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Universiti Tun Hussein Onn Malaysia

**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER I  
SESSION 2019/2020**

COURSE NAME : ENVIRONMENTAL ENGINEERING  
COURSE CODE : BFC 32403  
PROGRAMME : BFF  
EXAMINATION DATE : DECEMBER 2019/JANUARY 2020  
DURATION : 3 HOURS  
INSTRUCTIONS : ANSWER ALL QUESTIONS

THIS PAPER CONSISTS OF <sup>FIVE 5</sup>~~SIX (6)~~ PAGES

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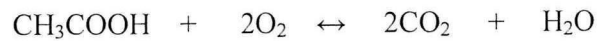
**Q1** (a) Explain briefly the effects of the following wastewater pollutants towards the environment:

(i) Suspended solids (2 marks)

(ii) Organic matter (2 marks)

(iii) Heavy metals (2 marks)

(b) The reaction of decomposition organic waste in the river produces acetic acid (CH<sub>3</sub>COOH) as shown below:



(i) Define theoretical oxygen demand (ThOD). (2 marks)

(ii) Determine ThOD of 300 mg/L acetic acid. [C = 12; H=1; O = 16]. (4 marks)

(c) Using Thomas's graphical method and the following data tabulated in **Table Q1(c)**:

**Table Q1(c): BOD values vs day**

Time (day)	BOD( mg/L)
2	70.0
5	102.4
7	111.0
8	114.0
10	118.8

(i) Plot the graph of  $\left[ \frac{t}{BOD_t} \right]^{1/3}$  versus time. (2 marks)

(ii) Calculate the rate constant,  $k$  using  $k = 6 (B/A)$ . (4 marks)

(iii) Calculate ultimate BOD,  $L_0$  using  $L_0 = 1/6(A^2)(B)$ . (2 marks)

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- Q2** (a) Distinguish between coagulation and flocculation in water treatment process. (4 marks)
- (b) Explain the functions of aeration in water treatment. (4 marks)
- (c) In the primary settling tank of the water treatment plant:
- (i) Determine the surface area of a primary settling tank sized to handle a maximum hourly flow of  $0.600 \text{ m}^3/\text{s}$  at an overflow rate of  $60 \text{ m}^3/\text{d}/\text{m}^2$ . (4 marks)
- (ii) If the effective tank depth is  $3.0 \text{ m}$ , what is the effective theoretical detention time? (4 marks)
- (iii) If an equalization basin is installed a head of the primary tank, the average flow to the tank is reduced to  $0.400 \text{ m}^3/\text{s}$ . What is the new overflow and detention time? (4 marks)

$$\text{Given } t_0 = Q/V$$
$$\text{SOR} = Q/A$$

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- Q3** (a) State the need for secondary wastewater treatment. (2 marks)
- (b) Differentiate between the attached growth and suspended growth system of biological wastewater treatment with an example of each system. (4 marks)
- (c) The operation of primary settling tank and activated sludge system in wastewater treatment plant are as follows:

Primary Settling Tank:

Parameter	Influent (mg/L)	Removal Efficiency (%)
BOD	150	35
Suspended solids	275	60

Activated sludge system with 90% removal efficiency for BOD and Suspended Solid operates under the following conditions:

Flow : 0.08m<sup>3</sup>/s  
 Aeration Tank Dimension : 7.5 wide, 30m long, 4m deep  
 (2 tanks are operated in series)  
 Mixed Liquor Suspended Solid : 3000 mg/L  
 Return Flow : 0.03m<sup>3</sup>/s  
 Waste Sludge Concentration : 6000 mg/L  
 Waste Sludge Flow : 0.001m<sup>3</sup>/s

Calculate:

- (i) Hydraulic Retention Time (2 marks)
- (ii) F/M ratio (3 marks)
- (iii) Mean cell residence time (5 marks)

Given:  $\frac{F}{M} = \frac{QS_o}{VX}$ ;  $\theta_c = \frac{MLVSS \times V}{(Q_w X_r) + (Q - Q_w)(X_e)}$ ;

SS in effluent =  $Q_e \times \text{Concentration SS}$

- (d) Propose **ONE (1)** of the treatment methods of sludge produced from a municipal wastewater treatment plant. (4 marks)

- Q4** (a) Discuss briefly factors that affect waste generation and collection rates. (4 marks)
- (b) (i) Point out **TWO (2)** categories of schedule waste according to the Environmental Quality (Scheduled Wastes) Regulations 2005. (2 marks)
- (ii) Outline **ONE (1)** example of the schedule waste treatment. (4 marks)
- (c) A sanitary landfill serves a population of 10,000 houses. Each household comprises of 5 people. Solid waste is collected weekly by using 8 compactor trucks with the volume capacity of  $15 \text{ m}^3$ . Density of solid waste compacted in the compactor truck is  $300 \text{ kg/m}^3$ .
- (i) Determine the unit waste generation rate in  $\text{kg/capita/day}$ . (2 marks)
- (ii) Determine the compacted volume of solid waste to be collected and number of trips per week. Collection vehicle capacity is  $50 \text{ m}^3$ . (2 marks)
- (d) A city consists of 520,000 people, generating municipal solid waste (MSW) at a rate of  $1.5 \text{ kg/capita/day}$ . The volume of the landfill is  $12,000,000 \text{ m}^3$  with the density of the compacted waste is  $490 \text{ kg/m}^3$ . Currently 70% of the landfill is used and the ratio of cover to compacted fill is 2.0. Estimate the anticipated life of the landfill? (6 marks)

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