
UNIVERSITI SAINS MALAYSIA

Second Semester Examination
2010/2011 Academic Session

April/May 2011

EAP 215/3 – Water Supply and Water Treatment Engineering
[*Kejuruteraan Bekalan dan Olahan Air*]

Duration : 3 hours
[*Masa : 3 jam*]

Please check that this examination paper consists of **EIGHT (8)** pages of printed material before you begin the examination.

[*Sila pastikan bahawa kertas peperiksaan ini mengandungi **LAPAN (8)** muka surat yang bercetak sebelum anda memulakan peperiksaan ini.*]

Instructions : This paper contains **SIX (6)** questions. Answer **FIVE (5)** questions.

[**Arahan** : Kertas ini mengandungi **ENAM (6)** soalan. Jawab **LIMA (5)** soalan.

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

[*Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris*].

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

[*Semua soalan **MESTILAH** dijawab pada muka surat baru*].

In the event of any discrepancies, the English version shall be used.

[*Sekiranya terdapat percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai*].

1. (a) You are required to make an assessment for the capability of an intake site. Briefly discuss **TWO (2)** criteria need to be considered. [6 marks]
- (b) Briefly describe the differences in water quality between water sources obtained at upstream and downstream of a river. [6 marks]
- (c) Table 1 shows historical population data from a particular district in Malaysia. Calculate the projected population in rural and urban areas using Arithmetic and Geometric Methods in year 2030.

| Year | 1970 | 1980 | 1990 | 2000 |
|--------------------------------|--------|--------|--------|--------|
| Total Population | 30,000 | 35,000 | 38,000 | 45,000 |
| Percentage of Rural Population | 60 | 50 | 45 | 40 |

[8 marks]

2. (a) Briefly explain the purpose of the following process with respect to potable water treatment:
- (i) Aeration [2 marks]
- (ii) Screening [2 marks]
- (b) Hydraulic rapid mixing is used for a treatment plant with a capacity of 5 million litres per day. The design was made based on an effective head difference of 2.5m for the feed water to fall into the mixing chamber. Calculate power dissipated and velocity gradient for the hydraulic rapid mixing. Retention time in the tank is 30 seconds and dynamic viscosity of the water is 1.145×10^{-3} Ns/m².

[6 marks]

- (c) A laboratory jar test indicates that 5 mL alum solution which was added with 1000 mL raw water has given an optimum floc. Alum solution was made based on 8 gram of alum dissolved in 1000 mL of distilled water. Calculate the amount of alum requires for one day if the treatment plant operates with a capacity of 5 million litres per day (MLD). If the treatment plant operates in three shifts for a period of 24 hours, calculate the volume of alum mixing tank that should be provided for one shift if 10% alum solution is prepared.
- [10 marks]
3. (a) Briefly explain the following terms:
- (i) Coagulation [2 marks]
- (ii) Flocculation [2 marks]
- (b) A water treatment plant has a capacity of 2 million litres per day (MLD). Flocculation process involves two stages with two tanks constructed in series. Retention times in both tanks are the same at 20 minutes with velocity gradients at 30s^{-1} and 20s^{-1} for the first and second stages of flocculation respectively. Calculate the volume and power input in each tank if the dynamic viscosity of the water is $1.145 \times 10^{-3} \text{Ns/m}^2$.
- [6 marks]
- (c) A horizontal flow sedimentation tank is designed with a capacity of 1.8 million litres per day (MLD) with length to width ratio of 4:1, surface loading of 30 m/day and retention time of 3 hours. Calculate the length, width and depth of the sedimentation tank. If the outlet weir is made of concrete shaped as a box or rectangular, that does not touch the downstream wall of the tank, calculate the total length of this weir and sketch your design.
- [10 marks]
4. (a) Describe and discuss the mechanisms involve in slow sand filtration with respect to potable water treatment.
- [6 marks]

- (b) Suggest **FOUR (4)** characteristics of disinfection agent with respect to potable water treatment.

[4 marks]

- (c) With the aid of sketch diagrams discuss the strength and weaknesses of gravity and direct pumping for water distribution system.

[10 marks]

5. (a) If you are given the task as a waterworks engineer to propose a water distribution system for a residential area of 10 hectares, suggest reticulation system to be used, pipe material to be recommended and justify your decisions.

[10 marks]

- (b) Figure 1 shows a reticulation system for a housing scheme. Estimate the flow rate in each pipe using Hardy-Cross and Hazen William Method up to two iterations. Use an initial flow rate of $80 \text{ m}^3/\text{hour}$ from point A to B. The lengths of pipes AB, BC, CD and DA are 1000m, 800m, 300m and 700m respectively. The diameters of pipes AB, BC, CD and DA are 300mm, 250mm, 250mm and 300mm respectively. Hazen-William coefficient for all pipes is 100.

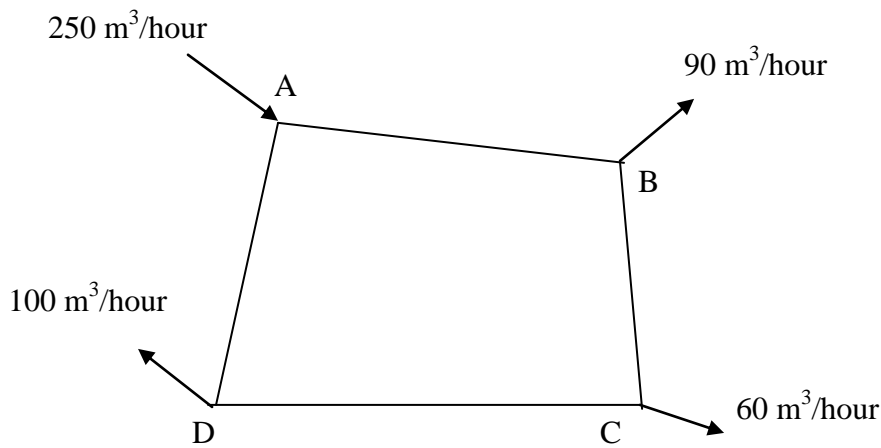


Figure 1

[10 marks]

6. (a) Describe the definition of the following terms:

- (i) Water
- (ii) Water quality

[4 marks]

(b) Choose **TWO (2)** the following characteristics and describe with respect to potable water supply.

- (i) Physical
- (ii) Chemical
- (iii) Biological
- (iv) Radiological

[10 marks]

(c) Discuss the following water standards in Malaysia.

- (i) Interim National Water Quality Standards for Malaysia
- (ii) National Drinking Water Quality Standards (NDWQS) 1983

[6 marks]

1. (a) *Anda dikehendaki membuat penilaian terhadap kebolehpayaan sebuah takat pengambilan air. Bincangkan DUA (2) kriteria yang perlu diambil kira.*
[6 markah]

(b) *Terangkan dengan ringkas perbezaan kualiti air di antara punca air di hulu dan hilir sungai.*
[6 markah]

(c) *Jadual 1 menunjukkan sejarah data penduduk daripada suatu daerah di Malaysia. Hitung pertambahan penduduk untuk kawasan luar bandar dan bandar menggunakan Kaedah Aritmatik dan Geometrik untuk tahun 2030.*

| Tahun | 1970 | 1980 | 1990 | 2000 |
|------------------------------|--------|--------|--------|--------|
| Jumlah Penduduk | 30,000 | 35,000 | 38,000 | 45,000 |
| Peratus Penduduk Luar Bandar | 60 | 50 | 45 | 40 |

[8 markah]

2. (a) *Terangkan dengan ringkas tujuan proses berikut berdasarkan olahan air minuman:*

(i) *Pengudaraan*
[2 markah]

(ii) *Penabiran*
[2 markah]

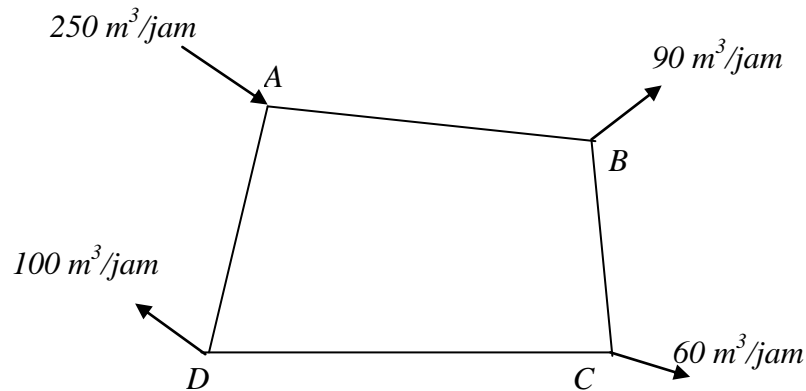
(b) *Pencampur deras hidraulik digunakan di loji olahan air berkeupayaan 5 juta liter sehari (JLH). Rekabentuk dibuat berdasarkan perbezaan turus efektif 2.5m untuk air suapan memasuki kebuk pencampuran. Hitung kuasa yang digunakan dan kecerunan halaju untuk pencampur deras hidraulik.*
[6 markah]

(c) *Ujian balang di makmal menunjukkan 5 mL larutan alum yang dicampur dengan 1000 mL air mentah telah memberikan flok optimum. Larutan alum telah disediakan berdasarkan 8 gram alum dilarutkan dengan 1000 mL air suling. Hitung amaun alum yang diperlukan untuk satu hari jika loji olahan beroperasi dengan kapasiti 5 juta liter sehari (JLH). Jika loji olahan beroperasi dalam 3 shif untuk tempoh 24 jam, hitung isipadu tangki pencampuran alum yang perlu disediakan untuk satu shif jika 10% larutan alum disediakan.*

[10 markah]

3. (a) *Terangkan dengan ringkas terma-terma berikut:*
- (iii) *Pengentalan* [2 markah]
- (iv) *Pemberbukuan* [2 markah]
- (b) *Loji olahan air mempunyai kapasiti 2 juta liter sehari (JLH). Proses pemberbukuan melibatkan dua peringkat dengan dua tangki dibina dalam susunan siri. Masa tahanan untuk kedua dua tangki adalah sama iaitu 20 minit dengan kecerunan halaju masing-masing pada $30s^{-1}$ dan $20s^{-1}$ untuk peringkat pertama dan kedua. Hitung isipadu dan kuasa yang dikenakan pada setiap tangki jika kelikatan dinamik air adalah $1.145 \times 10^{-3} \text{ Ns/m}^2$.* [6 markah]
- (c) *Tangki enapan aliran mendatar direkabentuk dengan kapasiti 1.8 juta liter sehari (JLH) dengan nisbah panjang kepada lebar 4:1, beban permukaan 30 m sehari dan masa tahanan 3 jam. Hitung panjang, lebar dan kedalaman tangki enapan. Jika alur limbah keluar diperbuat daripada konkrit dalam bentuk kekotak atau segi empat tepat yang tidak bersentuhan dengan dinding tangki di hilir aliran, hitung jumlah panjang alur limbah dan lakarkan rajah yang anda rekabentuk.* [10 markah]
4. (a) *Hurai dan bincangkan mekanisma yang terlibat dalam penuras pasir perlahan berdasarkan olahan air minuman.* [6 markah]
- (b) *Huraikan dengan ringkas empat (4) ciri bahan pemusnah kuman berdasarkan olahan air minuman.* [4 markah]
- (c) *Dengan bantuan rajah yang dilakar, bincangkan kekuatan dan kelemahan sistem graviti dan pengepaman terus untuk sistem agihan air.* [10 markah]
5. (a) *Jika anda diberikan tugas sebagai jurutera air untuk mencadangkan sistem agihan air untuk kawasan kediaman seluas 10 hektar, cadangkan sistem retikulasi yang akan digunakan, bahan paip yang akan digunakan dan berikan justifikasi terhadap segala keputusan anda.* [10 markah]

- (b) *Rajah 1 menunjukkan sistem retikulasi untuk sekim perumahan. Anggarkan kadar alir dalam setiap paip menggunakan Kaedah Hardy-Cross dan Hazen William sehingga dua iteratif. Menggunakan kadar alir awal $80 \text{ m}^3/\text{jam}$ dari titik A ke B. Panjang paip-paip AB, BC, CD dan DA masing-masing 1000m, 800m, 300m and 700m. Garispusat paip-paip AB, BC, CD dan DA masing-masing 300mm, 250mm, 250mm dan 300mm. Pekali Hazen-William untuk semua paip ialah 100.*



Rajah 1

[10 markah]

6. (a) *Terangkan takrifan istilah berikut:*

- (i) *Air*
- (ii) *Kualiti air*

[4 markah]

- (b) *Pilih DUA (2) ciri-ciri berikut dan terangkan berdasarkan bekalan air minuman*

- (i) *Fizikal*
- (ii) *Kimia*
- (iii) *Biologi*
- (iv) *Radiologi*

[10 markah]

- (c) *Terangkan standard/piawaian air berikut di Malaysia.*

- (i) *Standard Kualiti Air Kebangsaan Interim untu Malaysia*
- (ii) *Standard Kualiti Air minuman Kebangsaan (1983)*

[6 markah]