Choose the Correct Answer from the Multiple Choices (A, B, C & D)

1. Falling rate drying occurs if:
   (A) Initial moisture content is less than critical moisture content
   (B) Final moisture content is greater than critical moisture content
   (C) E.M.C. is greater than critical moisture content
   (D) Moisture content is continuously falling during drying

2. Rate of drying is influenced by:
   (A) Air temperature   (B) Air Humidity
   (C) Air Velocity   (D) All the above

3. The moisture commonly removed in drying is:
   (A) Total moisture   (B) Equilibrium moisture
   (C) Free moisture   (D) Bound moisture

4. Deep bed drying is characterized by:
   (A) Ambient temperature drying
   (B) Uniform drying rate
   (C) Underground drying structure
   (D) Significant moisture and temperature gradients in bed

5. Page's model is used to describe:
   (A) Deep bed drying   (B) Thin layer drying
   (C) Continuous drying   (D) Fluidized bed drying

6. The cutoff moisture content between constant rate and falling rate of drying is called:
   (A) Equilibrium moisture content   (B) Critical moisture content
   (C) Entropic moisture content   (D) Cut-off moisture content

7. Advantages of fluidized bed drying are:
   (A) Complete removal of moisture
   (B) Can be used for dense and heavy products
   (C) Fast and uniform drying
   (D) Simple and can be done even by unskilled labor

8. In convection drying of agricultural materials, rate of drying can be controlled by:
   (A) Air velocity   (B) Air Temperature
   (C) Humidity   (D) All the above

9. In freeze drying, the point at which all the three phases of water (solid ice, liquid water and water vapor) coexist at equilibrium is called:
   (A) Equilibrium moisture content   (B) Equilibrium phase
   (C) Triple point   (D) Dew point

10. A large part of droplets in a spray dryer can be expected to have the size of:
    (A) 5 microns   (B) 40 microns
    (C) 80 microns   (D) 200 microns

11. The drying process of grain can be represented on a psychrometric chart by:
    (A) Constant entropy line   (B) Constant humidity line
    (C) Constant pressure line   (D) Constant enthalpy line

12. The critical moisture content of agricultural produce is:
    (A) Equivalent to initial moisture content
    (B) Equivalent to final moisture content
    (C) In between constant and falling rate periods of drying
    (D) None of the above

13. In sack drying maximum air temperature should be used:
    (A) 48.3°C   (B) 45.3°C   (C) 41.3°C   (D) 43.3°C

14. In foam mat drying, foaming agent help to:
    (A) Decrease surface area
    (B) Increase surface area
    (C) Neither increase nor decrease surface area
    (D) Stabilizes

15. The temperature of milk droplets in spray drying is kept at:
    (A) 49–54°C   (B) 54–60°C   (C) 60–65°C   (D) 65–70°C

16. Recommended maximum grain drying temperature for production of seed is:
    (A) 50°C   (B) 43°C   (C) 45°C   (D) 40°C

17. One kg of water can be evaporated from grains by heat (approximately) is:
    (A) 500 kcal   (B) 550 kcal   (C) 600 kcal   (D) 650 kcal

18. Floor area required to dry one tonne of grains under sun is:
    (A) 5 m^2 (B) 10 m^2 (C) 15 m^2 (D) 20m^2

19. In freeze drying the liquid phase occurs at the pressure above:
    (A) 4.7mm   (B) 3.7 mm   (C) 2.7mm   (D) 1.7mm

20. High moisture paddy should be dried within the definite hours of harvesting given as:
    (A) 30 hours   (B) 40 hours   (C) 48hours   (D) 72 hours

21. As the tea moves down the drying chamber of regulated dryer the wet temperature should remain constant at:
    (A) 37.7°C   (B) 38.7°C   (C) 34.7°C   (D) 47.7°C

22. The moisture content at which the drying rate of a product change from a constant rate to a falling rate is:
    (A) Equilibrium moisture content   (B) Critical moisture content
    (C) Moisture concentration difference   (D) Drying rate

23. As the capacity of dryer is decreased which type of operation is cheaper when capital cost becomes significant?

    (A) Continuous type   (B) Batch type
    (C) Semi-continuous type   (D) All the above

24. The infrared heating of foods for drying is accomplished by absorption of thermal spectrum of electromagnetic radiation of:

    (A) 0.75–100 μm   (B) 100–1000 μm   (C) 5–500 nm   (D) None of these

25. In presence of suspended particles in juices, the suitable atomizer to be used in spray dryer is:

    (A) Pressure nozzle atomizer   (B) Rotary wheel atomizer
    (C) Pneumatic two – fluid nozzle   (D) None of these

26. Explosion puffing is a process of:

    (A) Drying   (B) Extrusion   (C) Size reduction   (D) All the above

27. Rancidity will develop earliest in the fat containing products prepared by:

    (A) Spray drying   (B) Freeze drying   (C) Fluid bed drying (D) Tray drying

28. The product quality is poorer in which type of dryer under same operating conditions:

    (A) Fluid bed dryer (B) Spray dryer   (C) Tray dryer   (D) Freeze dryer

29. The point at which dried products just become lumpy is known as:

    (A) Critical point (B) Saturated point (C) Danger point   (D) Safety point

30. Sublimation is associated with:

    (A) Vacuum drying   (B) Spray drying   (C) Flash drying   (D) Freeze drying

31. The heating of infrared drying in comparison to convection drying is higher by:

    (A) 10 times   (B) 12 times   (C) 14 times   (D) 16 times

32. LSU dryer is:

    (A) Cross flow dryer   (B) Counter current flow dryer
    (C) Co-current flow dryer   (D) Continuous flow mixing type flow drier

33. When drying air is flowing parallel with the surface of the drying solid, and the mass velocity is 4 kg/s-m^2, the heat transfer coefficient for constant rate drying is:

    (A) 43.36 W/m^2 K   (B) 433.6 W/m^2 K   (C) 0.04 W/m^2 K   (D) 0.4 W/m^2 K

34. The removal of water from a food material by sublimation from the frozen state to the vapor state is known as:

    (A) Cryogenic freezing   (B) Freeze concentration
    (C) Freeze drying   (D) Heat pump drying

35. In spray drier particles are separated by:

    (A) Cyclone   (B) Hydro cyclone
    (C) Centrifuge   (D) None of these

36. In drying of food materials in a mechanical dryer_____ is taking place:
 (A) Forced convection
 (B) Natural convection
 (C) Radiation
 (D) Conduction

37. Constant rate of drying is directly proportional to:
 (A) Wet bulb temperature
 (B) Latent heat of vaporization
 (C) Convective heat transfer coefficient
 (D) None of the above

38. Thin layer drying equation is given by:

 (A) $\dfrac{M - M_e}{M_0 - M_e} = e^{-k\theta}$

 (B) $\dfrac{M - M_0}{M_e - M_0} = e^{-k\theta}$

 (C) $\dfrac{M_e - M}{M_0 - M_e} = e^{k\theta}$

 (D) $\dfrac{M_e - M_0}{M - M_e} = e^{k\theta}$ *(ASRB)*

39. In thin layer drying, generally thickness of grain bed is taken as:
 (A) Above 20 cm
 (B) Upto 20 cm
 (C) 20 cm only
 (D) None of the above   *(ASRB)*

40. Milk powder is prepared by drying the milk in:
 (A) Vacuum dryer
 (B) Spray dryer
 (C) Tray dryer
 (D) Fluidized bed dryer   *(ASRB)*

41. Freeze drying time is directly proportional to the:
 (A) Thickness of material being drying
 (B) Square of the thickness of material being drying
 (C) Cube of the thickness of material being drying
 (D) Fourth power of the thickness of material being drying   *(ASRB)*

42. During dehydration of vegetables, the temperature of dehydration should be:
 (A) 40 to 50°C
 (B) 60 to 70°C
 (C) 80 to 90°C
 (D) 100 to 115°C   *(ASRB)*

43. The draft in a furnace is mainly dependent on:
 (A) The thickness of the bed
 (B) The nature and size of the fuel
 (C) The rate of combustion of the fuel
 (D) All the above   *(ASRB)*

44. Drying of foams can be rapid at atmospheric pressure at a reduced temperature because foaming creates enormous _____ for quick moisture removal:
 (A) Surface area
 (B) Volume
 (C) Mass
 (D) Specific surface area   *(ASRB)*

45. Potato flakes (moisture content 75% wb) are being dried in a concurrent flow drier. It was found that 70% of original water has been removed in a dryer. The moisture content in dried potatoes flakes on db will be:
 (A) 90%
 (B) 95%
 (C) 80%
 (D) None of the above   *(ASRB)*

46. A liquid food having 80% moisture content and 1030 kg/m³ density is to be concentrated to 80% solids in a single drum dryer of 0.6 m diameter and 0.75 m width. The food is preheated to 90°C and operating temperature is 150°C, the material is scraped after ¾ revolutions and the layer of food is observed to be 0.5 mm. If the overall heat transfer coefficient is 1250 W/m²-K and the latent heat of vaporization is 2250 kJ/kg, the mass of water evaporated will be:

   (A) 0.041 kg   (B) 4.1 kg

   (C) 0.41 kg   (D) None of the above   *(ASRB)*

47 Atmospheric air at 30°C room temperature is heated to 160°C for drying 100 kg milk containing 80% water at the room temperature in a spray dryer to moisture content of 4%. The temperature of the milk powder and the outlet air are respectively 55 and 95°C. If specific heat of milk, specific heat of air and latent heat of vaporization are respectively 0.93 kcal/kg °C, 0.23 kcal/kg °C and 545 kcal/kg, the water removed in drying process will be:

   (A) 79.71 kg   (B) 79.17 kg

   (C) 7.971 kg   (D) None of the above   *(ASRB)*

48. A wet material is dried inside a tray using air at 65°C (db) and 50°C (wb). If the heat transfer coefficient on the surface of material is 10 W/m²-K and the latent heat of vaporization of water at 65°C and 50°C are respectively 2346 and 2406 kJ/kg, respectively, the rate of drying (in kg water removed per square meter of the exposed surface) per hour will be:

   (A) 0.25 kg of water/h   (B) 2.245 kg of water/h

   (C) 22.45 kg of water/h   (D) 0.2245 kg of water/h

   (ASRB)

49. Type of moisture that can be removed by common drying techniques is:

   (A) Free moisture   (B) Bound moisture

   (C) Total moisture   (D) Equilibrium moisture

50. Microwave oven as dryer is an example of:

   (A) Vacuum drying   (B) Dielectric drying

   (C) Radiation drying   (D) Freeze drying

51. LSU type dryer was developed in:

   (A) India   (B) England   (C) USA   (D) Canada

52. The wavelength of 0.76 to 400 μm radiation is known as:

   (A) Infrared radiation   (B) x-rays

   (C) γ-rays   (D) None of the above

53. The capacity of thermal dryer depends upon:

   (A) Rate of heat transfer   (B) Rate of mass transfer

   (C) Rate of heat and mass transfer   (D) None of the above

54. Critical moisture content varies with:

   (A) Thickness of the material   (B) Rate of drying

   (C) Thickness of material and rate of drying (D) None of the above

55. The wavelength of electromagnetic radiation for drying of food lies between:
(A) 0.76 to 400 μm (B) 0.76 to 100 μm (C) 100 to 500 μm (D) 500 to 1000 μm

56. The recommended air flow rate (m^3/min-ton) in a deep bed dryer is:
(A) 1–2 (B) 2–2.5 (C) 2.9–3.9 (D) 4.2–5.2

57. In a deep layer drying system if heated air at temperatures 45°C is employed, each layer thickness recommended is:
(A) 0.45 m or less (B) 0.5 m to 1.0 m (C) 1.0 m to 1.25 m (D) 1.25 m to 1.5 m

58. Natural air drying needs dehumidification if the atmospheric humidity is:
(A) Low (B) Intermediate (C) High (D) Very high

59. The cost of mechanical drying per unit of grain as compared to sun drying is relatively:
(A) Higher (B) Lower (C) Optimum (D) No change

60. The net perforated drying area of deep bed dryer of the total floor area should be:
(A) 5% (B) 10% (C) 15% (D) 20%

61. Deep bed drying theory is given by:
(A) Henderson (B) Becker-Arkema (C) Hukill (D) Newton

62. The ratio of steam consumption to water evaporation in drum drying is:
(A) 0.4 to 0.8 (B) 0.8 to 1.2 (C) 1.2 to 1.6 (D) 1.6 to 2.0

63. The temperature of milk droplets in spray drying is kept at:
(A) 49–54°C (B) 54–60°C (C) 60–65°C (D) 65–70°C

64. Spray dried milk has the moisture content in the range of:
(A) 1.5–2.5% (B) 2.0–3.5% (C) 3.5–5.0% (D) 5.0–6.0%

65. How much space the milk powder takes up as compared to milk?
(A) One fifth (B) One sixth (C) One seventh (D) One eighth

66. A two fluid nozzle is used in a:
(A) Spray dryer
(B) Falling film evaporator
(C) Drum dryer
(D) Tray dryer (GATE 1987)

67. Constant rate of drying is directly proportional to:
(A) Convective heat transfer coefficient (B) Latent heat of vaporization
(C) Wet bulb temperature (D) None of the above (GATE 1998)

68. Freeze drying time is directly proportional to the _____ of the material being dried:
(A) Thickness (B) Square of the thickness
(C) Cube of thickness (D) Fourth power of thickness (GATE 1998)

69. The drier most suitable for cereal grain is:
(A) Tunnel drier (B) Rotary drier
(C) Tray drier (D) Drum drier

70. The evaporation rate in a drum dryer is 50 kg/h. The heat transfer area is 1 m^2. The steam temperature is 152°C and vaporization point of moisture is 102°C. Latent heat of vaporization is 2250 kJ/kg. The overall heat transfer coefficient (kJ/h-m^2-°C) is:

    (A) 2250   (B) 2500   (C) 1500   (D) 2000

71. If the moisture content of the grain is above 18%, the layer depth of grain in deep bed dryer should be limited to:

    (A) 1.5 m   (B) 2.5 m   (C) 3.5 m   (D) 4.5 m

72. In freeze drying process, the drying time required to reduce moisture from initial to final level depends upon:

    (A) Thermal conductivity of the dried part of the food material
    (B) Thickness of the food material
    (C) Latent heat of sublimation
    (D) Temperature of heating surface

73. The amount of power absorbed (rate of heating) by a food during microwave heating will depend upon:

    (A) Frequency of radiation   (B) Dielectric loss factor
    (C) Electric field strength   (D) All the above

74. Type of moisture that can be removed by common drying techniques is:

    (A) Equilibrium moisture   (B) Free moisture
    (C) Total moisture   (D) Bound moisture   *(GATE 1991)*

75. The difference between the values of initial and equilibrium moisture content of a food is known as:

    (A) Unbound moisture content   (B) Bound moisture content
    (C) Free moisture content   (D) Critical moisture content *(GATE 1997)*

76. LSU dryer is basically a:

    (A) Co-current flow dryer   (B) Counter current flow dryer
    (C) Cross-flow batch dryer   (D) Through-flow batch dryer *(GATE 1997)*

77. Drying of fruit pulp can be accomplished by a:

    (A) Tray dryer   (B) Fluidized bed dryer
    (C) Drum dryer   (D) Spray dryer   *(GATE 1997)*

78. Under falling rate period the drying rate is proportional to the difference between:

    (A) Critical and equilibrium moisture content
    (B) Initial and equilibrium moisture content
    (C) Initial and critical moisture content
    (D) Moisture content below critical and equilibrium moisture content   *(GATE 2001)*

79. Constant rate of drying of agricultural produce is independent of:
    (A) Air velocity   (B) Thickness of bed
    (C) Air humidity   (D) Air temperature   (GATE 2002)

80. In drying, free moisture content of grain is defined as the difference between:
    (A) Initial moisture content and final moisture content
    (B) Initial moisture content and equilibrium moisture content
    (C) Initial moisture content and critical moisture content
    (D) Critical moisture content and equilibrium moisture content   (GATE 2003)

81. A bed of grain has height H (m), cross-sectional area A (m^2), porosity ε (fraction) and
    particle density ρ_p (kg m^{-3}). The grains are to be dried by heated air at temperature T (°C)
    under fluidized condition. The air pressure P (Pa) needed for the onset of fluidization of the
    bed will depend on:
    (A) H, A, ε, ρ_p and T   (B) H, ρ_p and T
    (C) H, A, ε and ρ_p (D) H, ε, ρ_p and T   (GATE 2003)

Q. 82. is multiple selection type with multiple choices. Choose one right combination from the
       alternatives A, B, C and D.

82. The internal moisture movement mechanisms during drying in food grains cannot be due
    to:
    P   capillary flow
    Q   gravitational flow
    R   liquid water diffusion
    S   water vapor diffusion
    (A) P, Q   (B) Q, R
    (C) R, S   (D) P, S   (GATE 2004)

83. Fresh carrot cubes weighing 10 kg-f at an initial moisture content of 82 per cent (wet basis)
    is dried during constant rate drying period to 60 per cent (wet basis) moisture content.
    If the exposed surface area of carrot cubes is 3 m^2 and the constant drying rate is 2.53 kg
    H_2O m^{-2} h^{-1}, the time taken for drying is:
    (A) 5 s   (B) 3 min
    (C) 17 min   (D) 43 min   (GATE 2004)

Data for Q. 84-85 are Given Below. Solve the Problems and Choose the Correct Answers.

Atmospheric air at 30° C and 0.02 kg H_2O (kg dry air) $^{-1}$ is heated to 60° C in an indirect heat
exchanger using flue gases from husk fired furnace. The hot air enters the grain dryer of 1 tonne h^{-1}
capacity at the rate of 0.8 m^3 s^{-1}. The exhaust air from the dryer has a temperature of 40° C
and an absolute humidity of 0.04 kg H_2O (kg dry air)$^{-1}$. The humid volume of air at 40° C is
0.945 m^3 (kg dry air)$^{-1}$. The specific heat of air is 1.006 kJ kg^{-1} K^{-1}. The calorific value of husk is
12546 kJ kg^{-1} and the combined efficiency of the furnace and the heat exchange system is
30 per cent.   (GATE 2004)

84. The rate of moisture removal from the grain during drying is:

    (A) 0.907 kg min^{-1} (B) 1.016 kg min^{-1}

    (C) 1.814 kg min^{-1} (D) 2.032 kg min^{-1}

85. The husk consumption rate for the furnace is:

    (A) 2.2 kg h^{-1} (B) 4.9 kg h^{-1}

    (C) 24.5 kg h^{-1} (D) 48.9 kg h^{-1}

86. One hundred kg vegetable is dried in a dryer where 20 kg moisture is lost. 5 g of the dried product, when kept in an oven at 105°C for 24 h, gives 3.56 g dry matter. The moisture contents of vegetables before drying (x_i) and after drying (x_f) are:

    (A) x_i = 75.56% (db); x_f = 40.44% (db)   (B) x_i = 75.56% (db); x_f = 28.80% (db)

    (C) x_i = 43.04% (db); x_f = 28.80% (db)   (D) x_i = 43.04% (wb); x_f = 40.44% (wb)

                                                                              (GATE 2006)

87. A wet food is dried inside a tray dryer by allowing heated air to flow over the food surface at 3 m/s air velocity. Air having 14.2% relative humidity and 65°C dry bulb, 32.6°C wet bulb and 23.3°C dew point temperatures is used for the drying. The corresponding saturation vapor pressures of water at these temperatures are 26004 Pa, 5043.4 Pa and 2908.2 Pa. The vapor pressure driving force (Pa) for the transfer of moisture from the food surface to air will be:

    (A) 1350.8   (B) 2135.0

    (C) 20960.6   (D) 23095.8   (GATE 2006)

88. A heater is placed in front of a continuous countercurrent dryer. Air at 40°C and 70% RH is fed into the heater from which the air exits at 65°C. If saturation vapor pressure at 40°C and 65°C are 0.074 bar and 0.250 bar respectively, then relative humidity of the air coming out of the heater and entering the dryer is:

    (A) 21%   (B) 27%

    (C) 32%   (D) 38%   (GATE 2007)

89. The rate of moisture transfer from centre to the surface is influenced by:

    (A) Temperature
    (B) Physical structure and chemical composition
    (C) Seed coat permeability
    (D) All the above

90. During drying of seeds in bin, three zones present in the bin from bottom are in the following order:

    (A) Dried – drying – wet   (B) Drying – dried – wet
    (C) Wet – drying – dried   (D) Dried – wet – drying

91. LSU dryer was developed at:

    (A) Punjab Agricultural University, Ludhiana
    (B) Lousiana State University, USA
    (C) London State University
    (D) Indian Institute of Sugarcane Research, Lucknow

Natural air drying is recommended if the RH is below:

(A) 60% (B) 70% (C) 80% (D) 90%

If the moisture content of the grain is upto 18%, the layer depth of grain in deep bed dryer should limited to:

(A) 3 m (B) 4 m (C) 5 m (D) 6 m

The recommended air temperature in °C for batch or bin dryer is:

(A) 30 to 40 (B) 45 to 55 (C) 60 to 70 (D) 75 to 85

The relationship between EMC and RH for biological materials has been given by:

(A) Perry (B) Rankine (C) Henderson (D) Janssen

The EMC gives an idea about:

(A) Initial moisture content of the material

(B) Final moisture content of the material

(C) Critical moisture content of the material

(D) Whether the material will loose or gain the moisture at particular atmospheric conditions

Falling rate drying occurs if _____ than critical MC:

(A) Initial MC is less (B) Final MC is greater

(C) Equilibrium MC is more (D) Bound moisture is more

The moisture content at which drying rate ceases to be constant is called:

(A) EMC (B) CMC

(C) DMC (D) Safe MC

The drying time in constant rate period is _____ wet bulb depression:

(A) Directly proportional to (B) Inversely proportional to

(C) Not affected by (D) None of the above

In constant rate drying, the surface of food material is at _____ of the drying air:

(A) Dry bulb temperature (B) Wet bulb temperature

(C) Dew bulb temperature (D) Lower temperature than wet bulb

In an experiment on drying, an amount of 25 gram of moisture was removed from the product during 10 minute time interval. The initial moisture of 1 kg product is 30% (db). Drying rate in gram of water per minute per 100 gram of bone dry material will be:

(A) 0.300 (B) 0.375

(C) 0.357 (D) 0.400

Which of the following uses conduction heat transfer to provide energy for vaporization of water?

(A) Tray dryer (B) Tunnel dryer

(C) Drum dryer (D) Belt dryer

Data for Q. 103 to 105 are given below. Solve the problems and choose the correct answer

One tonne of grain with 25% (wb) moisture content is to be dried to 15% (db) moisture content:

103. The weight of bone dry product will be:
    (A) 750 kg   (B) 75 kg   (C) 250 kg   (D) 25 kg

104. The weight of water evaporated will be:
    (A) 112.5 kg   (B) 122.5 kg   (C) 132.5 kg   (D) 137.5 kg

105. The weight of final dried product will be:
    (A) 887.5 kg   (B) 862.5 kg   (C) 867.5 kg   (D) 877.5 kg

106. Following information about drum dryer is given:
    Steam temperature = 150°C
    Vaporization temperature of milk = 102°C
    Overall heat transfer coefficient = 5000 kJ/h-m^2-°C
    Latent heat of vaporization = 2250 kJ/kg
    Heat transfer area = 1.5 m^2
    The evaporation rate (kg/h) in drum dryer is about:
    (A) 150   (B) 160   (C) 200   (D) 180

107. Drum dryers are used for drying of:
    (A) Granules   (B) Pieces   (C) Whole fruits   (D) Purees and liquids

108. Fruits and vegetables are preferably dried in a:
    (A) Spray drier   (B) Fluidized bed drier
    (C) Freeze drier   (D) Cabinet drier

109. Absolute pressure inside the drying chamber must be maintained at a minimum of 620 Pa in a:
    (A) Belt dryer   (B) Spray dryer   (C) Drum dryer   (D) Freeze dryer

110. A popular technique involving atomization, for producing dried powder from liquid products is:
    (A) Drum drying   (B) Fluidized bed drying
    (C) Belt drying   (D) Spray drying

111. Fruits and vegetables are generally dried in:
    (A) Tray drier   (B) Bin drier   (C) Rotary drier   (D) Spray drier

112. For drying painted surfaces of machinery and in timber processing, type of dryers used are:
    (A) Radiation dryers   (B) Tray dryers
    (C) Spray dryers   (D) Vacuum dryers

113. The recommended temperature for drying of grain for seed purpose is:
   (A) 45°C   (B) 60°C   (C) 90°C   (D) 100°C

114. Drying is a process of:
   (A) Heat transfer
   (C) Heat & mass transfer
   (B) Mass transfer
   (D) None of the above

115. Major portion of drying of food grains takes place in:
   (A) Constant rate period
   (C) Increasing rate period
   (B) Falling rate period
   (D) None of the above

116. The dryer commonly used for liquids foods is:
   (A) Bin dryer   (B) Spray dryer   (C) Freeze dryer   (D) Tray dryer

117. The drying process is considerably accelerated on irradiating grain by infrared rays and simultaneously:
   (A) Heating air   (B) Cooling air   (C) Drying air   (D) Blowing air

118. Natural air flow takes place in dryer based on the variation of:
   (A) Volume of air   (B) Pressure of air (C) Moisture of air (D) Temperature of air

119. Majority of the drying of agricultural produce fall under:
   (A) Constant rate period
   (C) Rising rate period
   (B) Falling rate period
   (D) All the above

120. Evaporators as compared to dryers are:
   (A) Less efficient   (B) More efficient (C) Effect is same (D) None of the above

121. The heat utilization factor of a drying system is equal to:
   (A) 1 – COP   (B) 1 + COP   (C) 1/COP   (D) COP

122. The usual range of speed of disc atomizer of a spray drier is:
   (A) 6000-20000 rpm
   (C) Less than 6000 rpm
   (B) 6000-10000 rpm
   (D) 20000-25000 rpm

123. Half time period of drying is equal to:
   (A) k/ln2   (B) k × ln2   (C) ln2/k   (D) None of the above

124. The volume of drying zone under deep bed drying varies with:
   (A) Velocity of air movement
   (C) Temperature and RH of entering air
   (B) Moisture content of the grain
   (D) All the above

125. Which drying method is successful for heat sensitive foods?
   (A) Spray drying   (B) Drum drying   (C) Tray drying   (D) Belt drying

126. The process of drying in which ice is directly converted into vapors is known as:
   (A) Sun drying   (B) Cabinet drying (C) Tunnel drying   (D) Sublimation

127. The drying time in falling rate period is _____ wet bulb depression:
    (A) Directly proportional to   (B) Inversely proportional to
    (C) Not affected by   (D) Either directly or inversely proportional to

128. LSU dryer:
    (A) Is a continuous flow mixing type dryer
    (B) Does not have high capital investment
    (C) Does not produce uniform drying
    (D) Is not costlier for drying

129. Deep bed drying problems are solved by:
    (A) Henderson equation   (B) Fick's law
    (C) Hukill's analysis   (D) Newton's law

130. Drying air temperature in non mixing drier is used as:
    (A) 30°C   (B) 45°C   (C) 54°C   (D) 60°C

Data for Q. 131 to 133 are Given below. Solve the Problems and Choose the Correct Answer

The particulars of a fan used in a drying system are as follows:
Air flow rate = 12.6 m³/s
Total pressure head = 600 Pascal
Pressure loss/m = 12 Pascal
Specific volume of air = 0.90 m³/kg
Efficiency of motor = 70%

131. Mass flow rate (kg/s) of air will be:
    (A) 11.34   (B) 12.6   (C) 13.63   (D) 14.0

132. Pressure head (m) of air will be:
    (A) 12   (B) 50   (C) 40   (D) 60

133. Power requirement (kW) of fan will be:
    (A) 9.8   (B) 6.86   (C) 7.0   (D) 12.2

134. The moisture content at which the drying of grains makes transition from constant rate period to falling rate period of drying is known as:
    (A) Equilibrium moisture content   (B) Free moisture content
    (C) Bound moisture content   (D) Critical moisture content

135. Dryers utilizing high gas temperatures of 500°C or more, but for a short exposure time are called:
    (A) Fluidized bed dryers   (B) Flash dryers
    (C) Turbo dryers   (D) Drum dryers

136. Liquid foods are commonly dried using:
    (A) Plate type heat exchanger   (B) Spray dryer
    (C) Freeze drier   (D) Tray drier

137. Three types of air and grains flow *i.e.* cross flow, counter flow and concurrent flow takes place in:

    (A) Sun drying   (B) Solar drying

    (C) Mechanical drying   (D) None of the above

138. Under the given drying conditions as the equilibrium moisture content of the product is reached, the drying rate:

    (A) Approaches infinity   (B) Approaches zero

    (C) Remain constant   (D) Increases marginally

139. In the process of grain drying, the higher wet bulb depression leads to:

    (A) Reduction in drying time   (B) Longer drying period

    (C) Has no effect on drying time   (D) None of the above

Fill up the Blanks

1. Thin layer drying is limited to _____ cm of grain depth.

2. The equilibrium moisture properties of materials are important in _____ and _____.

3. In batch dryers, the air temperature seldom exceeds _____ °C.

4. In drying process _____ kcal of heat is required to convert one kg of grain moisture to water vapor.

5. The falling rate period is _____ than constant rate period.

6. The recommended temperature for the drying of grains for seed purposes is about _____ °C.

7. Recirculation type hot air dryers maintain a high _____ of the air inside the dryer.

8. _____ of the grain and its temperature on the one hand, and RH of the air on the other, plays a major role in drying grain.

9. The principle of heat transfer and hygrometry is applied in _____ process of post harvest technology.

10. The equation representing the movement of moisture during falling rate period of drying is _____.

11. The relationship of equilibrium relative humidity with the moisture content of the grain at a particular temperature is represented by a curve known as _____.

12. RPEC drier was first developed at _____ in 1974.

13. The most popular continuous flow type drier in India is _____ type.

14. Osmo-vac drying is a _____ step process usually employed for drying fruit juices.

15. If cut fruit is exposed to the sun before dehydration, the _____ disappears.

16. Sorption isotherm is a relationship between _____ and _____ at a constant temperature.

17. The difference between initial and equilibrium moisture content of a food is known as _____.

18. _____ is a popular technique for producing dried powder from liquid products.

19. Sorption isotherm curve is obtained if water content is plotted against _____ at constant temperature.

88. At equilibrium moisture content, the water vapor pressure of the material and that of the surrounding is same.

89. Henderson equation is used to determine the EMC of grain.

90. This layer in drying is limited to 35 cm.

91. LSU dryer is a continuous dryer.

92. The surface temperature of food during drying in constant period can be approximated as wet bulb temperature corresponding to temperature of drying air.

93. Conditioning of the grains after drying is must for uniform moisture distribution.

94. Under the given drying conditions, the drying rate approaches infinity as the equilibrium moisture of the product is reached.

ANSWERS

Multiple Choice Questions

1. A	2. D	3. C	4. D	5. B	6. B	7. C	8. D
9. C	10. C	11. D	12. C	13. D	14. B	15. A	16. B
17. D	18. C	19. A	20. C	21. A	22. B	23. B	24. A
25. B	26. A	27. B	28. C	29. B	30. D	31. A	32. D
33. A	34. C	35. A	36. A	37. C	38. A	39. B	40. B
41. B	42. B	43. D	44. A	45. A	46. C	47. B	48. D
49. A	50. B	51. C	52. A	53. C	54. C	55. A	56. C
57. A	58. C	59. A	60. C	61. C	62. C	63. A	64. B
65. D	66. A	67. A	68. B	69. B	70. A	71. B	72. B
73. D	74. B	75. C	76. B	77. C	78. A	79. B	80. B
81. D	82. C	83. D	84. B	85. C	86. A	87. A	88. A
89. D	90. A	91. B	92. B	93. A	94. B	95. C	96. D
97. A	98. A	99. B	100. B	101. C	102. C	103. A	104. D
105. B	106. B	107. D	108. D	109. D	110. D	111. A	112. A
113. A	114. C	115. B	116. B	117. A	118. D	119. B	120. B
121. A	122. A	123. C	124. D	125. A	126. D	127. B	128. A
129. C	130. B	131. D	132. B	133. A	134. D	135. B	136. B
137. C	138. B	139. A					

Fill Up the Blanks

1. 20
2. storage, drying
3. 45
4. 650
5. greater
6. 43
7. flow
8. moisture content
9. drying
10. $(M - M_e)/(M_0 - M_e) = e^{-kt}$
11. sorption isotherm
12. IIT, Kharagpur
13. LSU
14. two