UNIVERSITY OF SWAZILAND

FINAL EXAMINATION PAPER

PROGRAM	:	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) Canned food is thermally treated in a sterilizer at 140°C. The initial microbial load is 1000 CFU/container and it is required to reduce it to 10^{-6} CFU/container. The target microorganism for this thermal process has a decimal reduction time of 3.5 min for a reference temperature of 121°C. Calculate the processing time. ($j_h = 2$, $f_h = 35$, $z = 10$°C The initial product temperature is 25 °C).

(15 Marks)

(b) How much dry salt must be added in 150 kg of aqueous salt solution in order to increase its concentration from 15% to 40%? **(10 Marks)**

(c) Air with 20°C dry bulb temperature and 9 g water/kg dry air at 1 atm was heated to 40°C dry bulb temperature. The heated air passes through a dryer, picking up moisture adiabatically and leaves the dryer at 35°C. Determine the properties of the heated air and the air leaving the dryer. **(15 Marks)**

[TOTAL MARKS = 40]

QUESTION 2

(a) Write short notes on the following:

i. Decimal reduction time
ii. Cooling load
iii. Survivors curve
iv. Component balance **(20 Marks)**

(b) Explain batch and continuous systems. **(10 Marks)**

[TOTAL MARKS = 30]

QUESTION 3

(a) Explain the factors that influence the mode of heat transfer in canned (packed) foods. **(12 Marks)**

(b) Outline the factors that influence schedule process time. **(10 Marks)**

(c) Describe differential and integral mass balances. **(8 Marks)**

[TOTAL MARKS = 30]

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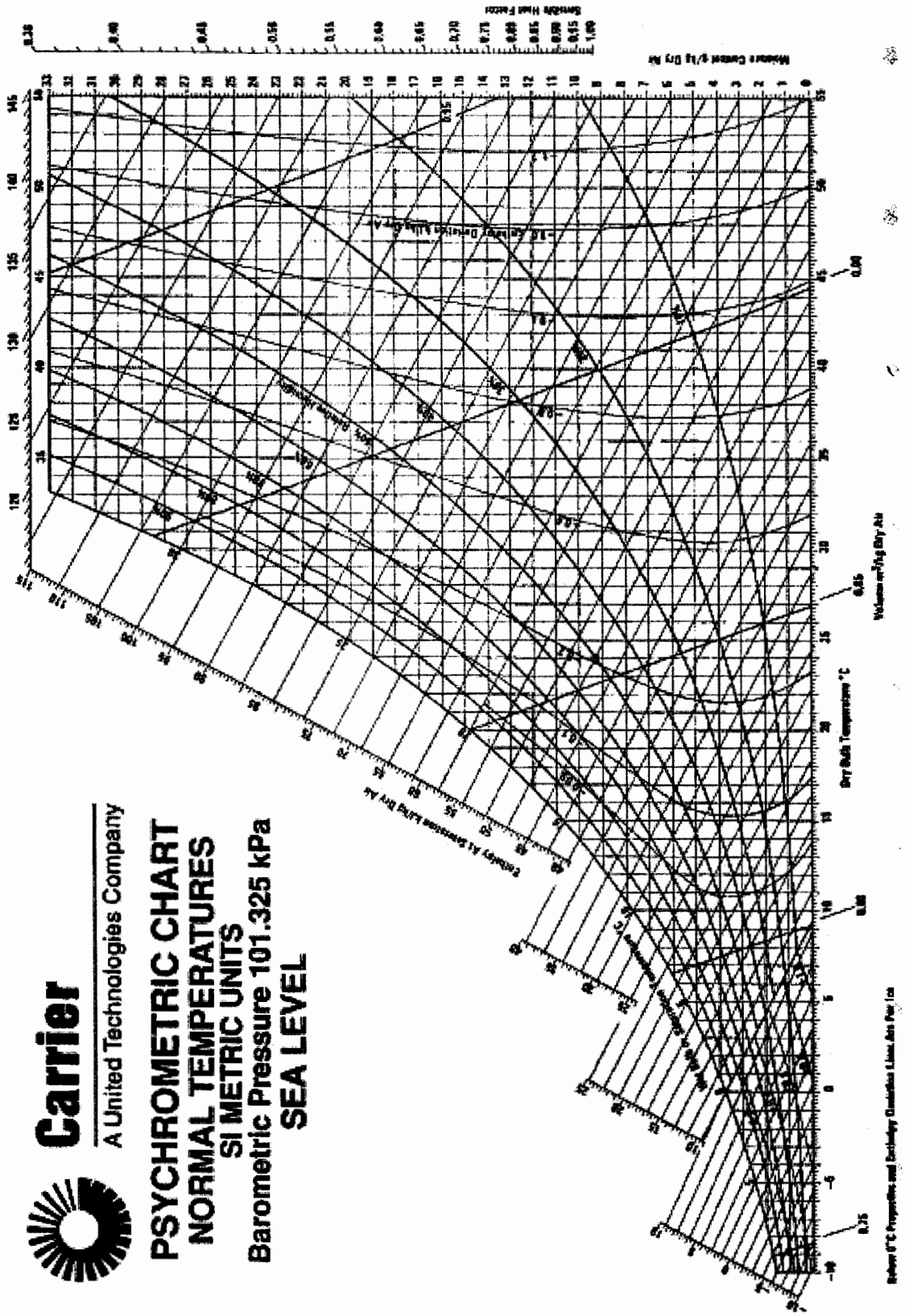
QUESTION 4

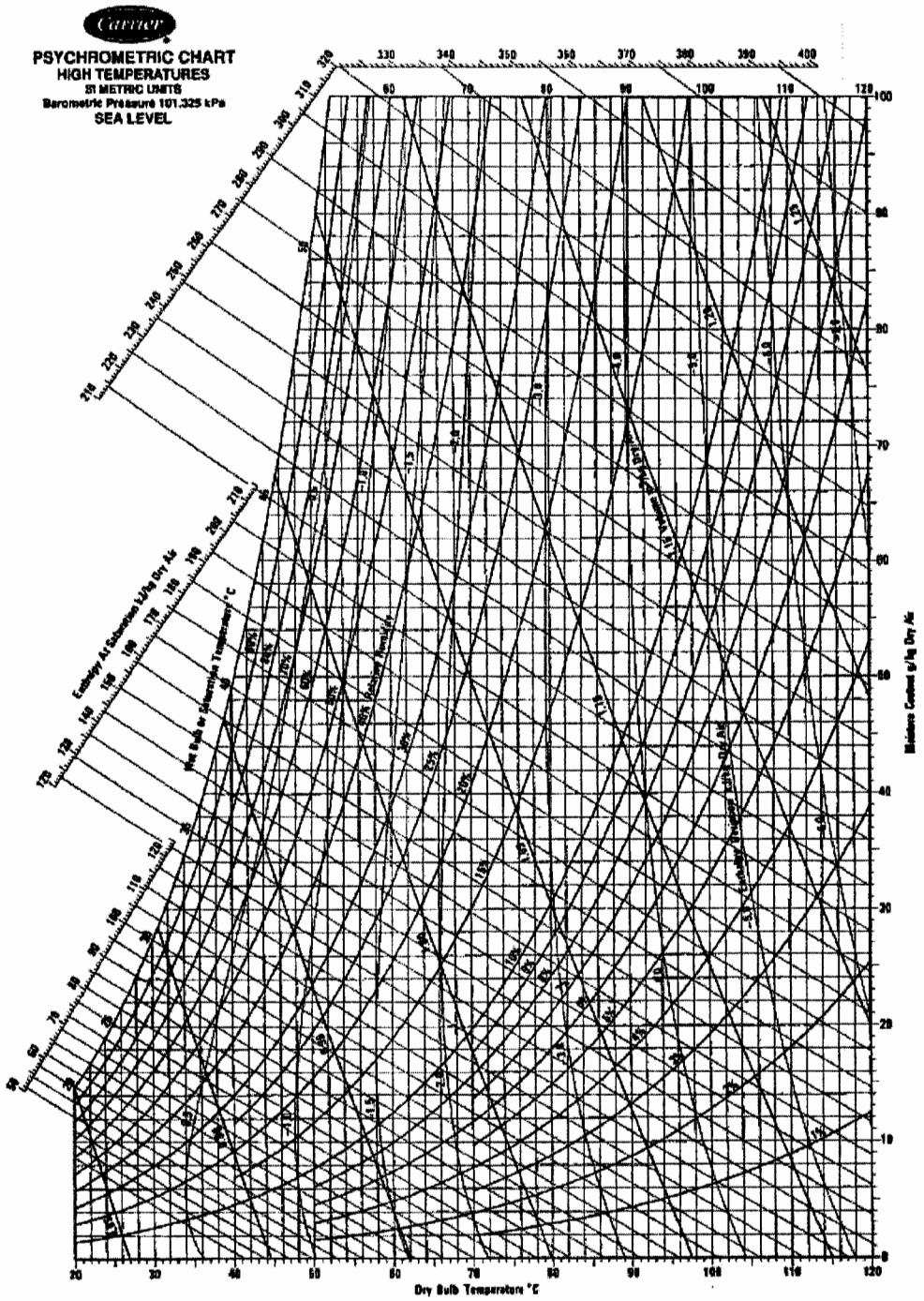
(a) With the help of a plot describe a typical temperature profile when heating canned (packed) foods in a batch retort. **(14 Marks)**

(b) An air–vapour mixture is at 40°C dry bulb temperature and 20°C wet bulb temperature. Using the psychrometric charts provided on pages 4 and 5, determine all other properties **(10 Marks)**

(c) Describe the phenomenon of boiling point rise. **(6 Marks)**

[TOTAL MARKS = 30]


Carrier
A United Technologies Company
PSYCHROMETRIC CHART
NORMAL TEMPERATURES
SI METRIC UNITS
Barometric Pressure 101.325 kPa
SEA LEVEL


Carrier
PSYCHROMETRIC CHART
HIGH TEMPERATURES
SI METRIC UNITS
Barometric Pressure 101.325 kPa
SEA LEVEL
Dry Bulb Temperature °C
Moisture Content g/kg Dry Air

Relationships f_h/U:g for Values of z = 10 °C

	Values of g (°C) when j is:								
f_h/U	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0
0.2	2.27×10^{-5}	2.46×10^{-5}	2.64×10^{-5}	2.83×10^{-5}	3.02×10^{-5}	3.20×10^{-5}	3.39×10^{-5}	3.58×10^{-5}	3.76×10^{-5}
0.4	7.39×10^{-3}	7.94×10^{-3}	8.44×10^{-3}	9.00×10^{-3}	9.50×10^{-3}	1.00×10^{-2}	1.06×10^{-2}	1.11×10^{-2}	1.16×10^{-2}
0.6	4.83×10^{-2}	5.24×10^{-2}	5.66×10^{-2}	6.06×10^{-2}	6.44×10^{-2}	6.83×10^{-2}	7.28×10^{-2}	7.67×10^{-2}	8.06×10^{-2}
0.8	0.126	0.136	0.148	0.159	0.171	0.182	0.194	0.205	0.217
1	0.227	0.248	0.269	0.291	0.312	0.333	0.354	0.376	0.397
2	0.85	0.92	1.00	1.07	1.15	1.23	1.30	1.38	1.45
3	1.46	1.58	1.69	1.81	1.93	2.04	2.16	2.28	2.39
4	2.01	2.15	2.30	2.45	2.60	2.74	2.89	3.04	3.19
5	2.47	2.64	2.82	3.00	3.17	3.35	2.53	3.71	3.88
6	2.86	3.07	3.27	3.47	3.67	3.88	4.08	4.28	4.48
7	3.21	3.43	3.66	3.89	4.12	4.34	4.57	4.80	5.03
8	3.49	3.75	4.00	4.26	4.51	4.76	5.01	5.26	5.52
9	3.76	4.03	4.31	4.58	4.86	5.13	5.41	5.68	5.96
10	3.98	4.28	4.58	4.88	5.18	5.48	5.77	6.07	6.37
20	5.46	5.94	6.42	6.89	7.37	7.84	8.32	8.79	9.27
30	6.39	6.94	7.56	8.11	8.72	9.33	9.89	10.5	11.1
40	7.11	7.72	8.39	9.06	9.72	10.4	11.1	11.7	12.4
50	7.67	8.39	9.11	9.83	10.6	11.3	12.0	12.7	13.4
60	8.22	8.94	9.72	10.5	11.2	12.0	12.7	13.5	14.3
70	8.67	7.78	10.2	11.1	11.8	12.6	13.4	14.2	15.0
80	9.01	9.89	10.7	11.6	12.3	13.2	14.0	14.8	15.6
90	9.44	10.28	11.2	12.0	12.8	13.7	14.5	15.3	16.2
100	9.78	10.7	11.6	12.4	13.3	14.1	15.0	15.8	16.7