UNIVERSITY OF SWAZILAND

FINAL EXAMINATION PAPER

PROGRAMME	:	BACHELOR OF SCIENCE IN FOOD SCIENCE, NUTRITION AND TECHNOLOGY YEAR II
COURSE CODE	:	FSNT 205
TITLE OF PAPER	:	PRINCIPLES OF FOOD ENGINEERING
TIME ALLOWED	:	TWO (2) HOURS
INSTRUCTIONS	:	ANSWER QUESTION ONE (1) AND ANY OTHER TWO (2) QUESTIONS. ILLUSTRATE YOUR ANSWERS WITH DIAGRAMS WHERE NEEDED

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QUESTION 1 [COMPULSORY]

(a) Calculate the rate of heat transfer through a composite wall of a vegetable store room made of concrete lined with an insulation layer with 10 m^2 surface area. The insulation and concrete have thickness of 12 cm and 20 cm, respectively. The temperature on the two sides of the composite wall is 15 °C and 30 °C, The thermal conductivity of the insulator is 0.05 W/m°C and that of the concrete is 0.5 W/m°C. The system is at steady state. **(15 Marks)**

(b) Air with 25 °C dry bulb temperature and 10 g water/kg dry air at 1 atm was heated to 45°C dry bulb temperature. The heated air passed through a dryer, picking up moisture adiabatically, and left the dryer at 100% relative humidity. Show the process on a psychrometric chart and determine the properties of the heated air and the air leaving the dryer. **(15 Marks)**

(c) Mango juice flowing through a pipe at a rate of 40 kg/min is sweetened by adding concentrated sugar solution (25 % sugar) to the pipe line at constant rate. At what rate would the concentrated sugar solution be added to provide 15% sugar in the product? **(10 Marks)**

[TOTAL MARKS = 40]

QUESTION 2

(a) Write short notes on the following: **(4x5 = 20 Marks)**

i. A steady state system
ii. Thermal death time (F-value)
iii. Forced convection
iv. Equilibrium moisture content

(b) Explain the importance of energy balance in food processing operations. **(10 Marks)**

[TOTAL MARKS = 30]

QUESTION 3

(a) Name the components of a refrigeration system and explain what happens in any two. **(12 Marks)**

(b) Outline the factors that influence the rate of heat transfer in conduction through a rectangular slab (wall). **(10 Marks)**

(c) Describe single and multiple-effect evaporation system **(8 Marks)**

[TOTAL MARKS = 30]

QUESTION 4

(a) Explain the location of the slowest heating point in packed food where the heat transfer is predominantly by: **(14 Marks)**

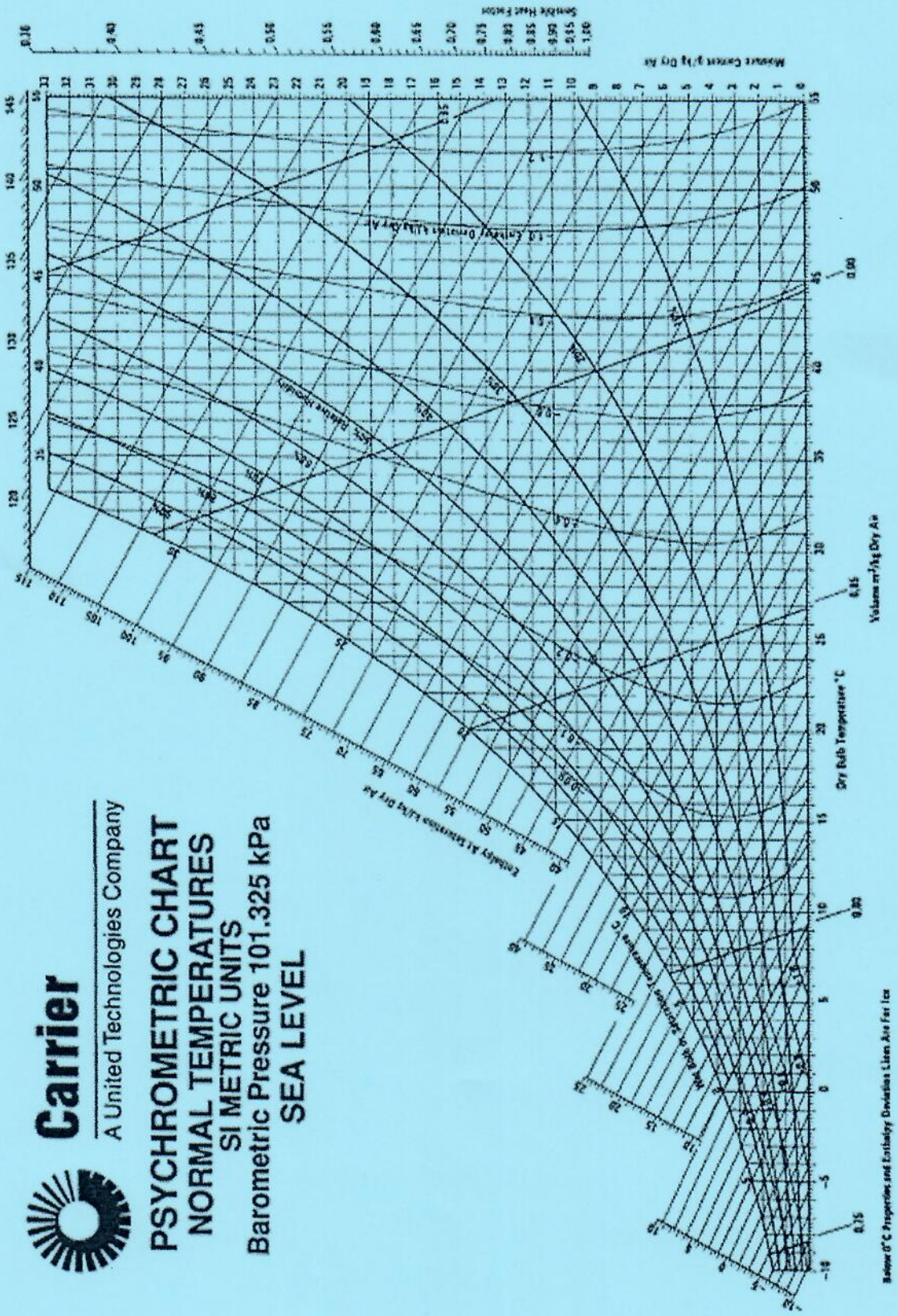
i. Conduction
ii. Convection

(b) An air–vapour mixture is at 30°C dry bulb temperature and 60% relative humidity. Using the psychrometric charts provided on pages 4 and 5, determine all other properties. **(10 Marks)**

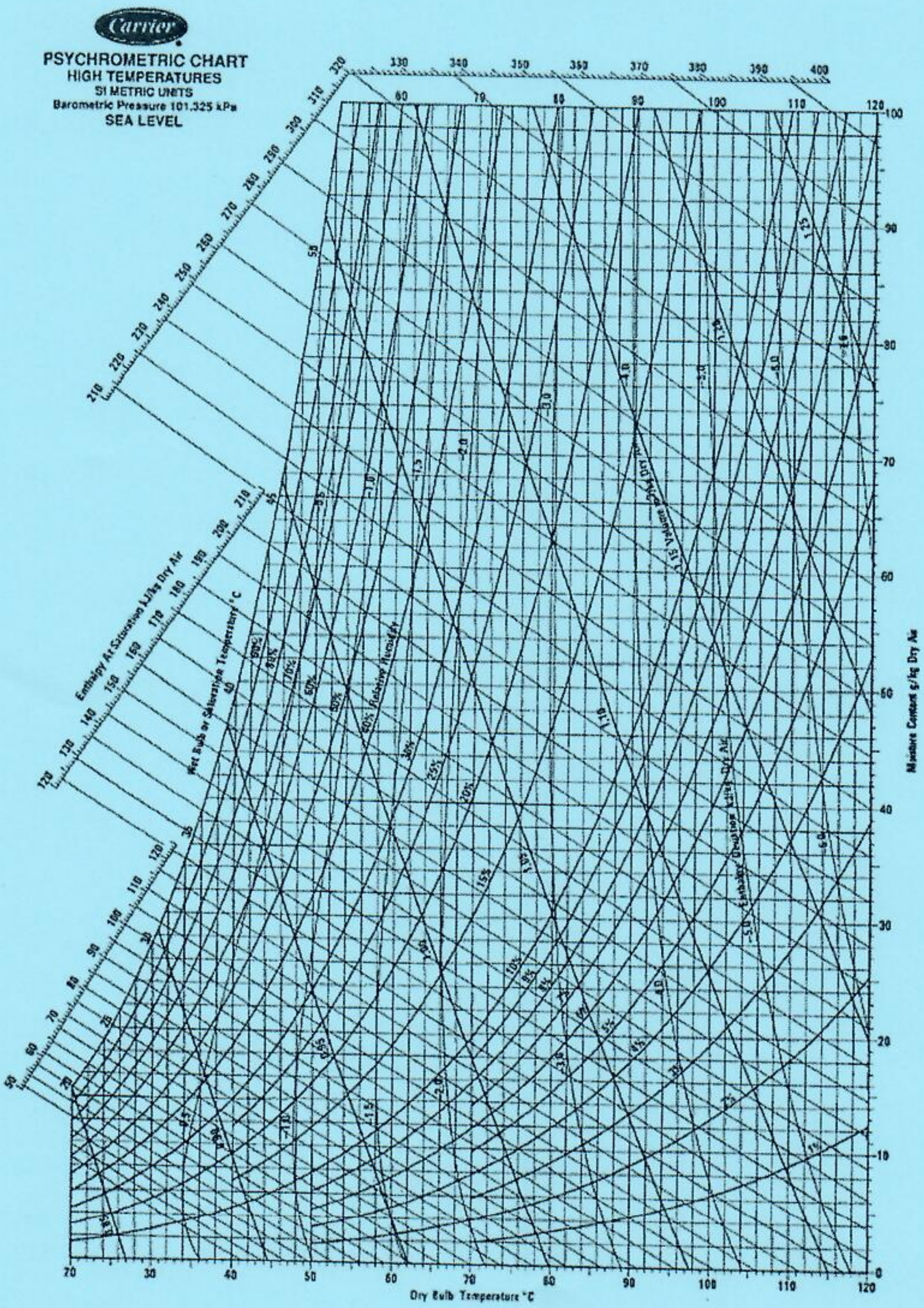
(c) Describe dimensional consistency and show an equation which is dimensionally consistent. **(6 Marks)**

[TOTAL MARKS = 30]

105


Carrier
A United Technologies Company
PSYCHROMETRIC CHART
NORMAL TEMPERATURES
SI METRIC UNITS
Barometric Pressure 101.325 kPa
SEA LEVEL
Dry Bulb Temperature °C
Volume m³/kg Dry Air
Enthalpy At Saturation kJ/kg Dry Air
Moisture Content g/kg Dry Air
Sensible Heat Factor

106


Carrier
PSYCHROMETRIC CHART
HIGH TEMPERATURES
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Barometric Pressure 101.325 kPa
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Moisture Content g/kg Dry Air
Enthalpy At Saturation kJ/kg Dry Air
Wet Bulb or Saturation Temperature °C
Relative Humidity