Critical Thinking Questions – Waste Generation and Characteristics

I. Waste Generation and Composition

1. List the components in MSW.
2. Why is quantifying waste generation rates important?
3. Describe the three methods for determining waste generation rates:
   a. Top-down approach
   b. Middle-up approach
   c. Facility-based approach
4. In 2013, which state landfilled the greatest percentage of their waste? Which landfilled the least?
5. Does your state import or export waste?
6. How is the majority of waste managed in the US?
7. When are waste-to-energy facilities most likely used?
8. How does the waste recycled and composted differ from the waste typically landfilled?
9. Develop a procedure for a waste composition study.

III. Municipal Solid Waste Composition

1. The table below describes landfilled and recycled wastes. If 11% of the waste generated is recycled, what is the composition of the generated waste?

Waste Component	Landfilled, % (by wt.)	Recycled % (by wt.)
Food	8	0
Paper	28	50
Cardboard	8	10
Plastic	9	6
Textiles	1	0
Rubber	0.8	0
Leather	0.8	0
YW	22	8
Wood	3	0
Glass	8	18
Ferrous Metal	11.4	8

2. The table below contains the composition of landfilled waste in a community and item specific recycling efficiencies. Calculate the % composition of the generated waste.

Waste Component	Landfilled Waste, % (by wt.)	Recycling Efficiency (%, generated)
Food waste	15	0
Mixed paper	30	70
Glass	7	40
Plastic	5	50
Metal	3	10
Textiles	7	0
Wood	8	0
Yard Waste	25	60

3. A community of 100,000 people generates 150 million pounds of waste per year and achieves an overall 20% recycling efficiency. The composition of this waste is shown in the table below. The waste from this community is taken to the county landfill, which has a capacity of 6,000,000yd^3.
   (a) What is the % composition, by weight, of the generated waste?
   (b) If the landfill is filled in 20 years, what is the compaction ratio of the waste? Compaction ratio is defined as the volume of waste placed in the landfill divided by the total landfill volume. Assume the waste does not settle over time and the composition and weight of waste generated and recycled stays the same every year.

Component	Landfilled Waste (% by wt)	Recycling Efficiency (%, of generated)	Density (lb/yd3)
Food	12	0	490
Paper	40	30	150
Plastic	8	15	110
Glass	7	10	330
Metal	15	8	540
Yard Waste	0	100	170
Other	18	0	810

4. The table below contains the composition of landfilled waste from a community, item specific recycling efficiencies, and the energy content of each waste component. Calculate the percent reduction in the energy content of the waste as a result of recycling. Note that without recycling, the landfilled waste is the same as the waste generated.

Component	Composition of Landfilled Waste, % by wt.	Individual Recycling Efficiency, %	Energy Content, BTU/lb wet waste
Food Waste	15	0	1797
Mixed Paper	30	70	6799
Glass	7	40	84
Plastics	5	50	14101
Metal	3	10	301
Textiles	7	0	7960
Wood	8	0	6640
Yard Waste	25	60	2601

IV. <u>Physical and Chemical Properties of Municipal Solid Waste</u>

1. Estimate the moisture content and volume of a waste with the following composition:

Waste Component	Composition of waste (%, by weight)
Paper	50
Glass	20
Food	20
Yard Waste	10

2. Define the following terms:

Term	Definition
Proximate analysis	
Ultimate analysis	
HHV	
LHV	

3. Determine the chemical composition of a typical yard waste with and without water. Assume the yard waste has a moisture content of 40%.

4. Calculate the molecular formula for a 50:50 mixture of food waste and paper waste, including water and normalizing to S. The food waste has a moisture content of 70% and the paper has a moisture content of 6%.

5. Determine the energy value of the waste in the table below:

Component	Wet Weight, lb	Moisture Content (%)	Heat Value, BTU/lb dry waste
Food Waste	8	70	2,000
Paper	28	6.1	72,000
Cardboard	8	5	7,000
Plastics	9	4.4	14,000
Wood	3	60	8,000
Glass	8	2.5	60
Metals	11.4	1.8	300