First Semester Examination
Academic Session 2019/2020

December 2019/January 2020

EAP585 – Solid and Hazardous Waste Management

Duration : 2 hours

Please check that this examination paper consists of **SIX (6)** pages of printed material before you begin the examination.

Instructions : This paper contains **FIVE (5)** questions. Answer **FOUR (4)** questions.

All questions must be answered in English.

Each question **MUST BE** answered on a new page.

(1). (a). In an essay form, describe the various aspects of a sanitary landfill design. The following terms and phrases may be used in your sentences: municipal solid waste, construction waste, open dump, designed sanitary landfill, $k = 10^{-7}$ m/s, clay, geosynthetic clay liner (GCL), high-density polyethylene (HDPE), geomembrane, leachate, leachate generation, leachate collection pipe, leachate collection sump, leachate holding pond, leachate treatment plant, gas ventilation pipe, gas generation, gas mitigation facility, groundwater, groundwater level, excavation, decomposition, anaerobic decomposition, aerobic decomposition, daily cover, final cover, biological treatment, physio-chemical treatment, berm, batter face, cell bund, wash through, monitoring well, bore hole, front loader bulldozer, weighbridge, wash bay.

[12 marks]

(b). A municipality disposes 50 tons of waste per day. A new, 56 m wide, 1 km long landfill site has been acquired which is located in a valley. The picture of the landfill while being prepared is given in **Figure 1**. The traverse cross section is given in **Figure 2** while the longitudinal cross section is given in **Figure 3**. Assume that the final landfill surface is as given in the figures. The volumes of daily and final cover can be neglected. Calculate the expected service lifetime, in years, of the landfill by assuming that the average density of the deposited waste as 400 kg/m^3.

[13 marks]

Figure 1: The landfill while being prepared

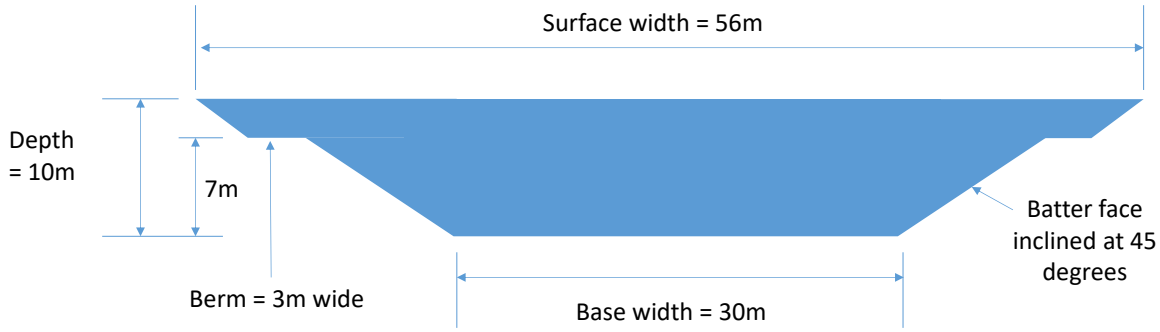

Figure 2: Traverse cross section

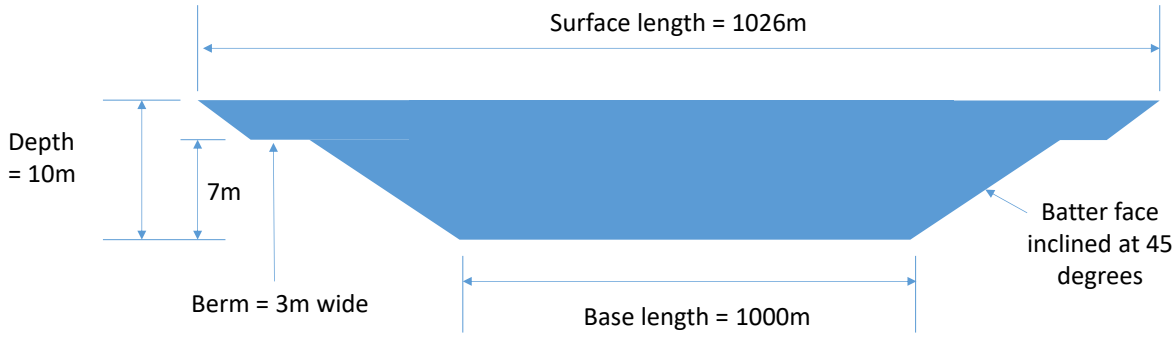

Figure 3: Longitudinal cross section

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(2). (a). Determine the time required to complete a filling and emptying cycle for a waste collection truck serving a residential area if the following conditions pertain:

(i). Truck volume is 20 m^3.

(ii). Each location has on average two containers of 360 L each at 75% full. Solid waste is picked up twice a week.

(iii). Truck has compaction ratio 1:2. Pickup time is 1.58 minute per service. It takes 20 minute to drive to disposal site. Truck spends 20 minute at the disposal site. Density of uncompacted waste is 120 kg/m^3 and 350 kg/m^3 for compacted waste.

[10 marks]

(b). Briefly discuss the advantages and disadvantages of biological treatment of solid waste.

[5 marks]

(c). With the aid of illustration, discuss the differences between composting and aerobic digestion technique in solid waste treatments.

[10 marks]

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(3). (a). Bukit Tagar Landfill is operated with support of Taman Beringin Transfer Station to cater 4000 tons of solid waste per day. Describe the benefits of having a waste transfer station.

[10 marks]

(b). Assume it costs RM 0.35/ton/km to operate a local compactor truck and RM 0.15/ton/km to operate a transfer truck. A transfer station also has affixed cost of RM 9.50/ton. Determine the least expensive transportation alternative, given the distance to the landfill is 40 km. With the support of a graph, justify your decision.

[15 marks]

(4). (a). Hazardous waste has the potential to cause an unacceptable risk to public health and the environment, which makes identifying hazardous waste important. Describe the characteristics of hazardous waste and give **ONE (1)** example of waste for each of the characteristics.

[8 marks]

(b). The Environmental Quality (Scheduled Wastes) Regulations 1989 was revoked with the implementation of Environmental Quality (Scheduled Wastes) Regulations 2005 on 15 August 2005. Describe **THREE (3)** major changes that were introduced in the 2005 regulation.

[6 marks]

(c). It is important to control the behaviour of liquid waste while it is transported to prevent incidences of roll over when making a turn. With the aid of sketches, discuss the behaviour of liquid waste during vehicle manoeuvres in tankers.

[11 marks]

(5). (a). Waste management hierarchy ranks the various management strategies from most to least environmentally preferred. The third step focuses on treatment and recovery as part of the waste management system.

(i). Explain the treatment and recovery process that is relevant to SW 102 (Waste of lead acid batteries in whole or crushed form)

[4 marks]

(ii). Describe the treatment and recovery process concerning SW307 (spent mineral oil-water emulsion)

[4 marks]

(b). A solvent recovery system is a process system that takes effluent and extracts useful solvent and raw materials back out of the process waste stream.

(i). Give the definition of distillation.

[2 marks]

(ii). Explain the **THREE (3)** main steps of solvent recovery.

[3 marks]

(iii). Draw a schematic diagram that illustrates the mechanics of solvent distillation process operates to recover waste solvent.

[6 marks]

(c). Small-scale incinerators used in hospitals, of capacity 200 – 1000 kg/day, are operated on demand. Explain **THREE (3)** activities involved in operating a pyrolytic hospital incinerator.

[6 marks]

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