Problem 2: Search in a Weird City (30 points)

You have decided to look for a job driving a cab. The recruiter, an MIT graduate, asks you to solve some search problems for streets laid out as shown by the lines in the figure. The map is repeated on a tear-off sheet at the end of the exam!

The map is drawn to scale, but note that the final, jagged streets converging on G can be assumed to be 100 times longer than any other street. All streets are one-way, left to right. In the absence of any other criterion, or a tie, you are to follow the option closer to the top of the page.

Your job is to find a path from the Start node, S, to the Goal node, G, according to various conditions.

You may express your answers either as numbers (e.g. 8) or variable-free expressions (e.g. $2^0 + 2^1 + 2^2 + 2^3$) or both. You get full credit if either is right. Also, you will increase your partial credit if you correctly note when two answers should be the same, even if both are wrong.
Part A: Depth First Search, with backup (4 points)

You are not to use an enqueued list (also known as visited list) or an extended list (also known as an expanded list). Search is to terminate when a path that reaches the goal appears at the front of the search queue. Indicate the number of nodes extended.

Part B: Breadth First Search (4 points)

You are to use an enqueued list. Search is to terminate when a path that reaches the goal appears at the front of the search queue. Indicate the number of nodes extended.

Part C: Branch and Bound (4 points)

You are to find the optimal path, using neither an extended list, nor any heuristic. Indicate the number of partial paths that will be on the search queue when the goal appears at the front of the search queue.

Part D: Branch and Bound (4 points)

You are to find the optimal path, using an extended list, and the distance to the goal as an admissible heuristic. Indicate the number of nodes extended.
For the rest of this problem, consider the same graph, but with S and G reversed, along with the direction of the one-way streets. All streets are one-way, right to left. In the absence of any other criterion, or a tie, you are to follow the option closer to the top of the page. Remember that the map is drawn to scale, except that the connections leaving S are very long.

Part E: Depth First Search, with backup (4 points)

You are not to use an enqueued list or an extended list. Search is to terminate when a path that reaches the goal appears at the front of the search queue. Indicate the number of nodes extended.

Part F: Breadth First Search (4 points)

You are to use an enqueued list. Search is to terminate when a path that reaches the goal appears at the front of the search queue. Indicate the number of nodes extended.
Part G: Branch and Bound (3 points)

Suppose you were to look for the optimal path, using neither an extended list, nor any heuristic. Indicate (yes or no) whether all possible paths will be from S to G will be computed. Remember that the map is drawn to scale (except that the connections leaving S are very long).

Yes                                                      No

Part H: A* (3 points)

Suppose you were to look for the optimal path, using an extended list (with no heuristic measure of distance remaining). Indicate the number of paths from S to I₁ that are extended beyond I₁.
