The mark sweep algorithm for garbage collection begins by marking the immediately accessible cells. It then sets a pointer P to the first cell of memory (the area where the garbage and useful cells are) and repeats the following two steps until the pointer goes past the end of memory:

1. If the current cell is marked, mark any cells that are pointed to by pointers in the current cell and reset P to the minimum of P and the address of those cells that were newly marked in this step. (Thus when marking cells the algorithm had to notice whether the cell was already marked.) If the current cell is not marked, nothing is done in this step.
2. P is set to $P + 1$ (we are assuming that cells have size 1).

For the rest of the question, assume that each cell has two pointer fields.

A. Give a layout of memory where mark sweep takes a long time. Describe a general scheme (one that applies to an infinite number of possible memory sizes) and also a particular example with about 8 memory cells for your general scheme.

B. Give an exact formula for the time that the algorithm uses for the scheme that you give in part A.

C. Give and prove an upper bound on the worst case time for the algorithm. It is desirable that the answers to parts B and C be close together.

One could do garbage collection using a graph traversal algorithm which uses a stack. Such an algorithm would run in linear time. However, there is very little room for a stack during garbage collection. One approach to garbage collection is to use a stack of limited size combined with the ideas of the mark sweep algorithm to handle cases where the stack size is exceeded during the execution of the algorithm.

D. Write such an algorithm.

E. Explain why the particular way that you combined the ideas are better than other ways that the ideas could have been combined.

F. If your algorithm has H cells available for a stack, what is the worst case time it needs to collect garbage from N cells of memory. (If time permits, your answer to this part should be organized in a way similar to your answers for parts A, B, and C.)