water vapour contain 18 kg of water vapour for every 186 kg of dry air. The temperature of the mixture is 93,5 °C and the total pressure is 101,3 KPa.

Given: $H_a = \frac{18\,P_a}{29\,(P - P_a)}$, $H_s = \frac{18\,P_s}{29\,(P - P_s)}$, $H_p = H_R \cdot \frac{(P - P_s)}{(P - P_a)} \times 100$

$H_R = \frac{P_a}{P_s} \times 100$

Calculate each of the following:

4.4.1 H_a of the mixture (3)

4.4.2 The actual vapour pressure of the water in dry air (4)

4.4.3 H_s of the mixture (6)

4.4.4 The percentage humidity of the dry air (3)

4.4.5 The relative humidity of the dry air (3)

[50]

TOTAL: 200

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