
UNIVERSITI SAINS MALAYSIA

1st. Semester Examination
2004/2005 Academic Session

October 2004

EAP 585/4 – Solid and Hazardous Waste Management

Duration : 3 hours

Instructions to candidates:

Arahan kepada calon:

1. Ensure that this paper contains **LIMA (5)** printed pages before you start your examination.
Sila pastikan kertas peperiksaan ini mengandungi LIMA (5) muka surat bercetak sebelum anda memulakan peperiksaan ini.
2. This paper contains **SIX (6)** questions. Answer **FIVE (5)** questions only. Marks will be given to the **FIRST FIVE (5)** questions put in order on the answer script and **NOT** the **BEST FIVE (5)**.
Kertas ini mengandungi ENAM (6) soalan. Jawab LIMA (5) soalan sahaja. Markah hanya akan dikira bagi LIMA (5) jawapan PERTAMA yang dimasukkan di dalam buku mengikut susunan dan bukannya LIMA (5) jawapan terbaik.
3. All questions **CAN BE** answered in English or Bahasa Malaysia or combination of both languages.
Semua soalan boleh dijawab dalam Bahasa Inggeris atau Bahasa Malaysia ataupun kombinasi kedua-dua bahasa.
4. Each question carry equal marks.
Tiap-tiap soalan mempunyai markah yang sama.
5. All question **MUST BE** answered on a new sheet.
Semua jawapan MESTILAH dijawab pada muka surat yang baru.
6. 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) Describe the listing approach for the classification of hazardous wastes. (10 marks)
(a) Bincang mengenai senarai pendekatan untuk mengklasifikasikan sisa berbahaya. (10 markah)
(b) Explain sludge stabilization by chemical fixation. (10 marks)
(b) Jelaskan mengenai kestabilan enapcemar melalui pengikatan kimia. (10 markah)

2. (a) Describe any **TWO (2)** of the following characteristics of hazardous wastes:
(i) Flammability
(ii) Toxicity
(iii) Reactivity
(iv) Corrosiveness (10 marks)
*(a) Bincangkan mengenai sebarang DUA (2) ciri-ciri sisa merbahaya:
(i) kebolehnyaalaan
(ii) ketoksikan
(iii) kereaktifan
(iv) kehakistan (10 markah)*
(b) Discuss the use of personal protective equipment (PPE) at hazardous waste sites. (10 marks)
(b) Bincangkan mengenai penggunaan peralatan perlindungan personal/peribadi (PPE) di tapak sisa merbahaya. (10 markah)

3. (a) What is incineration? Discuss the advantages and disadvantages of a rotary kiln incinerator. (10 marks)
(a) Apakah penunuan? Senaraikan kebaikan dan keburukan penunu tanur putar. (10 markah)
(b) Describe the operation and working of a fluidized-bed incinerator. (10 marks)
(b) Terangkan mengenai operasi dan cara kerja sebuah penunu lapik terbendalir. (10 markah)

4. (a) Once equipment and labour requirements have been determined, collection route must be laid out. List any **FIVE (5)** rules to determine the collection route of waste truck.

(5 marks)

- (a) *Setelah keperluan peralatan dan buruh ditentukan, jalan untuk kutipan perlu dibentangkan. Senaraikan **LIMA (5)** peraturan untuk menentukan perjalanan truk kutipan sampah.*

(5 markah)

- (b) Estimate the generation rate of waste from a residential area if the following data were given:

No of trucks to collect domestic waste	=	20/ week
Capacity of the truck	=	12m ³
Truck compaction factor	=	1.5
No of open-top trucks to collect yard waste	=	10/week
Factor of truck usage	=	0.85
Density of domestic solid waste	=	180 kg/m ³
Density of yard waste	=	120kg/m ³
Total no of houses	=	2,000
Average no. of household	=	4 people

(5 marks)

- (b) *Kira kadar perjanaan sisa dari kawasan perumahan jika data berikut diberikan:*

<i>Bil. Truk mengutip sisa domestik</i>	=	<i>20/minggu</i>
<i>Muatan truk</i>	=	<i>12 m³</i>
<i>Faktor mampatan truk</i>	=	<i>1.5</i>
<i>Bil. Truk dengan atas terbuka</i>		
<i> untuk kutipan sisa taman</i>	=	<i>10/minggu</i>
<i>Faktor penggunaan truk</i>	=	<i>0.85</i>
<i>Ketumpatan sisa domestik</i>	=	<i>180 kg/m³</i>
<i>Ketumpatan sisa taman</i>	=	<i>120 kg/m³</i>
<i>Jumlah bilangan rumah</i>	=	<i>2,000</i>
<i>Purata bilangan penghuni</i>	=	<i>4 orang</i>

(5 markah)

- (c) Write short notes on any **TWO (2)** of the following:

- i) Physical properties of waste
- ii) Leachate treatment
- iii) Siting of landfill

(10 marks)

- (c) *Tulis nota ringkas mengenai sebarang **DUA (2)** dari berikut:*

- (i) Ciri-ciri fizikal sisa*
- (ii) Olahan larut lesapan*
- (iii) Penentuan tapak pelupusan*

(10 markah)

5. (a) Develop a process flow diagram to process mixed recyclable composed of tin and ferrous cans.

(5 marks)

- (a) *Lakarkan rajah proses untuk memproses bahan kitar semula yang terdiri daripada campuran tin, timah dan ferum.*

(5 markah)

- (b) Using the process flow diagram developed in question 5(a), prepare a layout of the materials recovery facility.

(5 marks)

- (b) *Dengan menggunakan rajah carta proses yang telah dibina dalam soalan 5(a), berikan susunatur fasiliti pemulihan bahan (MRF) tersebut.*

(5 markah)

- (c) Solid waste from a new apartment block is to be collected in large containers. Determine the number of trips per day, based on 8 hour workday.

Assume the following data holds:

Time from garage to first container	=	15 min
Time from last container to garage	=	25 min
Haul distance to landfill	=	30 km
Average speed of truck	=	80km/h
Time required to pick up loaded container	=	21 min/trip
Time required to unload container	=	3min/trip
Time driving between container locations	=	6 min
Off - route factor	=	0.15

(5 marks)

- (c) *Sisa pepejal dari blok pangsapuri akan dikutip dalam bekas besar. Tentukan bilangan perjalanan per hari, berdasarkan 8 jam waktu kerja.*

Anggap data-data berikut:-

<i>Masa dari garaj ke bekas yang pertama</i>	=	<i>15 min</i>
<i>Masa dari bekas terakhir ke garaj</i>	=	<i>25 min</i>
<i>Jarak menghala ke tapak pelupusan</i>	=	<i>30 km</i>
<i>Had laju purata truk</i>	=	<i>80km/h</i>
<i>Masa untuk mengutip bekas berisi</i>	=	<i>21 min/trip</i>
<i>Masa untuk mengosongkan bekas</i>	=	<i>3min/trip</i>
<i>Masa memandu di antara bekas</i>	=	<i>6 min</i>
<i>Faktor 'off - route'</i>	=	<i>0.15</i>

(5 markah)

5. (d) Discuss the environmental monitoring systems used during closure and postclosure of landfill.

(5 marks)

- (d) *Bincang mengenai penggunaan sistem pengawasan alam sekitar semasa penutupan dan pasca-penutupan tapak pelupusan.*

(5 markah)

6. (a) Calculate the volume of methane and carbon dioxide gases from organic waste with the following characteristics:

Component	Dry weight (kg)	kg			
		C	H	N	O
Food wastes	25.0	12.3	0.35	0.07	2.5
Paper	10.0	25.0	5.0	0.10	29.0
Cardboard	5.0	4.5	6.0	0.02	4.5
Yard wastes	7.5	2.5	4.5	0.15	7.5

Given : Density of methane, $CH_4 = 0.11 \text{ kg/m}^3$, $CO_2 = 1.98 \text{ kg/m}^3$
Relative atomic mass: C=12, H=1, O=16, N=14

(8 marks)

- (a) *Kirakan isipadu gas metana dan karbon dioksida dari sisa organik yang mempunyai ciri-ciri berikut:-*

Komponen	Jisim kering (kg)	kg			
		C	H	N	O
<i>Sisa makanan</i>	25.0	12.3	0.35	0.07	2.5
<i>Kertas</i>	10.0	25.0	5.0	0.10	29.0
<i>Kadbod</i>	5.0	4.5	6.0	0.02	4.5
<i>Sisa taman</i>	7.5	2.5	4.5	0.15	7.5

*Diberikan: Ketumpatan metana, $CH_4 = 0.11 \text{ kg/m}^3$, $CO_2 = 1.98 \text{ kg/m}^3$
Jisim atom relatif: C=12, H=1, O=16, N=14*

(8 markah)

- (b) By using suitable diagram(s), discuss the variation in the generation of landfill gases according to the different phases.

(6 marks)

- (b) *Dengan menggunakan rajah yang sesuai, bincang perubahan penjanaan gas-gas tapak pelupusan menurut fasa-fasa yang berbeza.*

(6 markah)

- (c) Discuss the passive and active control of landfill gases.

(6 marks)

- (c) *Bincang mengenai kawalan secara pasif dan aktif gas tapak pelupusan.*

(6 markah)