UNIVERSITY COLLEGE TATI

UNIVERSITY COLLEGE TATI (UC TATI)

FINAL EXAMINATION QUESTION BOOKLET	
COURSE CODE	: BCE 4043 6/1
COURSE	: WASTE WATER ENGINEERING
SEMESTER/SESSION	: 1- 2024/2025
DURATION	: 3 HOURS

Instructions:

1. This booklet contains 4 questions. Answer **ALL** questions.
2. All answers should be written in answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, raise your hands and ask the invigilator.

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO

THIS BOOKLET CONTAINS 7 PRINTED PAGES INCLUDING COVER PAGE

QUESTION 1

a) Describe the processes needed to supply a modern city with clean drinking water from well to river. Describe also the processes needed to treat water after use. (Clarify your answer with sketches if needed) (10 marks)

b) The results shown in **Table (1)** were obtained for a wastewater sample taken at the headworks to a wastewater-treatment plant. All of the tests were performed using a sample size of 50 ml.

Table (1)

Item	Weight, g
Tare mass of evaporating dish	43.5433
Mass of evaporating dish + residue after evaporation at 105°C.	43.5794
Mass of evaporating dish + residue after ignition at 550°C.	43.5625
Tare mass of Whatman paper filter	1.5433
Mass of Whatman paper filter + residue after evaporation at 105°C.	1.5554
Mass of Whatman paper filter + residue after ignition at 550°C.	1.5476

Determine the followings: (3 marks)

i. Concentration of total solids (3 marks)

ii. Total volatile solids (3 marks)

iii. Total suspended solids (3 marks)

iv. Volatile suspended solids (3 marks)

v. Dissolved solids.

QUESTION 2

a) If the Dissolved Oxygen (O_2) in H_2O is 100g/L, determine the mole fraction of dissolved oxygen (4 marks)

b) Differentiate the characteristic between soft water and hard water. (4 marks)

c) The results of a water analysis are shown in **Table (2)** below:

Table (2)

Cations	Mg/L	Anions	Mg/L
Ca	58.0	HCO_3	342
Mg	32.8	SO_4	72
Na	46.0	Cl	48
K	35.0	-	-

i. Convert miligrams per liter concentration to miliequivalents per liter (4 marks)

ii. Illustrate the miliequivalence per liter bar graph (4 marks)

iii. List hypothetical combinations (4 marks)

iv. Calculate hardness as mg/L of $CaCO_3$ for this water analysis (5 marks)

QUESTION 3

a) The BOD_5 of a wastewater is determined to be 150 mg/L at 20°C. The k value is known to be 0.23 per day. Find the BOD_8 if the test were run at 15°C. (6 marks)

b) Ten (10) identical test bottles were prepared, each with 50 ml of treated wastewater and 250 ml of dilution water. After setup, three (3) bottles were titrated to establish an initial dissolved oxygen (DO) of 9.0 mg/L. The remaining seven (7) bottles were incubated, and DO measurements were taken over time as follows:

1.2 days, DO = 8.0 mg/L
3.2 days, DO = 7.0 mg/L
4.2 days, DO = 6.8 mg/L
5.2 days, DO = 6.5 mg/L
7.2 days, DO = 5.3 mg/L
10.2 days, DO = 4.0 mg/L

i. Determine the 5 -day biochemical oxygen demand (BOD_5) (10 marks)

ii. Illustrate the BOD-time curve and graph for determination of the k-rate. (9 marks)

QUESTION 4

a) Explain the followings:

i. Multiple-tube fermentation technique (5 marks)

ii. Most Probable Number (MPN) (4 marks)

b) A sample of wastewater was collected every 3 hours from an industrial treatment plant over a 24-hour period, as shown in **Table 3**.

Table 3

Time (h)	BOD (mg/L)	TSS (mg/L)	Flowrate (m^3/d)
0000	100	130	7000
0300	120	140	8500
0600	150	160	9300
0900	190	200	11000
1200	210	215	12500
1500	195	205	11800
1800	185	190	10000
2100	170	180	9500
2400	150	170	8700

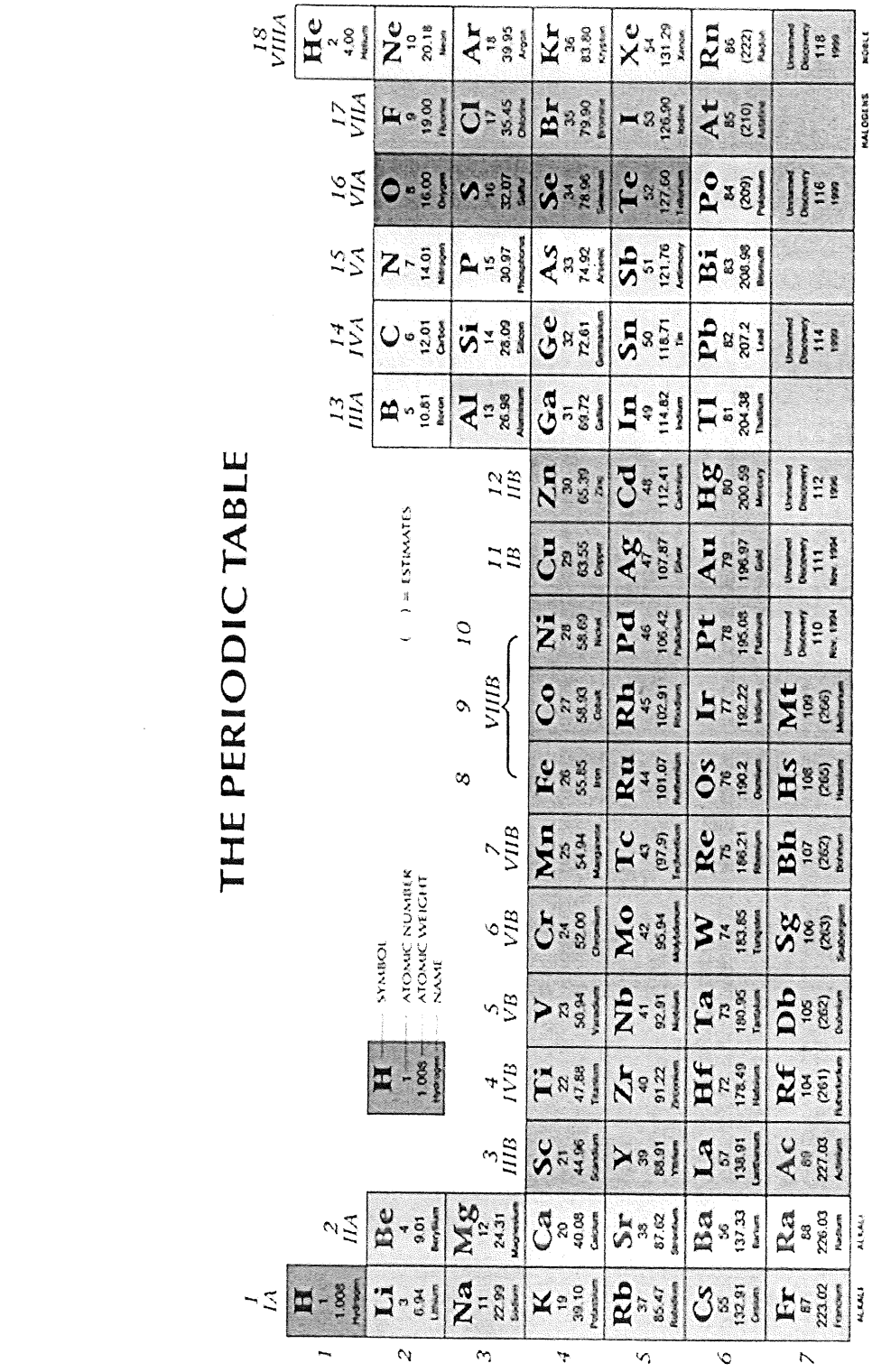
Calculate the following:

i. Weighted total BOD in g/m^3 (8 marks)

ii. Weighted total TTS in g/m^3 (8 marks)

----------End of question----------

APPENDIX I


THE PERIODIC TABLE
SYMBOL
ATOMIC NUMBER
ATOMIC WEIGHT
NAME
( ) = ESTIMATES
ALKALI
HALOGENS
NOBLE

APPENDIX II

TABLE 3-2 MPN Index and 95 Percent Confidence Limits for Coliform Counts by the Multiple-Tube Fermentation Technique for Various Combinations of Positive and Negative Results When Five 10-ml, Five 1-ml, and Five 0.1-ml Portions Are Used

No. of Tubes Giving Positive Reaction out of			MPN Index per 100 ml	95 Percent Confidence Limits		No. of Tubes Giving Positive Reaction out of			MPN Index per 100 ml	95 Percent Confidence Limits	
5 of 10 ml Each	5 of 1 ml Each	5 of 0.1 ml Each		Low	High	5 of 10 ml Each	5 of 1 ml Each	5 of 0.1 ml Each		Low	High
0	0	0	1.8	—	6.8	4	2	1	26	9.8	70
0	0	1	1.8	0.09	6.8	4	3	0	27	9.9	70
0	1	0	1.8	0.09	6.9	4	3	1	33	10.0	70
0	2	0	3.7	0.70	10	4	4	0	34	14.0	100
1	0	0	2.0	0.10	10	5	0	0	23	6.8	70
1	0	1	4.0	0.70	10	5	0	1	31	10.0	70
1	1	0	4.0	0.71	12	5	0	2	43	14.0	100
1	1	1	6.1	1.8	15	5	1	0	33	10.0	100
1	2	0	6.1	1.8	15	5	1	1	46	14.0	120
						5	1	2	63	22.0	150
2	0	0	4.5	0.79	15						
2	0	1	6.8	1.8	15	5	2	0	49	15.0	150
2	1	0	6.8	1.8	17	5	2	1	70	22.0	170
2	1	1	9.2	3.4	22	5	2	2	94	34	230
2	2	0	9.2	3.4	22	5	3	0	79	22	220
2	3	0	12.0	4.1	26	5	3	1	110	34	250
						5	3	2	140	52	400
3	0	0	7.8	2.1	22						
3	0	1	11.0	3.5	23	5	3	3	170	70	400
3	1	0	11.0	3.5	26	5	4	0	130	36	400
3	1	1	14.0	5.6	36	5	4	1	170	58	400
3	2	0	14.0	5.7	36	5	4	2	220	70	440
3	2	1	17.0	6.8	40	5	4	3	280	100	710
						5	4	4	350	100	710
4	0	0	13.0	4.1	35	5	5	0	240	70	710
4	0	1	17.0	5.9	36	5	5	1	350	100	1100
4	1	0	17.0	6.0	40	5	5	2	540	150	1700
4	1	1	21.0	6.8	42	5	5	3	920	220	2600
4	1	2	26.0	9.8	70	5	5	4	1600	400	4600
4	2	0	22.0	6.8	50	5	5	5	>1600	700	—

American Public Health Association. *21st Edition of Standard Methods for the Examination of Water and Wastewater,* APHA, 2005: Section 9221. Reprinted with permission from the American Public Health Association.