Firstly, suppose that there exists a path from s to v, such that it is the shortest path and $d[v] = \delta(s, v)$. For this shortest path, it could have at most $|V| - 1$ edges. And according to Lemma 24.2, after $|V| - 1$ iterations of the first for loop of Bellman-Ford, we have $d[v] = \delta(s, v)$ for all vertices v that are reachable from s. Hence $d[v] < \infty$ when it runs on G in this case. Now, suppose that Bellman-Ford terminates with $d[v] < \infty$, but for some vertex $v \in V$, there is no path from s to v. Then in this case, according to the No-path property, since no path connects a source vertex $s \in V$ to a given vertex $v \in V$, we would have $d[v] = \delta(s, v) = \infty$ after the termination of Bellman-Ford. But this contradicts with the assumption that Bellman-Ford terminates with $d[v] < \infty$. Hence for each vertex $v \in V$, there is a path from s to v if and only if Bellman-Ford terminates with $d[v] < \infty$ when it is run on G.