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**Name:** _____

1. (1 pt.)

   - **Read all material carefully.**
   - *If in doubt whether something is allowed, ask, don't assume.*
   - You may refer to your books, papers, and notes during this test.
   - No computer or network access of any kind is allowed (or needed).
   - Write, and draw, carefully. Ambiguous or cryptic answers receive zero credit.
   - Use class and textbook conventions for notation, algorithmic options, etc.

   Write your name in the space provided above.

2. (10 pts.) Depict tables similar to those in Figure 15.5 of the textbook for MATRIX-CHAIN-ORDER on the following input:

| matrix: | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ |
|---|---|---|---|---|---|
| dimension: | $100 \times 70$ | $70 \times 10$ | $10 \times 50$ | $50 \times 40$ | $40 \times 20$ |

3. (10 pts.) Trace the execution of the BOTTOM-UP-CUT-ROD algorithm for $n = 10$ and the following pricing scheme. After each iteration of the outermost loop of the algorithm, depict the state of the array $r$. Indicate the optimal total price and corresponding locations of cuts.

| length $i$: | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| price $p_i$: | 0 | 3 | 5 | 8 | 13 | 14 | 19 | 20 | 22 | 22 | 21 |

4. (9 pts.)

   (a) Provide pseudocode (using the textbook's style and conventions) for *bubble sort*. The input is in the form of an array $A[1, 2, \ldots, n]$ of integers that are to be sorted, in place, into non-decreasing order.

   (b) Sketch the proof of correctness of your pseudocode using appropriate loop invariants.

[additional space for answering the earlier question]