THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

FIRST SEMESTER EXAMINATIONS - 2020

FOOD TECHNOLOGY - 3RD YEAR DEGREE

FT 321 FOOD CANNING AND PACKAGING

TUESDAY 23RD JUNE, 2020, 12.50 P.M

TIME ALLOWED: 3 HOURS

INFORMATION FOR CANDIDATES:

1. You have 10 minutes to read the paper. You must not begin writing in the answer book during this time.

2. **ANSWER ALL QUESTIONS.**

3. All answers must be written in the answer books provided.

4. Write your name and number clearly on the front page. **Do it now.**

5. Calculators are permitted in the examination room. Notes and textbooks are not allowed.

6. Show all workings and calculations in the answer book.

7. Data required is given on the data sheet.

MARKING SCHEME

SECTION A

Question 1 [12 marks]
Question 2 [20 marks]
Question 3 [12 marks]
Question 4 [16 marks]

SECTION B

Question 5 [12 marks]
Question 6 [21 marks]
Question 7 [7 marks]

SECTION A

ANSWER ALL QUESTIONS

1. A company is to establish experimental groundwork before launching a new product. The tables below contain the experimental findings.

Table 1.0. Microbial history of bacteria under consideration.

Decimal reduction time of organism (min)	Temperature (°C)
0.020	132
0.105	124
0.400	118
2.90	110
10.00	104
20.00	100
50.00	95

Table 2.0. Heat penetration data at retort temperature of 121°C.

Time from start of process (min)	Temperature at can centre (°C)
0	82
2	95
4	103
6	108
8	111
10	115
12	119
14	120
16	121
18	121
20	121
22(start cooling)	120
24	100

(a) Given the data above , calculate the following under *Cl.botulinum cook* .
Use graphical plots to support your answers:

(i) Z and D_{121} for the organism. [3 marks]
(ii) Lethal rate for each temperature. [3 marks]
(iii) Sterilization value of the process. [2 marks]

(b) Critically comment on the acceptability of the operation. [1 mark]

(c) Assume the product obeys a convective heating pattern and needs to be cooled after F_o = 6 min instead of cooling as in Table 2.0. Calculate the heating time and comment on the quality and cost of the operation. [3 marks]

(Total = 12 marks)

2. (a) What do you understand when one says that organic solvents have higher heat capacities than water? Despite organic solvents having better heat capacities, industries still use water as a heat transfer medium instead of organic solvents. Why is this so? Discuss. [6 marks]

(b) Identify and briefly discuss the TWO prime reasons why food is processed. [3 marks]

(c) Discuss fully THREE modes by which foods are processed. For each of the modes discussed, give an example. [5 marks]

(d) A low acid food is heated at 119°C . F_o value of the process was found to be 9.0 minutes. From heat penetration data the following information were obtained: T_{ih} = 85°C, f_h = 15 min, j_c = 1.4 min, T_{pih} = 50°C. Take reference temperature and Z to be 121°C and 10 °C respectively. The retort took 12 minutes to reach the process temperature. Calculate:

(i) U value. [2 marks]
(ii) g value. [2 marks]
(iii) Heating time. [1 mark]
(iv) Processing time. [1 mark]

(Total = 20 marks)

3. (a) With the aid of diagrams discuss the following terms:

(i) Decimal reduction time (D_{value}). [2½ marks]
(ii) Thermal resistant constant (Z_{value}). [2½ marks]

(b) (i) Differentiate between sterilization and commercial sterility. [2 marks]
(ii) With a sketch of temperature–time plot , trace the heating and cooling curves of conduction and convection heating packs. [1 mark]
(iii) Briefly discuss the heating curves in (b)(ii). [4 marks]

(Total = 12 marks)

4. (a) With respect to food safety, why are fungi given detail consideration compared then bacteria? Discuss. [5 marks]

(b) Draw a flow diagram of a typical canning operation. [4 marks]

(c) With respect to heating, discuss ANY TWO factors that affect length of time required to reach sterilization. [4 marks]

(d) Discuss in detail why diameters of the safety and inlet steam valves are different. [3 marks]

(Total = 16 marks)

SECTION B

ANSWER ALL QUESTIONS

5. (a) Write notes on MAP for seafoods. [3 marks]

(b) State the properties and purposes of oxygen, nitrogen and carbon dioxide in MAP. [4½ marks]

(c) What are the major packaging technologies in active packaging? [3 marks]

(Total = 10½ marks)

6. (a) Explain the difference(s) between Ultra High Temperature (UHT) and other methods of heat processing in food manufacturing. [3 marks]

(b) The main limitations of UHT processing are costs and complexity of the plant. What do these arise from? [4 marks]

(c) What are the characteristics of UHT processing equipment? [2½ marks]

(d) Discuss the direct method equipment of UHT processing. [3 marks]

(Total = 12½ marks)

7. (a) Discuss the functions of food packaging. [3 marks]

(b) Why is food packaging said to be an essential part of the modern society? [2 marks]

(c) Discuss two-piece and three-piece cans and give an example each. [3 marks]

(d) Discuss the properties of a glass packaging. [3 marks]

(e) Each carton is to be made to contain 20 cans of product (can size = Dia 73mm x 112mm Length) and the cans are to be packed so that there is 0.5 mm space between cans or between a can and the carton wall on all surfaces. The longer carton closures should leave a 14.5 mm space between their edges and the shorter closure edges be at least 100 mm apart.

(i) Draw the plan view of the carton (open top), marking clearly, all the measurements in centimetres (cm). [3 marks]

(i) Determine the quantity (cm^2) of cardboard sheet required for this job. Ensure the design uses minimal material and is easy to handle. [3 marks]

(Total = 17 marks)

DATA AND FORMULA SHEET

1. $L = \frac{(T-121)/10)}{10}$

2. $B = f_h \log(j_h I_h / g)$

3. $I_h = (T_r - T_{ih})$

4. $j_h = \frac{T_r - T_{pih}}{T_r - T_{ih}}$

5. $U = FF_1$

6. $F_i = \frac{((121-Tr)/Z)}{10}$

7. $j_c = \frac{T_c - T_{pic}}{T_c - T_{ic}}$

8. $P_t = B - 0.4I$

Table 1.0. Selected f_h/g and g values when Z = 10°C

	Values of g for the following j_c values						← j_c
f_h/U	0.40	0.80	1.00	1.40	1.80	2.00	↓ g
0.50	0.0411	0.0474	0.0506	0.0570	0.0602	0.0665	
0.60	0.0870	0.102	0.109	0.123	0.138	0.145	
0.70	0.150	0.176	0.189	0.215	0.241	0.255	
0.80	0.226	0.267	0.287	0.328	0.369	0.390	
0.90	0.313	0.371	0.400	0.458	0.516	0.545	
1.00	0.408	0.485	0.523	0.600	0.676	0.715	
2.00	1.53	1.80	1.93	2.21	2.48	2.61	
3.00	2.63	3.05	3.26	3.68	4.10	4.31	
4.00	3.61	4.14	4.41	4.94	5.48	5.75	
5.00	4.44	5.08	5.40	6.03	6.67	6.99	
10.0	7.17	8.24	8.78	9.86	10.93	11.47	
20.0	9.83	11.55	12.40	14.11	14.97	16.68	
30.0	11.5	13.6	14.6	16.8	18.9	19.9	
40.0	12.8	15.1	16.3	18.7	21.1	22.3	
50.0	13.8	16.4	17.7	20.3	22.8	24.1	
100.0	17.6	20.8	22.3	25.4	28.5	30.1	
500.0	26.0	30.6	32.9	37.5	42.1	44.4	

Adapted from Stumbo (1973).