

National Examination, May 2009

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

*3 hours duration*

**NOTES:**

1. There are **18** questions for a total possible examination mark of **100**.
2. This examination is a **CLOSED BOOK EXAM**.
3. Other aids: 1 sheet (8.5" x 11") both sides, any non-communicating calculator.
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 assumption made.*

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- 5 marks 1. Estimate the required landfill area (not including a buffer zone) for a community of 31,000 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.
- 5 marks 2. A community is implementing their integrated solid waste management program. A landfill site needs to be identified. What landfill siting considerations must you address?
- 3 marks 3. Name 3 leachate management options.
- 5 marks 4. Name 5 processes/operations used for the treatment of leachate.
- 4 marks 5. 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?
- 5 marks 6. Name 5 important elements of a landfill operations plan.
- 3 marks 7. What do you have to address in the development of a long-term landfill closure plan?
- 3 marks 8. What must you consider in the development of a landfill post-closure plan?
- 5 marks 9. Name 5 types of air emissions from a thermal recovery system?
- 10 marks 10. Name the important design considerations for aerobic composting and state why they are important.
- 6 marks 11. Name 6 key issues in materials recycling.
- 10 marks 12. Identify 6 public concerns and a typical mitigation action/strategy for this concern at a new landfill.
- 9 marks 13. What are the typical engineering calculations that you need to make for the following to see whether or not a particular performance criterion is met:
- Gas testing
  - Leachate control
  - Groundwater monitoring
- 7 marks 14. Calculate the mass of water taken up per kg of dry rapidly biodegradable organic waste that is consumed in the formation of landfill gas. Assume that the organic waste can be represented as C<sub>68</sub>H<sub>111</sub>O<sub>50</sub>N and the end products in the reaction are methane, carbon dioxide and ammonia. The gas production is 250 m<sup>3</sup>/ton organic waste. Calculate the corresponding amount of water consumed per m<sup>3</sup> of gas produced.

C = 12, H = 1, O = 16, N = 14. **State clearly any assumptions made**

80 marks

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- 5 marks 15. An experimental 200 t/day resource recovery plant, salvaging ferrous metals (8%) and glass (7%), each at \$30/t and savings from the reduced amount to be landfilled (at \$30/t). If capital and operating costs for the plant amount to \$75/t, what amount subsidy must be provided to keep the plant operating?
- 3 marks 16. You are asked to design of a refuse collection system, what are the factors that you must consider?
- 6 marks 17. Identify 2 refuse disposal methods and cite their advantages and disadvantages.
- 6 marks 18. When is waste separation at source warranted?  
18.1 What items might be considered for separate collection?

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**100 marks**