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UNIVERSITI SAINS MALAYSIA

First Semester Examination  
Academic Session 2009/2010

November 2009

**EAP 581/4 – Water Supply 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 consists of **SIX (6)** questions. Answer **FIVE (5)** questions only.

You may answer the question either in Bahasa Malaysia or English.

All questions **MUST BE** answered on a new page.

Write the answered question numbers on the cover sheet of the answer script.

1. a) To aid coagulation in the primary settling tank, 15.0 mg/l of Ferric Chloride ( $\text{FeCl}_3 \cdot 4 \text{H}_2\text{O}$ ) is added to raw water. Determine the amount of natural alkalinity required for coagulation.

(6 marks)

- b) Given that liquid alum is used as a coagulant. Specific gravity of alum is 1.33. One gallon of alum weighs 11.09 pounds (5.03 kg) and contains 5.34 pounds of dry alum. Determine:

- (i) The alum concentration
- (ii) mL of liquid alum required to prepare a 100 ml solution of 20,000 mg/L alum concentration,
- (iii) The dosage concentration of 1 mL of stock solution in a 2000 mL Gator jar sample.

(8 marks)

- c) Discuss the following advanced water treatment methods:

- i) Removal of Dissolved Solid
- ii) Removal of Phosphate
- iii) Removal of dissolved organic compound

(6 marks)

2. a) Discuss the difference between Class I, Class IIA/IIB, for National Water Quality Standard for Malaysia.

(3 marks)

- b) Discuss and explain briefly about SWMM and QUAL2K Model that can simulate the water quality in the certain area or catchment.

(8 marks)

- c) Write the algorithm which can simulate the design of a water treatment.

(9 marks)

3. a) Discuss on the effect of temperature on flocculation, horizontal flow sedimentation tank and upflow clarifiers.

(8 marks)

- b) Head loss through an upflow and downflow baffles of a flocculation tank is 0.405 when the output is 20 MLD (million litres per day) at a temperature of 20°C. At this flowrate, the retention time in the flocculation chamber is 30 minutes.

- i) Calculate the velocity gradient and camp number for the above condition.  
ii) Calculate the velocity gradient and camp number when the flowrate is changed to 15 MLD at a temperature of 25°C.

Given that:

At 20°C; absolute viscosity  $\mu = 1.005 \times 10^{-3}$  kg/ms and density  $\rho = 998$  kg/m<sup>3</sup>

At 25°C; absolute viscosity  $\mu = 0.894 \times 10^{-3}$  kg/ms and density  $\rho = 997$  kg/m<sup>3</sup>

(8 marks)

- (c) Briefly describes the following terminology with respect to water treatment and public water supply:

- (i) Fire Demand  
(ii) Non Revenue water

(4 marks)

4. a) Explain **FOUR** (4) types of water softening process that are normally used and for each process explain on its appropriateness.

(6 marks)

- b) A treatment plant with a capacity of 20 MLD (million litres per day) is required to have an ion exchange process due to water hardness at 300mg/L as CaCO<sub>3</sub>. Resin media with the adsorption capacity of 100kg/m<sup>3</sup> at flow rate 0.5m<sup>3</sup>/min./m<sup>2</sup> is proposed. Calculate the volume of media required for the water treatment and surface area for the media.

(6 marks)

- c) Based on water quality in Table 1, calculate the amount in mg/L as CaCO<sub>3</sub>. Periodical table for element is supplied for your reference (Ca = 40, Mg = 24, Na = 23, C = 12, O = 16, S = 32, Cl = 35).

**Table 1**

Ion	mg/L as ion
Ca <sup>2+</sup>	103
Mg <sup>2+</sup>	5-5
Na <sup>+</sup>	16
HCO <sub>3</sub> <sup>-</sup>	255
SO <sub>4</sub> <sup>2-</sup>	49
Cl <sup>-</sup>	37

(8 marks)

5. a) Discuss the concept of water resources sustainability as defined by Brundtland Commission Report (1987), i.e.;

“Sustainable water resources as the ability to provide and manage water quantity and quality so as to meet the present needs of humans and environmental ecosystems, while not impairing the needs of future generations to do the same” (Brundtland Commission Report , 1987).

(5 marks)

- b) In assessing the sustainability of a water supply and sanitation services, discuss the **FOUR (4)** specific issues related to economic efficiency, political legitimacy and social acceptability.

(5 marks)

- c) In organising the water supply and sanitary services, assess the management models and regulatory issues.

(10 marks)

6. a) Assess the relationship of property rights in water.

(5 marks)

- b) In water law, discuss the following :

- i) Riparian doctrine
- ii) Appropriation doctrine
- iii) Groundwater rights
- iv) Diffuse surface water rights

(10 marks)

- c) Is water resources legislation in Malaysia based on Federal Jurisdiction? Discuss in detail by giving appropriate examples.

(5 marks)