

National Examination, December 2013

04-Env-A6 – Solid Waste Engineering and Management

3 hours duration

NOTES:

1. This examination consists of **16** question.
2. The total possible examination mark is **100**.
3. This examination is a **CLOSED BOOK EXAM**.
4. Candidates are permitted **ONE** (1) letter sized aid sheet (8.5 “x 11”) both sides.
5. One calculator (Casio or Sharp).
6. 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.

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- points 10 1. Define:
- 1.1 Pyrolysis
 - 1.2 Btu
 - 1.3 Pathogens
 - 1.4 Vadose zone
 - 1.5 Soil porosity
 - 1.6 Henry's Law
 - 1.7 Wet oxidation
 - 1.8 Darcy's Law
 - 1.9 Breakthrough time
 - 1.10 Life-cycle analysis
- points 6 2. Name and briefly discuss 3 considerations that are critical in solid waste management.
- points 8 3. Name and briefly discuss 4 considerations for the design of a solid waste collection system.
- points 6 4. Name and briefly discuss 3 different leachate treatment processes.
- points 8 5. Name and briefly discuss 4 common problems that you must consider when designing a landfill.
- points 5 6. Outline a strategy that you would propose to you client municipality that will reduce Green House Gas emissions due to solid waste generation.
- points 5 7. For a population of 50,000 estimate the annual area required (excluding buffer zone) for a normally compacted landfill having a refuse depth of 4 m excluding cover material. State any assumptions made.
- points 10 8. 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?
- points 5 9. Sketch a cross section through a sanitary landfill and name all associated components.
- points 5 10. Sketch a diagram of essential process components of a typical resource recovery plant.

Sub-total 68

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- points 6 11. You have been commissioned to devise a strategy for extending the life of a community landfill. Outline what you would propose.
- points 3 12. State three methods commonly used to estimate municipal refuse quantities.
- points 7 13. 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.
13.1 How would you go about it?
13.2 If these data were needed in 30 days and thus you had no time to assess seasonal effects, how would you estimate this factor?
- points 7 14. You are retained by a municipality to assess the feasibility of building a waste-to-energy conversion plant and use this energy to supply their local industrial park.
14.1 Outline in point form the approach you would take in conducting this assessment.
- points 6 15. Municipal solid wastes from packer trucks are placed and well compacted in a sanitary landfill in three lifts, each 2 m deep, separated by a 250 mm clay layer and topped with a 1 m thick clay cap having a 4% slope. If annual precipitation in the area is 900 mm, of which 67% is lost through evapotranspiration.
15.1 estimate the quantity of leachate that will be generated
15.2 estimate the time until the refuse is saturated and the leachate flows from the landfill
assume:
 - density of the waste as delivered = 300 kg/m³
 - average moisture content as delivered = 25% by weight
 - density of well compacted landfill = 600 kg/m³
 - maximum moisture content of compacted refuse = 30 % by volume**make and state clearly any other assumptions made**
- points 3 16. Name 3 variables that govern landfill gas production.

Total 100