



Name :

Roll No. :

Invigilator's Signature :

CS/B. Tech (FT)/SEM-3/FT-303/2009-10

2009

**PROCESS CALCULATION, THERMODYNAMICS
AND FOOD SCIENCE**

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

**GROUP – A
(Multiple Choice Type Questions)**

1. Choose the correct alternatives of the following : $10 \times 1 = 10$

i) A correlation is represented by $X = X_0 2^{t/g}$. The type of graph paper fitted for this equation will be

- | | |
|----------------|-------------------|
| a) log-log | b) semi-log |
| c) rectangular | d) none of these. |

ii) Specific heat of water is

- | | |
|----------------|-------------------|
| a) same of ice | b) double of ice |
| c) half of ice | d) none of these. |



- iii) Henry's law is applicable for
- a) very diluted sample
 - b) very concentrated solution
 - c) for molar solution
 - d) for normal solution.
- iv) For a pure substance at the triple point F is equal to
- a) 2
 - b) 1
 - c) 0
 - d) 3.
- v) The values of P_1^{sat} & P_2^{sat} are obtained from
- a) Raoult's law
 - b) Henry's law
 - c) Antoine equations
 - d) modified Raoult's law.
- vi) In a pressure vs temperature diagram sublimation curve separates region.
- a) solid & liquid
 - b) liquid & gas
 - c) solid & gas
 - d) solid, liquid & gas.



vii) At dew point

- a) vapour phase ceases to exist
- b) liquid phase ceases to exist
- c) both liquid & vapour phases co-exist
- d) none of these.

viii) Unit of enthalpy is

- a) $\text{kJ}/(\text{kg}.\text{K})$
- b) $\text{kJ}/(\text{kgmole}.\text{K})$
- c) kJ/K
- d) kJ .

ix) Which one of the following is fermented cereal product ?

- a) Rice
- b) Dosa
- c) Roti
- d) None of these.

x) The protein-rich outer layers surrounding the starchy endosperm of a cereal grain is called

- a) scutellum
- b) nucellus
- c) testa
- d) aleurone.



GROUP – B
(Short Answer Type Questions)

Answer any *three* of the following.

3 × 5 = 15

2. Define coefficient of performance of a refrigeration cycle.
Derive an expression for the amount of heat absorbed by the refrigerator.
3. Prove that $dH = C_p dT + [V - T (\delta V / \delta T)_P] dP$.
4. Derive the mathematical expression of absolute humidity.
How is psychometric chart utilized in food engineering problem ?
5. What are the characteristic features of a cereal ? What is wheat protein and how does it control the wheat flour quality ?
6. What is “flour” ? Arrange cake flour, bread flour, and all-purpose flour in the order of increasing gluten content in them. Besides human consumption, what is the 2nd most common use of cereal grains ? What are the two major nutritional significances of fruits and vegetables ?

3 + 2

2 + 3

1 + 1 + 1 + 2



GROUP – C
(Long Answer Type Questions)

Answer any *three* of the following.

3 × 15 = 45

7. a) What do you mean by steam quality ? Define limiting reactant and excess reactant in a chemical process.
- b) How many kilogram of guava would be required to produce 100 kg of jam ? The standard formula of 45 parts fruit to 55 parts sugar is used. The soluble solid content of the finished product is 65% and the guavas have 12% initial soluble solid content. 5 + 10
8. a) Describe the vapour compression cycle with the help of schematic diagram.
- b) Discuss your opinion about the choice of refrigerant.
- c) Give the flow-chart of absorption refrigeration cycle. 6 + 5 + 4
9. a) How much of water is required to raise the moisture content of a 100 kg of a material from 30% to 75% ?
- b) Determine the amount of apple juice concentrate containing 65% solid and single strength juice containing 15% solid that must be mixed to produce 100 kg of an apple juice concentrate containing 45% solid. 5 + 10



10. a) i) Prove that C_p is a function of temperature.
- ii) Show that $C_p - C_v = R$ for an ideal gas.
- b) Air at 1 bar and 298.15 K is compressed to 5 bar and 298.15 K by two different mechanically reversible processes :
- i) Cooling at constant pressure followed by heating at constant volume
- ii) Heating at constant volume followed by cooling at constant pressure

Calculate the heat and work requirements and U and H of the air for each path. The following heat capacities for air may be assumed independent of temperature :

$C_v = 20.78$ and $C_p = 29.1 \text{ J mol}^{-1} \text{ K}^{-1}$; assume also for air that PV/T is a constant, regardless of the changes it undergoes. At 298.15 K and 1 bar the molar volume of air is $0.02479 \text{ m}^3 \text{ mol}^{-1}$.

Whether enthalpy is a path function or not ?

$$(2 + 2) + (10 + 1)$$



11. a) Write the steps for material balance calculation.
- b) 1000 kg of Na_2CO_3 solution containing 25% Na_2CO_3 is subjected to evaporative cooling during which process 15% of the water present in the solution is evaporated. From the concentric solution $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ crystallizes out. Calculate how much crystals would be produced if the solubility of $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ is 21.5 gm per 100 gm of H_2O .
- c) What is the significance of K-value in VLE ? 5 + 7 + 3
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