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**UNIVERSITI SAINS MALAYSIA**

1<sup>st</sup> Semester Examination  
2010/2011 Academic Session

November 2010

**EAP 582/4 – Wastewater Engineering**

Duration : 3 hours

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Please check that this examination paper consists of **FIVE (5)** printed pages before you begin the examination.

[Instructions: This paper contains **FIVE (5)** questions. Answer **ALL** questions only.

You must answer the questions in English.

All question **MUST BE** answered on a new sheet.

1. a) The water content of a sludge is reduced from 98 percent to 95 percent. What is the percent reduction in volume by approximate method and by more exact method, assuming that the solids contain 70 % organic matter of specific gravity 1.00 and 30 % mineral matter of specific gravity of the 98 and the 95 percent sludge?.

[12 marks]

- b) Discuss waste stabilization pond design criteria and describe the removal mechanism of waste stabilization pond.

[8 marks]

2. a) An industrial wastewater is discharged into a municipal waste water sewer. The characteristics of the two wastes are as follow:-

<b>Industrial</b>	<b>Municipal</b>
Flow = 3000 m <sup>3</sup> /d	Flow = 7,400 m <sup>3</sup> /d
BOD <sub>5</sub> = 1200 mg/L	BOD <sub>5</sub> = 200 mg/L
PO <sub>4</sub> <sup>=</sup> = 140 mg/L	PO <sub>4</sub> <sup>=</sup> = 2,0 mg/L
Temp. = 33°C	Temp. = 29°C

Determine the characteristics of the mixture.

[8 marks]

- b) Assuming suitable criteria, Calculate the dimension of facultative pond for waste water treatment from residential area with 4500 people. Use the given following data:

Temperature : 30° C

Sewage influent 260 mg/L

Desired effluent 20 mg/L

Water demand; 300 L/c. day

[12 marks]

3. a) i. Explain the importance of metallic constituents in wastewater and how they are measured
- ii. List the **THREE (3)** group of metal in wastewater and give at least **THREE (3)** examples of metal from each group

[4 marks]

- b) i. Explain the purpose of using  $\text{Ag}_2\text{SO}_4$ ,  $\text{HgSO}_4$  and FAS in the COD test.
- ii. Discuss the environmental significance of DO.
- iii. Write the order of  $\text{O}_2$  demand value between COD, ThOD and BOD. Under what condition, the value of COD will be almost the same as ThOD

[3 marks]

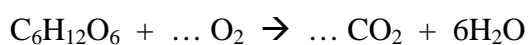
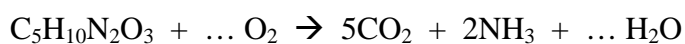
- c) i. List and briefly explain at least **FIVE (5)** factors affecting wastewater quantity.
- ii. Discuss the relationship between temperature, viscosity, precipitation and sewage discharge.
- iii. What is the role of alkalinity in wastewater treatment?.

[3 marks]

- d) From a mixture of wastewater containing 130 mg/L glutamic acid and 210 mg/L glucose, calculate the value of UBOD and  $\text{BOD}_5$  (in mg/L) if the value of the  $\text{BOD}_5$  first-order reaction rate constant is 0.27/d.

Oxidation reactions:

(Balance the stoichiometric coefficients before continuing).



[10 marks]

4. a) What is high strength wastewater? Write the typical range of major pollutant constituent's concentration in raw sewage and landfill leachate.

[7 marks]

- b) Design an aerated grit chamber installation for an average wastewater flowrate of  $0.3 \text{ m}^3/\text{s}$  and peaking factor 3.334. The average depth of the grit chamber is 3 m, the width to depth ratio is 1.5:1, and the detention time at peak flow is 3.5 min. The aeration rate is  $0.4 \text{ m}^3/\text{min}$  per meter of the grit chamber length. Determine the dimensions of the grit chamber and total aeration air required.

[7 marks]

- c) A treatment plant was receiving wastewater from a population of 6250 persons in a community and daily water use was 200 L/day per person. Due to infiltration and evaporation 15% and 5% wastewater losses before reached in the treatment plant. After treating the wastewater, plant discharged effluents for land treatment purpose which contented BOD of 250 mg/L. The slow-rate land treatment field area was 2 ha/day. The land treatment effluent application cycle time was 5 days between two applications. Findout the daily effluent flow rate to treatment plant and cycle average BOD loading rate.

[6 marks]

5. a) What is bio-film in attached growth of biological treatment?. Write the mechanism with illustration of bio-fringe activities in sequencing batch treatment of wastewater.

[7 marks]

- b) Derive the first order kinetic equation for BOD in wastewater treatment. The following information was obtained from a seeded 5 days BOD test on a wastewater sample. Dilution water was prepared with a seed dilution of 1 in 100 and the BOD bottles were prepared by diluting the wastewater sample to 1 in 200. The initial DO of diluted sample was 8.5 mg/L and the final 5 day BO was 2.2 mg/L. The corresponding initial and final DO of the seed dilution water was 8.8 and 7.6 mg/L respectively. Calculate the  $\text{BOD}_5$  of the wastewater sample.

[7 marks]

- c) Derive wastewater reuse index (WRI). Determine the 1-day BOD and Ultimate first-stage BOD for a wastewater whose 5-day 20°C BOD is 200 mg/L. The reaction constant  $k$ (base  $e$ ) = 0.23/day. What would have been the 5 day BOD if the test had been conducted at 25°C.

[6 marks]

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