

UNIVERSITI SAINS MALAYSIA

KSCP EXAMINATION  
Academic Session 2007/2008

June 2008

**EAP 581/4 – Water Supply Engineering**  
**[Kejuruteraan Bekalan Air]**

Duration: 3 hours  
[Masa : 3 jam]

Please check that this examination paper consists of **SEVEN** (7) printed pages including appendix before you begin the examination.  
[Sila pastikan kertas peperiksaan ini mengandungi **TUJUH** (7) muka surat bercetak termasuk lampiran sebelum anda memulakan peperiksaan ini.]

**Instructions:** This paper consists of **SIX** (6) questions. Answer **FIVE** (5) questions only. All questions carry the same marks.  
[**Arahan:** Kertas ini mengandungi **ENAM** (6) soalan. Jawab **LIMA** (5) soalan sahaja. Semua soalan membawa jumlah markah yang sama.]

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.]

Write the answered question numbers on the cover sheet of the answer script.  
[Tuliskan nombor soalan yang dijawab di luar kulit buku jawapan anda.]

1. (a) You are given the task by your superior to evaluate the water quality from a river water source where agricultural as well as farming activities are prevalent in the river basin. The water from this source is required to be used for public water supply. Provide a detail description on **THREE (3)** significant water quality parameters that need to be sampled and studied. For each water quality parameter justify its importance, treatment process to overcome the problem and frequency of sampling.

[10 marks]

- (b) Briefly describe the following water quality with respect to water supply engineering:

- (i) Arsenic
- (ii) Iron
- (iii) Aluminium
- (iv) Lead

[10 marks]

2. (a) Contamination of water sources has been continuously discussed and yet rivers and seas still being polluted. This means there is a threat on the future source of water demand. Discuss briefly **FIVE (5)** sustainable approaches need to be developed by water authorities in Malaysia in order to optimize on the existing and future water demand.

[5 marks]

- (b) The amount of water consumed for public water supply will be affected by several factors. Discuss **FIVE (5)** factors that affecting the amount of water consumed with respect to water supply engineering.

[5 marks]

- (c) A medium cost housing scheme consists of 4000 units of terrace houses, each unit has a floor area of 900 square feet. The building is made up of ordinary construction. Domestic water demand is estimated at 350 litres per capital per day with population equivalent of 5 per unit. With the aid of the following information estimate the total flow required. You may use Tables 1 and 2 to help your estimation.

$$F=18C(A)^{0.5}$$

Note: Gallon per minute = [(L/min)/3.78],  $1\text{m}^2=10.76\text{ft}^2$ .

**Table 1- Residential fire flows**

Distance between adjacent units (m)	Required fire flow (litre/minute)
>30.5	1890
9.5 – 30.5	2835 – 3780
3.4 – 9.2	3780 – 5670
<3.0	5670 - 7560

**Table 2- Residential flow duration**

Required fire flow (litre/minute)	Duration (hour)
<3780 (<1000gpm)	4
3780-4725 (1000-1250 gpm)	5
4725-5670 (1250-1500 gpm)	6
5670-6615(1500-1750 gpm)	7
6615-7560 (1750-2000 gpm)	8
7560-8505 (2000-2250 gpm)	9
>8505(>2250 gpm)	10

[10 marks]

3. (a) Population data for certain area are shown in Table 3. Calculate the projected population in the rural areas in 2030 using the following methods.

- (i) Geometric
- (ii) Incremental increase and
- (iii) Decreasing rate of increase

Table 3

Year	1980	1990	2000
Total population	70,000	78,000	88,000
Percentage of urban population	30	35	38

[10 marks]

(b) **TWO (2)** sets of jar tests are conducted on raw water containing 30 NTU and an  $\text{HCO}_3^-$  alkalinity concentration of 45mg/L expressed as  $\text{CaCO}_3$ . Given the data as shown in Table 4, find the optimal pH, coagulant dose and the theoretical amount of alkalinity that would be consumed at the optimal dose. The reaction occurs when water is added with alum is shown below:



Molecular weights of the elements are shown as follows:

Oxygen = 16, sulphur = 32, aluminium = 27, hydrogen =1 and carbon = 12.

Table 4

Jar Test 1						
Jar	1	2	3	4	5	6
pH	5.0	5.5	6.0	6.5	7.0	7.5
Alum dose (mg/L)	12	12	12	12	12	12
Turbidity (NTU)	12	7	5.0	6.0	8	13
Jar Test 2						
Jar	1	2	3	4	5	6
pH	6.0	6.0	6.0	6.0	6.0	6.0
Alum dose (mg/L)	6	8	12	14	16	18
Turbidity (NTU)	14	10	5	4.5	6	13

[10 marks]

4. (a) To ensure efficient mixing, coagulant and their aids must be dosed at the correct points, in the correct order and as evenly as possible thoroughly the body of the water. In order to fulfil the above requirement, indicate or suggest where the coagulant should be dosed.

[4 marks]

- (b) With the aid of a sketch diagram together with the expression involves using hydraulic jump and Froude Number, describe on the principle of hydraulic jump for adequate rapid mixing.

[6 marks]

- (c) A water treatment plant is designed to cater a population of 50,000. Water demand for urban and rural areas are 200 and 160 litres per capita per day (lpcd) respectively. The percentage of population in the urban areas is 30% and the rest in the rural areas. Water demand for the industries and other categories is approximately 40% of the total domestic demand. Flocculation process involves with the construction of two tanks of equal sizes in series. Velocity gradients for the first and second tanks are  $60\text{s}^{-1}$  and  $30\text{s}^{-1}$  respectively. Retention time in each tank is 15 minutes and the dynamic viscosity of the water is  $1.145 \times 10^{-3} \text{ Nsm}^{-2}$ . Estimate the volume of the tank and the power input in each tank.

[10 marks]

5. (a) Dissolved-air flotation process has gained popularity not only in the developed countries but in Malaysia. With the aid of a sketch diagram, describe briefly on each process component involved in a recycled flow dissolved air flotation.

[5 marks]

- (b) Define the following terms:

- (i) Sedimentation
- (ii) Clarification
- (iii) Thickening
- (iv) Sludge and
- (v) Scum

[5 marks]

- (c) A dual media filter is composed of 0.3m anthracite (mean size of 2.0mm) that is placed over a 0.6m layer of sand (mean size of 0.7mm) with a filtration rate of 9.78 m/hr. Assume the grain sphericity  $\phi$  is 0.75 and porosity for both media is 0.40, estimate the head loss of the filter at 15°C where the kinematic viscosity is  $1.131 \times 10^{-6} \text{m}^2 \text{s}^{-1}$ . The following equation may be useful:

$$\frac{h}{L} = \frac{k\mu}{\rho g} \frac{(1-\varepsilon)^2}{\varepsilon^3} \left(\frac{a}{V}\right)^2 v$$

[10 marks]

6. (a) Disinfection process is very important so that the water is safe and free from pathogenic organisms. Elaborate **FIVE (5)** factors that affect the resistance of organisms to disinfection process.

[5 marks]

- (b) Hardness in water needs to be treated and one of the methods that may be used is a single-stage softening with recarbonation. Show a sketch flow chart of this typical process.

[5 marks]

- (c) Figure 1 shows a reticulation system. Estimate the flow rate in each pipeline using Hardy-Cross Method and Hazen-William formula up-to two iteration. Adopt Hazen-William coefficient C as 110. Use an initial flow rate of 60 litres per second (lps) from point A to B. The lengths and diameters for pipes AB, BC, CD and AD are as follows:

Pipe AB: length	=	800m and diameter	=	250mm
Pipe BC: length	=	700m and diameter	=	200mm
Pipe CD: length	=	700m and diameter	=	200mm
Pipe AD: length	=	700m and diameter	=	250mm.

The following formula may be useful

$$H_L = \frac{12.25 \times 10^9}{D^{4.87}} L \left( \frac{Q}{C} \right)^{1.85}$$

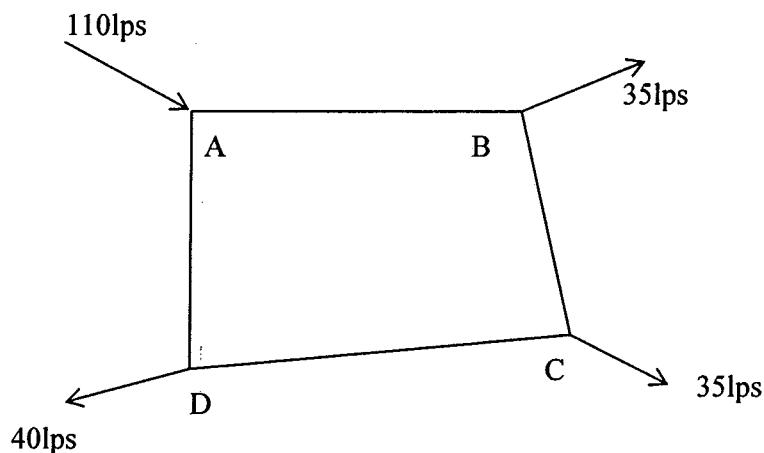


Figure 1

[10 marks]

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