19. Let S be a set of five different positive integers, the largest of which is m. It is impossible to construct a quadrilateral with non-zero area, whose side-lengths are all distinct elements of S. What is the smallest possible value of m?

A 2 B 4 C 9 D 11 E 12

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19. D Let S consist of h, j, k, l, m in ascending order of size. We want m to be as small as possible. Given three side-lengths, there is a quadrilateral with non-zero area with a specified fourth side-length if and only if the fourth side-length is less than the sum of the other three side-lengths. To ensure that j, k, l, m are not the side-lengths of such a quadrilateral, we must have $m \geqslant j + k + l$. Likewise, considering h, j, k, l, we must have $l \geqslant h + j + k$. Since the smallest possible values of h, j and k are 1, 2 and 3 respectively then $l \geqslant 1 + 2 + 3$ so 6 is the smallest value of l. Also $m \geqslant 2 + 3 + 6$ so 11 is the smallest value of m.