

National Examination, November/December 2016

**04-Env-A6 – Solid Waste Engineering and Management**

*3 hours duration*

**NOTES:**

1. There are a total of **TWENTY (20)** examination questions on **3** pages.
2. Each question is of the value indicated. There are **100 possible** marks for the examination.
3. **NO CALCULATOR** permitted. This is a **CLOSED BOOK EXAM**.
4. **If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made for the solution of the examination questions.**
5. Clarity and organization of the answers are important.

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- 8            1. As consulting engineer, you have been commissioned to develop a comprehensive solid waste management system for a community interested in achieving greater recovery and reuse of their solid wastes. Two of the possible alternatives are separation at home or separation at a materials recovery facility. *What important factors must you consider in evaluating these two alternatives?*
- 6            2. In your first position as junior city engineer you are assigned to report on the generation rates and composition of solid wastes from various sources of your community.  
              2.1 *How would you go about it?*  
              2.2 *If these data were needed in 30 days and thus you had no time to assess seasonal effects, how would you estimate this factor?*
- 5            3. *Name 5 important physical properties of MSW.*
- 4            4. *What is the goal of a waste characterization study? What are the major steps you have to take?*
- 2            5. *Name two major factors that cause the development of odors in on-site storage facilities.*
- 2            6. *What is the impact of the occurrence of hazardous wastes in solid waste management facilities?*
- 3            7. *Estimate the required landfill area (not including a buffer zone) for a community of 30,000 persons. Assume a solid waste generation of 3 kg/capita.day, a compacted specific weight of solid waste in the landfill at 500 kg/m<sup>3</sup> and average landfill compacted depth of solid waste at 8m*
- 3            8. *What factors do you have to consider in assessing under what circumstances and with what limitations you could discharge landfill leachate to a nearby wastewater treatment plant?*
- 4            9. You have been commissioned to devise a strategy for extending the life of a community landfill. *Outline what you would propose.*
- 3            10. *What do you have to address in the development of a long-term landfill closure plan?*

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- 8 11. Landfill mining is likely to play an important role in the future of waste management. Please provide concise answers to the following items:  
 11.1 *List four (4) reasons why one would consider landfill mining.*  
 11.2 *Provide a list of health and safety requirements.*  
 11.3 *Briefly describe items to be considered in the work plan.*
- 8 12. Your town is considering establishing a new landfill to manage their solid waste. The citizens have become concerned. In order to address this concern and opposition by the citizens to a landfill in their community, the mayor has called a public meeting where you, as the town engineer, has to address this opposition and attempt to soothe their concerns and fears. *Identify the steps of your strategy in point form.* Your objective is that at end of your talk the audience will have fewer concerns and the opposition has lessened.
- 3 13. *Name 3 variables that govern landfill gas production.*
- 4 14. *Name 4 factors that affect landfill gas (LFG) production.*
- 4 15. *Name 4 issues in the implementation of combustion facilities for MSW.*
- 5 16. Based on the energy contents of the components of municipal solid waste as collected (Table 1), *determine the energy content in refuse consisting of 50% paper and 20% metal, glass and ash, with the balance being food and other organic wastes.*

**TABLE 1 TYPICAL ENERGY CONTENT FOR COMBUSTIBLE MATERIALS**

MATERIAL	Typical Energy Content (kJ/kg)
<b>Municipal Solid Waste</b>	
• Per unit weight of refuse	<b>10,500</b>
• Per unit weight of combustibles	<b>23,200</b>
• Per unit weight of paper	<b>16,300</b>
• Per unit weight of organics	<b>5,800</b>

- 4 17. *What issues do you have to address when you wish to implement a Composting Facility?*

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- 4      18. In aerobic composting, *what happens* :
- 18.1 *if the C:N ratio is < 10, if it is > 40*
  - 18.2 *when temperature > 68 deg C*
  - 18.3 *if the pH > 8.5*
- 12      19. The town of Dangaroo is landfilling their municipal solid waste (MSW). The landfill only has enough remaining capacity to handle their MSW for another 3 years. Composting is one option to extend the landfill life. You have been commissioned to prepare a feasibility report about whether or not composting their municipal solid waste is a viable solution. *Prepare a report index showing major- and associated sub-headings of all factors that you consider to be important for this assignment.*
- 8      20. *List the essential elements you would use in a Life Cycle Analysis of a solid waste management plan.* State all of your assumptions.

**100 Total marks**