

**National Examination, December 2009**  
**04-Env-A6 – Solid Waste Engineering & Management**

*3 hours duration*

**NOTES:**

1. There are **15** questions for a total possible examination mark of **100**.
2. This examination is a **CLOSED BOOK EXAM**. One aid sheet allowed written on both sides.
3. Any non-communicating calculator is permitted.
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.

National Examination, December 2009

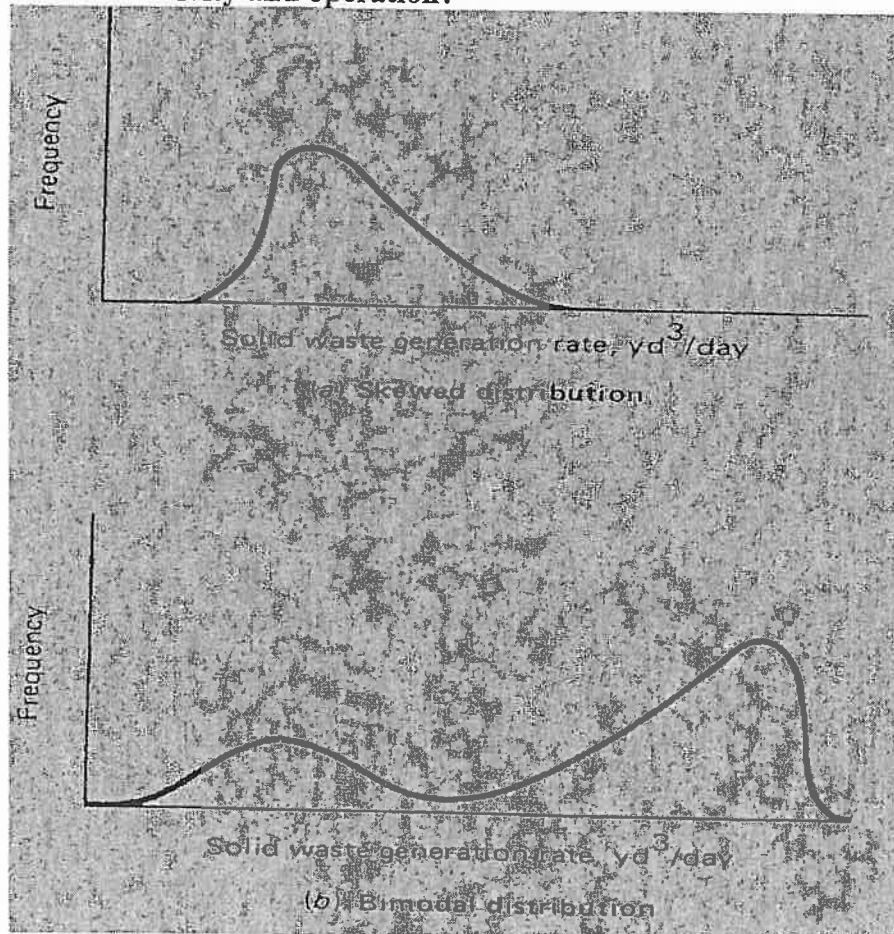
04-Env-A6 – Solid Waste Engineering and Management

8 points

1. In your first position as Junior City Engineer you are assigned by your supervisor to report on the generation rates and composition of solid wastes for various sources of your community. How would you go about it? If these data were needed in 30 days, and thus you had no time to assess seasonal effects, how would you estimate this factor?

8 points

2. The shape of a solid waste generation frequency curve reflects the nature of the generating facility. From the frequency curves shown what can you deduce about the facilities' activity and operation?



6 points

3. Why is the density of solid wastes a significant design parameter?

National Examination, December 2009

04-Env-A6 – Solid Waste Engineering and Management

4 points

4. What is the difference between compaction and consolidation?

5 points

5. What does the selection of specific waste processing techniques for a solid waste management system depend on?

6 points

6. In point form list the Advantages and Disadvantages of sanitary landfills.

8 points

7. List what factors you must consider when selecting a landfill site.

2 points

8. What are the products from a landfill?

5 points

9. Why is compacted density an important consideration?

9.1 How would you calculate it?

10 points

10. On a given day a cannery receives 12 tons of raw produce, 5 tons of cans, 0.5 tons of cartons and 0.3 tons of miscellaneous materials. The output includes 10 tons of processed produce, the remaining becoming part of the wastewater. Four tons of the cans are stored for future use and the remainder are used to package the produce. About 3 percent of the cans are damaged and recycled. The cartons are also used for packaging except for 3 percent which become damaged and are incinerated with other paper wastes. Of the miscellaneous materials, 75 % become paper wastes that are incinerated and the remainder are disposed of by the municipal agency. In preparation for a materials balance diagram draw a materials flow diagram.

6 points

11. Determine the thickness of a clay layer necessary to limit seepage of leachate to about 0.2 liters/day/unit area. Assume that the water table is located at the bottom of the landfill and that the leachate level in the landfill above the clay layer is to be maintained at 1 m by pumping. The K value for the clay material to be used is  $0.0008 \text{ m}^3/\text{m}^2 \cdot \text{d}$ .  $Q = -KAh/dL$

8 points

12. List the factors that you must address in developing a design and an operational plan for a landfill.

National Examination, December 2009

04-Env-A6 – Solid Waste Engineering and Management

10 points

13. List in point form the steps involved in the composting of waste solids.

6 points

14. You have developed the following Table. Now, estimate the reduction in waste volume after combusting. Assume that the specific weight of the residue is  $600 \text{ kg/m}^3$  and that the average specific weight of the solid wastes in the combustor storage pit is about  $200 \text{ kg/m}^3$ .

Component	Solid waste, <sup>a</sup> lb	Inert residue, <sup>b</sup> %	Residue	
			lb	%
<b>Organic</b>				
Food wastes	90	5	4.5	1.9
Paper	340	6	20.4	8.6
Cardboard	60	5	3.0	1.3
Plastics	70	10	7.0	2.9
Textiles	20	6.5	1.3	0.5
Rubber	5	9.9	0.5	0.2
Leather	5	9.0	0.5	0.2
Yard wastes	185	4.5	8.3	3.5
Wood	20	1.5	0.3	0.1
Misc. organics	—	—	—	—
<b>Inorganic</b>				
Glass	80	98	78.4	33.0
Tin cans	60	98	58.8	24.7
Aluminum	5	96	4.8	2.0
Other metal	30	98	29.4	12.4
Dirt, ash, etc.	30	68	20.4	8.6

8 points

15. Assuming that the compaction curves shown can be approximated by a first order equation, estimate the surface settlement after 10 yrs in a well compacted sanitary landfill (use the maximum compaction curve). What will be the maximum surface settlement after 50 yrs?

