

NATIONAL EXAMINATION DECEMBER 2019

18-Env-A6-Solid Waste Engineering and Management

3 hours duration

Notes:

1. Question 1 is compulsory, attempt any three questions from the remaining four questions.
2. If doubts exist as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
3. This is a closed book exam. However, one aid sheet is allowed written on both sides.
4. An approved Casio or Sharp calculator is permitted.
5. Marks of all questions are indicated at the end of each question.
6. Clarity and organization of answers are important.

Q1 (25 marks)

Give a brief description of the following in municipal solid waste management.

- i. Key concerns with a landfill (5 marks)
- i. Landfill leachate (5 marks)
- ii. landfill closure and post closure care (5 marks)
- iii. Principal landfill gas constituents (5 marks)
- iv. Windrow and aerated static pile composting techniques (5 marks)

Q2 (25 marks)

- a. Describe the key features of biological activity and leachate composition of Phase 3 (acid phase) of a landfill (12 marks)
- a. Sketch a cross section through a sanitary landfill and name all associated components. (15 marks)

Q3 (25 marks)

- a. List and briefly describe the steps involved in composting (9 marks)
- b. Describe the key causes of odour in a composting facility (9 marks)
- a. Name the key parameters that define the quality of the final compost product (7 marks)

Q4 (25 marks)

- a. Name the key constituents of landfill gas. Explain, with the help of generalized trend chart how the gas composition varies with ageing of the landfill. (10 marks)
- b. You completed an analysis of a municipal solid waste and summarized its' composition in the following Table. Using these data, estimate the percent moisture and dry solids contents, and bulk density of this municipal solid waste. (15 marks)

Component	Mass per 100 kg (kg/100 kg-solid waste)	Moisture %	Density kg/m ³
Paper	25	7	100
Organics	55	70	300
Metal (Fe)	10	3	480
Glass	7	2	160
Ash	3	8	480

Q5 (25 marks)

Name and briefly describe the five phases of a landfill with regard to the chemical and biological reactions and changes in the composition of the landfill leachate and gas. (25 marks)