1. Consider an instance of the single-source shortest path problem with n vertices, m edges, a source vertex s, and no negative cycles. Which of the following is true?

1. For every vertex v reachable from source s, there is a shortest $s - v$ path with at most $n - 1$ edges.
2. For every vertex v reachable from the source s, there is a shortest $s - v$ path with at most n edges.
3. For every vertex v reachable from the source s, there is a shortest $s - v$ path with at most m edges.
4. There is no finite upper bound on the fewest number of edges in a shortest $s - v$ path.

(1) is the correct answer. If we had a shortest $s - v$ path with more than $n - 1$ edges then we have a non-negative cycle, removing this cycle would produce a $s - v$ path of at most $n - 1$ edges that is better than the previous solution.

2 How many candiates are there for an optimal solution to a sub-problem with the destination v?

1. 2
2. $1 + the\, in - degree\, of\, v$
3. $1 + the\, out - degree\, of\, v$
4. n

(2) is the correct answer. The first case of the recurrence relation gives us a one candidate and the second case gives uses all neighbors of v that have v as a head node, which is the $in - degree\, of\, v$. Hence we have $1 + the\, in - degree\, of\ - v$.

3 What's the running time of the Bellman-Ford algorithm, as a function of m?

1. $O(n^2)$
2. $O(m \cdot n)$
3. $O(n^3)$
4. $O(m \cdot n^2)$

(2) is the correct answer.