UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2013/2014

COURSE NAME	:	SOLID WASTE AND HAZARDOUS WASTE MANAGEMENT
COURSE CODE	:	BFA 40303/BFA 4033
PROGRAMME	:	4BFF
EXAMINATION DATE	:	DECEMBER 2013/JANUARY 2014
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

Q1 (a) Municipal solid waste is generated within a community from several sources, not just the household. List and discuss these sources.

(8 marks)

(b) Describe the waste management hierarchy. What is the ultimate goal of such a hierarchy?

(8 marks)

(c) Municipal solid waste generation is influenced by both population size and consumer lifestyle. How do these two factors differ for the Malaysia and a less developed country?

(9 marks)

Q2 (a) Determine the energy content of typical residential Municipal Solid Waste with the chemical composition of the waste including sulfur and water is :

$$C_{655.3} H_{1028.8} O_{407.7} N_{10.1} S$$

Atomic weight : C-12, H-1, O-16, N-14, S-32

(8 marks)

(b) For the following waste mixture,

Table Q2(b) : Waste mixture

Component	% by Wt	Uncompacted Bulk Density (kg/m^3)
Corrugated cardboard	25	30
Paper products	15	61
Aluminium	9	38
Food waste	29	368
Yard waste	22	7.1

(i) Calculate the bulk density for the waste mixture prior to compaction. Assume that the compaction in the landfill cell is 500 kg/m^3.
(ii) Estimate the volume reduction (expressed as %), during compaction in the landfill.
(iii) If the food and yard waste is diverted for composting, calculate the uncompacted bulk density of the remaining waste.

(7 marks)

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(c)   Using the data for a Municipal Solid Waste sample provided below, determine the average moisture content of the sample. Base your calculations on a 100 kg sample size.

Table Q2(c) : Composition of Municipal Solid Waste

Component	Moisture Content (%)	Wt (%)	Discarded Weight (kg)
Paper waste	7	25	25
Yard waste	55	18	18
Food waste	65	20	20
Plastic	2	5	5
Wood	20	8	8
Glass	3	7	7
Metals	3	9	9
Textiles	12	8	8
Total		100	

(10 marks)

Q3   (a)   In the town of Batu Pahat, it is determined that the per capita waste generation rate is 1.4 kg per person per day. Collection is conducted once per week by the municipality. If the density of municipal solid waste in a typical trash container is 150 kg/m^3, calculate how many 120 L containers would be needed for a family of four.

(10 marks)

(b)   From the above question Q3(a), collection trucks have a capacity of 11.5 m^3, which can compact the waste to a density of 420 kg/m^3. How many customers can a truck handle in a single run, before departing for the transfer stations?

(2 marks)

(c)   Assume that home compaction units are to be installed in a residential area. Estimate the volume reduction that could be achieved in the solid wastes collected if the compacted specific weight is equal to 540 kg/m^3 and the data given in Table Q3(c).

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Table Q3(c) : The composition of solid waste

Component	Weight, kg	Specific weight, kg/m^3
Organic		
Food wastes	9.0	490
Paper	34.0	150
Cardboard	6.0	167
Plastics	7.0	110
Textiles	2.0	110
Rubber	0.5	220
Leather	0.5	270
Yard wastes	18.5	170
Wood	2.0	400
Inorganic		
Glass	8.0	330
Tin cans	6.0	150
Aluminium	0.5	270
Others metal	3.0	540
Dirt, ash, etc	3.0	810

(i) Determine the volume of compacted wastes, excluding yard wastes; wood, metals other than aluminium and tin cans; and dirt, ashes, etc.

(ii) Determine the volume reduction for the compressible material.

(iii) Determine the overall volume reduction achieved with a home compactor, taking into account garden trimmings; wood, metals other than aluminium and tin cans; dirt, ashes, etc.

(13 marks)

Q4 (a) How do source reduction, reuse and recycling differ?

(9 marks)

(b) Determine the area required for a new sanitary landfill with a projected lifetime of 25 years. The landfill will serve a population of 250,000 persons, generating 28 kg per household per week. Waste density in the landfill averages 550 kg/m^3. Landfill height is not to exceed 25 meters. Assume four persons per household.

(6 marks)

(c) List and discuss five (5) factors pertinent to the selection of a landfill site.

(10 marks)

Q5 (a) Define hazardous waste.

(5 marks)

(b) Explain why seismic risk is important in landfill sitting.

(5 marks)

(c) List **FIVE (5)** Environmental Protection Agency (EPA) requirements for a hazardous waste landfill and sketch a landfill that meets these.

(10 marks)

(d) Calculate the solids retentions (θ) time in a rotary kiln incinerator with the following data:

Kiln length = 6 m
Kiln rotational velocity = 0.8 r/min
Kiln diameter = 1.8 m
Kiln slope = 0.085 m/m

If the desired retention time is actually 12.0 min, what should the rotational velocity be adjusted to?

(5 marks)

-END OF QUESTION-