Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2018/2019

COURSE NAME	:	DESIGN OF WATER SUPPLY
COURSE CODE	:	BFA40203
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	DECEMBER 2018 / JANUARY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	PART A : ANSWER **ALL** QUESTIONS PART B: ANSWER ONLY **TWO (2)** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **ELEVEN (11)** PAGES

PART A

Q1 (a) **Table Q1(a)** represents the lowest seven consecutive days average discharge from 1994 to 2015. The river supply is intended for abstraction to meet an average demand of 10 m^3/s of a community.

(i) Tabulate the flows in order of severity using serial number M with values from 1 to n and the probability ranking using the formula M/(n+1).

(3 marks)

(ii) Plot the flows against their probability in the probability graph paper

(4 marks)

(iii) Calculate the minimum flow for a 10-year return period.

(3 marks)

(b) Estimate a total water demand for the following cases by referring to **Table Q1(b)(i)**, and **Table Q2(b)(ii)**.

(i) 30 acres of medium industrial area, 100 units of terraced house and 20 units of commercial lot.

(5 marks)

(ii) 350 beds of a hospital, 50 rooms of hotel, and 50 units of 2-storey bungalow lot.

(5 marks)

Q2 (a) Explain the mechanism of coagulation and flocculation processes.

(3 marks)

(b) A flocculation basin has the following data:

Flocculation basin	=	2 units
Design flow rate	=	12 m^3/min
Detention time	=	25 min
Water depth	=	4.2 m
Dynamic viscosity at 24°C	=	0.000911 Pa.s
Efficiency of transfer of motor power to water power	=	80%

Determine the followings;

(i) Basin volume.

(5 marks)

(ii) Tank size.

(5 marks)

(iii) Required input power.

(5 marks)

(iv) Impeller location.

(2 marks)

Q3 (a) Explain the relationship between quantity of water flow, velocity and area of flow.

(5 marks)

(b) Illustrate the system head-discharge curves for two operating conditions for the water system with 400 mm diameter pipe as shown in a **Figure Q3(b)**.

(7 marks)

(c) Using **Table Q3(c)**, evaluate the head loss of flow through a pump discharge line consists of 100 m of 300 mm new cast-iron pipe, three 90° medium-radius bends, two gate valves, and one butterfly valve. Assume the flow velocity is 1.2 m/s.

(8 marks)

PART B

Q4 (a) Explain the objective of flocculation.

(3 marks)

(b) Estimate the volume of flocculation tank and its dimension based on the following data:

(i) Design flowrate = 15 x 10^3 m^3/d
(ii) Number of tank = 2
(iii) Flocculation time = 30 minutes
(iv) Water depth = 4 m

(7 marks)

(c) The water quality of Sg Sembrong is as shown in **Table Q4(b)**. By using the given data:

(i) Prepare the bar chart of the raw water in mg/L as $CaCO_3$. Assume equivalent weight (EW) of $CaCO_3$, CO_2, Ca^{2+}, Mg^{2+}, Na^+, $HCO3^-$, Cl^- and $SO4^{2-}$ are 50.0, 22.0, 20.0, 12.2, 23.0, 61.0, 35.5 and 48.0 respectively.

(5 marks)

(ii) Calculate the lime dosage and soda dosage to soften the water to the practical solubility limits. Provide the answer in mg/L as $CaCO_3$.

(5 marks)

Q5 (a) Explain why it is more economical for water treatment plants to utilize quicklime (also known as lime) than hydrated lime.

(3 marks)

(b) Differentiate between Type I Sedimentation and Type II Sedimentation and give an example of where they are applied in water treatment

(7 marks)

(c) Design the horizontal-flow rectangular sedimentation tank(s) for Parit Raja Water Treatment Plant using the maximum day design flow of 0.8 m^3 to meet the following criteria:

(i) Minimum horizontal flow ranges of 0.005 to 0.018 m/s
(ii) Minimum length to width ratio (L: W) is 6:1
(iii) Minimum length to depth ratio (L: D) is 15:1

Given:

(i) The surface overloading rate is 40 $m^3/day.m^2$.
(ii) Width of each tank is 4 m.
(iii) Depth of the tank is 2 m

(10 marks)

Q6. (a) Explain **TWO (2)** disinfection practices.

(3 marks)

(b) Differentiate the methods for water distribution particularly on:

(i) Method of sections

(3 marks)

(ii) Circle method

(4 marks)

(c) A water supply system consisting of a reservoir with lift pumps, elevated storage, piping, and load center (withdrawal point) is shown in **Figure Q6 (c).**

(i) Sketch the hydraulic gradient for the system based on the following data:

$Z_A = 0$ m, $P_A = 550$ kPa,
$Z_B = 9.1$ m, $P_B = 200$ kPa
$Z_C = 12.2$ m, $P_C = 30$ m (water level in tank)

(3 marks)

(ii) For the conditions as stated in Q6(c)(i), compute the flow available at point B **(Figure Q6 (c))** from both supply pumps and elevated storage by using **Figure Q6 (c)(ii)**.

(7 marks)

-END OF QUESTIONS-

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Table Q1(a)

Year	River Discharge, m^3/s (average)
1994	2.6
1995	2.8
1996	2.1
1997	3.2
1998	2.9
1999	3.3
2000	3.2
2001	2.7
2002	3.5
2003	3.6
2004	4.8
2005	3.0
2006	3.5
2007	3.4
2008	2.6
2009	3.3
2010	2.4
2011	2.7
2012	3.4
2013	3.6
2014	3.6
2015	3.1

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Table Q1(b)(i)

No.	TYPE OF PREMISES	Water Demand
1	Low Cost Terrace House /Flat	1135 lpd (250 gpd)
2	Single Storey Terrace / Low Medium & Medium Costs Flats	1360 lpd (300 gpd)
3	Double Storey Terrace House/High Cost Flats	1590 lpd (350 gpd)
4	Semi Detached House	1820 lpd (400 gpd)
5	Bungalow / Condominiums	2270 lpd (500gpd)
6	Shophouse (Single Storey)/ Gerai	2270 lpd (500gpd)
7	Shophouse (Double Storey)	2730 lpd (600 gpd)
8	Shophouse (Three Storey)	4090 lpd (900 gpd)
9	Light Industrial Workshop	1590 lpd (350 gpd)
10	Semi Detached / Bungalow Workshops	2730 lpd (600 gpd)
11	Heavy Industry	65,000 l/ha/day
12	Medium Industry	50,000 l/ha/day
13	Light Industry	33,000 l/ha/day
14	Office / Complex / Commercial (Domestic Usage)	1,200 lpd/100s.q.m
15	Hotels (with dining and laundry facility – Domestic Usage)	
	Hotel (3 star)	1360 lpd/room
	Hotel (5 star)	2000 lpd/room
16	Schools /Education Institutions	
	-Day School / Institution	55 lpd/student
	- Fully Residential	360 lpd/student
17	Hospitals (domestic usage)	1100 lpd/bed
18	Mosque (domestic usage)	135 lpd/person
19	Other place of worship	55 lpd/person
20	Wet Market	820 lpd/store
21	Petrol Kiosk	5000 lpd/service bay
22	Stadium	55 lpd/person
23	Golf Course	5500 lpd/hole

Notes:- gpd = Gallon per day
lpd = Liter per day
l/ha/day = Liter/hectares/day

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Table Q1(b)(ii)

	Average Total Flow (Litres) (Per Minute)	Spanning (Meters)	Maximum No. Of. Hydrant Outlets Used Simultaneously
Class A Risk Large buildings, shopping complexes, high rise buildings, large industrial estate, warehouse and ports.	4100	90	3@ 1370 lpm
Class B Risk Congested areas with buildings up to 5 storeys.	2700	90	2 @ 1370 lpm
Class C Risk Shophouse up to 3 storey, light industry	1370	90	1
Class D Risk Residential terrace house, detached, semi detached	1140	120-terrace 150-detached / semi detached	1
Class E Risk Others	680	180	1

Note lpm = litre per minute

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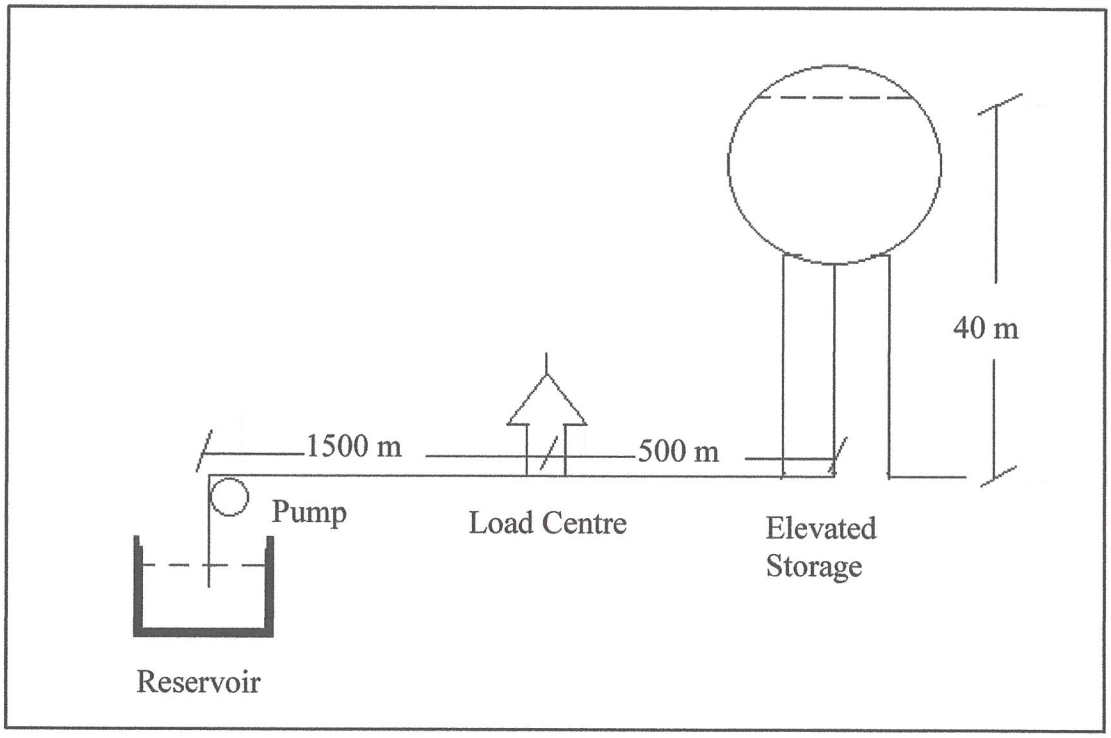

Figure Q3(b)

Table Q3(c)

Fitting or Valve	Loss Coefficient, K	Equivalent Length (Dia off pipe)
Tee (run)	0.6	20
Tee (branch)	1.80	60
90° bend		
Short radius	0.90	32
Medium radius	0.75	27
Long radius	0.60	20
45° bend	0.42	15
Gate valve (open)	0.48	17
Swing check valve (open)	3.7	135
Butterfly valve (open)	1.2	40

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Table Q4(b)

Constituents	mg/L
CO_2	9.0
Ca^{2+}	95.0
Mg^{2+}	12.0
Na^{+}	24.0
HCO_3^{-}	200.0
Cl^{-}	65.0
SO_4^{2-}	73.0

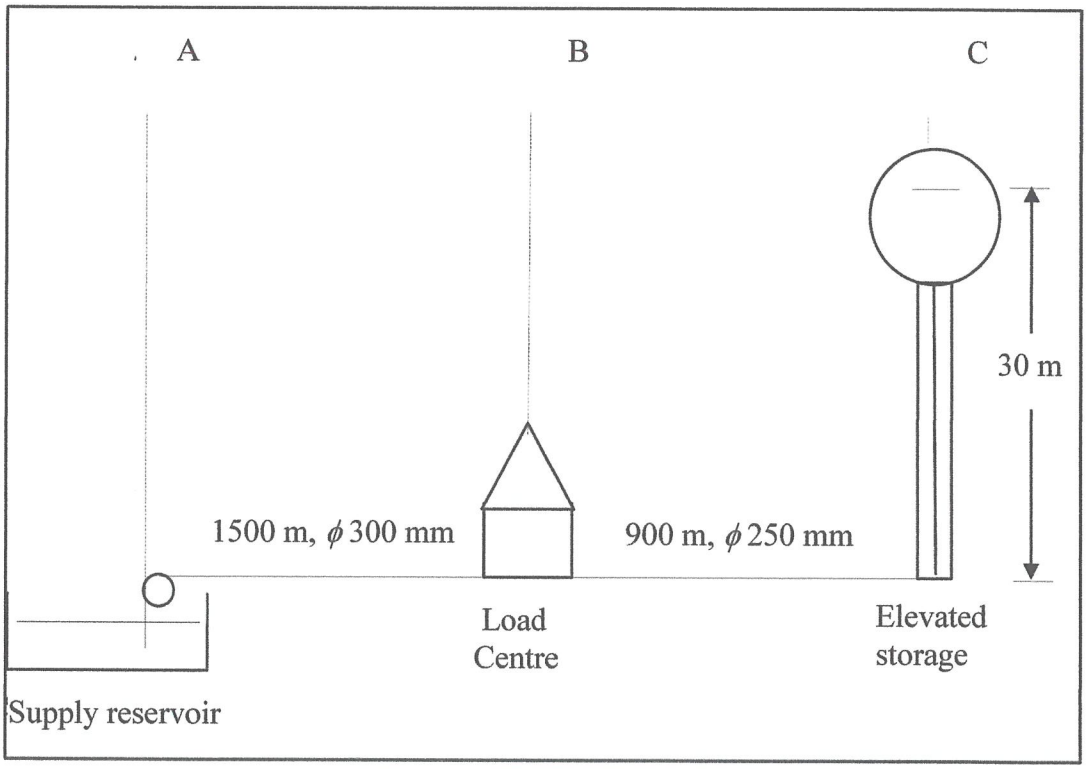

Figure Q6(c)(i)

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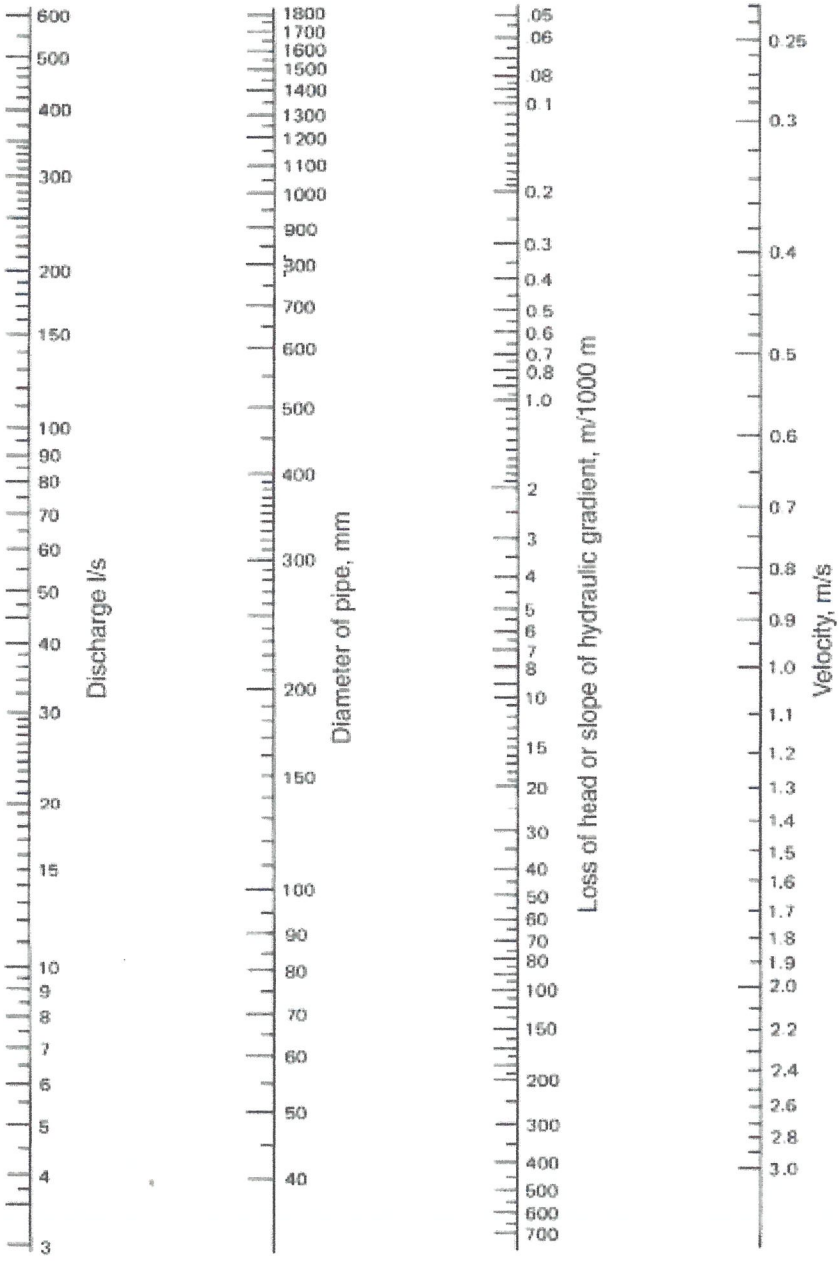

Figure Q6(c)(ii)