HW Problem 3: **Solution** **2005**

a. Explain why the as collected percentage of food waste is different in each scenario.

The amount of food waste collected as MSW is the same for each scenario. The amount of other materials, such as paper or yardwaste is less.
The least amount of MSW is collected under Scen. C, the most under Scen. A.
Because the amount of food waste stays the same, its waste compostion % increases.

b. Explain why the as collected percentage of paper is different for scenarios B and C.

The curbside collection program (Scen. C) diverts more paper than the drop-off program (Scen. B), both absolutely and relative to the total waste stream. Thus, the waste composition paper % decreases.

c. Determine the loose specific weight of each Scenario's MSW

	Percent Composition				Volume out of 100 pounds		
	Scen A	Scen B	Scen C	Spec wt	Scen A	Scen B	Scen C
Material	1	2	3	4	5	6	7
Food waste	7.5	8.4	8.9	490	0.02	0.02	0.02
paper	34.7	38.8	37.7	150	0.23	0.26	0.25
cardboard	6.2	6.9	6.7	85	0.07	0.08	0.08
plastic	6.7	7.5	7.6	110	0.06	0.07	0.07
textile	2.1	2.3	2.5	110	0.02	0.02	0.02
Rubber	0.5	0.6	0.6	220	0.00	0.00	0.00
Leather	0.2	0.2	0.2	270	0.00	0.00	0.00
yard waste	19.1	9.6	10.2	170	0.11	0.06	0.06
wood	2.1	2.3	2.5	400	0.01	0.01	0.01
Mics. Organ	--	--	--	--	--	--	--
glass	8.5	9.5	9.1	330	0.03	0.03	0.03
steel cans	5.5	6.1	5.8	150	0.04	0.04	0.04
aluminum cans	0.6	0.7	0.6	270	0.00	0.00	0.00
Other metal	3.2	3.6	3.8	540	0.01	0.01	0.01
Dirt, ash, etc	3.1	3.5	3.7	810	0.00	0.00	0.00
Total	100	100	100	--	0.59	0.60	0.59

Calculation

Column	Description
1, 2, 3	pounds out of 100 pounds as collected (MSW)
4	Specific weight of material, from a table, lb/cu-yd
5, 6, 7	volume out of 100 pounds as collected (MSW), cu-yd column 1, 2, or 3, divided by column 4

The specific weight of a Scenario's MSW is 100 lb / Sum(column 5, 6, or 7)

Scen A	100	/	0.59	=	168	lb/cu-yd
Scen B	100	/	0.60	=	168	lb/cu-yd
Scen C	100	/	0.59	=	169	lb/cu-yd

d. Determine the loose specific weight of the recyclables collected in Scenario C

Material	1	2	3
Paper (newspaper)	50	150	0.33
Cardboard	12	85	0.14
Glass	17.5	330	0.05
Steel cans	10	150	0.07
Plastic (HDPE & PET)	8	110	0.07
Aluminum cans	2.5	270	0.01
Total	100	--	0.68

The specific weight of Scenario C's recyclables is 100 lb / Sum(column 3)

100 / 0.68 = 148 lb/cu-yd

e. Determine the moisture content of each Scenario's MSW

	Percent Composition				Moisture out of 100 pounds		
	Scen A	Scen B	Scen C	Moisture	Scen A	Scen B	Scen C
	1	2	3	4	5	6	7
Food waste	7.5	8.4	8.9	70	5.25	5.87	6.26
paper	34.7	38.8	37.7	6	2.08	2.33	2.26
cardboard	6.2	6.9	6.7	5	0.31	0.35	0.33
plastic	6.7	7.5	7.6	2	0.13	0.15	0.15
textile	2.1	2.3	2.5	10	0.21	0.23	0.25
Rubber	0.5	0.6	0.6	2	0.01	0.01	0.01
Leather	0.2	0.2	0.2	10	0.02	0.02	0.02
yard waste	19.1	9.6	10.2	60	11.46	5.76	6.14
wood	2.1	2.3	2.5	20	0.42	0.47	0.50
Mics. Organ	--	--	--	--	--	--	--
glass	8.5	9.5	9.1	2	0.17	0.19	0.18
steel cans	5.5	6.1	5.8	3	0.17	0.18	0.17
aluminum cans	0.6	0.7	0.6	2	0.01	0.01	0.01
Other metal	3.2	3.6	3.8	3	0.10	0.11	0.11
Dirt, ash, etc	3.1	3.5	3.7	8	0.25	0.28	0.30
Total	100	100.0	100.0	--	20.59	15.96	16.71

Calculation

Column	Description
1, 2, 3	pounds out of 100 pounds as collected (MSW)
4	Moisture content, %
5, 6, 7	Moisture (pounds) out of 100 pounds as collected (MSW) column 1, 2, or 3, multiplied by column 4 / 100

The moisture content of a Scenario's MSW is the Sum of column 5, 6, or 7

Scen A	20.59 %
Scen B	15.96 %
Scen C	16.71 %

f. Determine the energy content of each Scenario's MSW

	Percent Composition				BTU out of 100 pounds		
	Scen A	Scen B	Scen C	BTU/lb	Scen A	Scen B	Scen C
	1	2	3	4	5	6	7
Food waste	7.5	8.4	8.9	2000	15000	16761	17874
paper	34.7	38.8	37.7	7200	249840	279166	271655
cardboard	6.2	6.9	6.7	7000	43400	48494	46554
plastic	6.7	7.5	7.6	14000	93800	104810	106835
textile	2.1	2.3	2.5	7500	15750	17599	18767
Rubber	0.5	0.6	0.6	10000	5000	5587	5958
Leather	0.2	0.2	0.2	7500	1500	1676	1787
yard waste	19.1	9.6	10.2	2800	53480	26891	28676
wood	2.1	2.3	2.5	8000	16800	18772	20018
Mics. Organ	--	--	--	--	--	--	--
glass	8.5	9.5	9.1	60	510	570	543
steel cans	5.5	6.1	5.8	300	1650	1844	1749
aluminum cans	0.6	0.7	0.6	0	0	0	0
Other metal	3.2	3.6	3.8	300	960	1073	1144
Dirt, ash, etc	3.1	3.5	3.7	3000	9300	10392	11082
Total	100	100	100	--	506990	533634.3	532642.2

Calculation

Column	Description
1, 2, 3	pounds out of 100 pounds as collected (MSW)
4	Energy content, BTU/lb
5, 6, 7	BTU's out of 100 pounds as collected (MSW) column 1, 2, or 3, multiplied by column 4

The energy content of a Scenario's MSW is the Sum of column 5, 6, or 7 divided by 100 lb

Scen A	5070 BTU/lb
Scen B	5336 BTU/lb
Scen C	5326 BTU/lb

g. Which Scenario results in MSW with the highest energy content. Why?

Scenario B or C result in the highest Energy content, primarily because low energy yard waste is removed.