

National Examination December 2012

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

3 hours duration

**NOTES:**

1. The total possible examination mark is **100**.
2. This examination is an **CLOSED BOOK EXAM**.
3. Candidates are permitted **ONE** (1) letter sized aid sheet (8.5 "x 11") both sides.
4. One non-communicating calculator (Casio or Sharp).
5. *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.*
6. All **15** questions constitute a complete paper.

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- points 7 1. As consulting engineer you have been commissioned to conduct a risk analysis on the municipality's landfill project. Outline in points form how you would proceed.
- points 6 2. Name, and briefly discuss 3 considerations that are critical in solid waste management.
- points 7 3. You are the consultant to a seasonal community that hired you to generate information to be used in the development of a community solid waste management strategy. The timeline is short. Outline in point form how you would go about finding the what you believe to be the best data source(s).
- points 6 4. In the generation of a healthy compost, a number of key process inputs are essential. Name six (6).
- points 7 5. Name, and briefly discuss, 4 common problems that you must consider when designing a landfill.
- points 3 6. Name 3 variables that govern landfill gas production.
- points 8 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 all assumptions you make.
- points 6 8. Name and briefly discuss 3 different leachate treatment processes.
- points 10 9. 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.  
9.1 What important factors must you consider in evaluating these two alternatives?  
9.2 What is your recommendation?
- points 7 10. Name the components of a water balance for a landfill leachate?
- points 8 11. You have been commissioned to devise a strategy for extending the life of a community landfill. Outline what you would propose.
- points 5 12. Name the essential components of a landfill long-term closure plan.
- points 9 13. What are the important design considerations for aerobic composting?

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- points 5 14. 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**

<b>MATERIAL</b>	
<b>Municipal Solid Waste</b>	<b>Typical Energy Content</b>
<i>per unit weight</i>	<i>(kJ/kg)</i>
refuse	<b>10,500</b>
combustibles	<b>23,200</b>
paper	<b>16,300</b>
organics	<b>5.8</b>

- points 6 15. You completed an analysis of a municipal solid waste and summarized its' composition in Table 2. Now using these data, estimate the moisture content and density of this municipal solid waste.

**TABLE 2 SOLID WASTE ANALYSES**

<b>COMPONENTS</b>	<b>Sample</b>					
	100 kg kg	<i>moisture</i>		<i>dry solids</i>		<i>density</i>
		%	kg	%	kg	kg/m <sup>3</sup>
<b>Paper</b>	45	7	3.2	93	41.9	80
<b>Organics</b>	20	70	14	30	6	300
<b>Metal (Fe)</b>	7	3	0.2	97	6.8	480
<b>Glass</b>	10	2	0.2	98	9.8	160
<b>Ashes</b>	3	8	0.2	92	2.8	480
<b>Miscellaneous</b>	15	20	3	80	12	160
<b>SOLID WASTE</b>	<b>100</b>					

**100 TOTAL MARK**