National Examination, May 2017

04-Env-A6 – Solid Waste Engineering and Management

3 hours duration

NOTES:

1. There are **16** questions for a total possible examination mark of 100.
2. Each question is of the value indicated.
3. This examination is a **CLOSED** BOOK EXAM.
4. Clarity and organization of the answer are important.
5. Any non-communicating calculator is permitted.
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.

8 **1.** Name and briefly discuss 4 considerations for the design of a solid waste collection system.

9 **2.** Name and briefly discuss 3 different leachate treatment processes.

10 **3.** Outline a strategy that you would propose to you client municipality that will reduce Green House Gas emissions due to solid waste generation.

10 **4.** 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?

5 **5.** Sketch a cross section through a sanitary landfill and name all associated components.

8 **6.** You completed an analysis of a municipal solid waste and summarized its' composition in the following Table. Using these data, estimate the moisture content and density of this municipal solid waste.

TABLE 1 SOLID WASTE ANALYSIS

				VALUES ESTIMATED		
	Sample 100 kg	*moisture**		dry solids		*density**
COMPONENTS	kg	%	kg	%	kg	kg/m³
Paper	45	**7**	3.2	93	41.9	**80**
Organics	20	**70**	14.0	30	6.0	**300**
Metal (Fe)	7	**3**	0.2	97	6.8	**480**
Glass	10	**2**	0.2	98	9.8	**160**
Ashes	3	**8**	0.2	92	2.8	**480**
Miscellaneous	15	**20**	3.0	80	12.0	**160**
SOLID WASTE	**100**					

*** from Reference**

3 **7.** What are some of the significant hazards that the generation/emission of CH_4 in land fill gas (LFG) can pose?

8 **8.** You have been commissioned to devise a strategy for extending the life of a community landfill. Outline what you would propose.

5 **9.1** What are the benefits of conducting a Life-Cycle Analysis?
9.2 List the variables you would include in a Life-Cycle analysis of MSW composting facility.

4 **10.** Name **4** (four) issues you have to address when you wish to implement a Composting Facility.

5 **11.** List in point form the steps involved in composting.

3 **12.** Identify **3** (three) factors that limit growth of vegetation on landfills.

3 **13.** Name 3 variables that govern landfill gas production.

7 **14.** Based on the energy contents of the components of municipal solid waste as collected (Table 2), 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 2 TYPICAL ENERGY CONTENT FOR COMBUSTIBLE MATERIALS

MATERIAL	Typical Energy Content (kJ/kg)
Municipal Solid Waste	
• **Per unit weight of refuse**	**10,500**
• **Per unit weight of combustibles**	**23,200**
• **Per unit weight of paper**	**16,300**
• **Per unit eight of organics**	**5.800**

7 **15.** 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.

5 **16.** In point form list the Advantages and Disadvantages of sanitary landfills.

100 TOTAL EXAMINATION MARKS