

Sharpest Central Needles on Sharpest Vertex Frame Stars

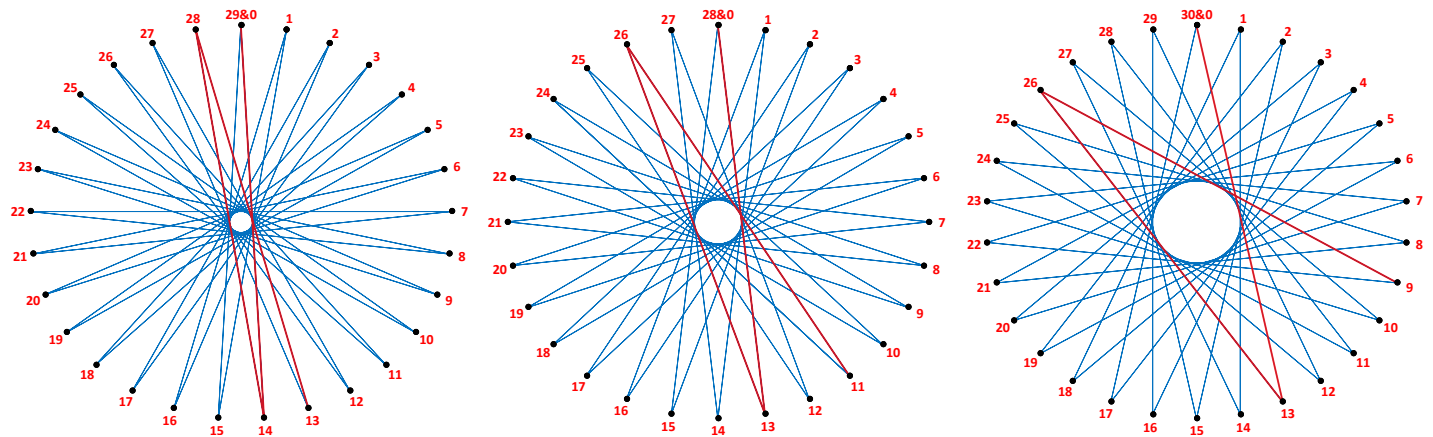
This brings together the sharpest central needles for odd n rule with even sharpest central needles rules. Each rule is based on the sharpest VF producing n points and works once n is sufficiently large. The needles become sharper, and the end of the first line stays on one side or the other of the vertical diameter as n gets larger. As discussed in [E2.3.3](#), the sharpest even star depends on whether $n = 4k$ or $n = 4k+2$. $n = 29, 28$, and 30 show structural examples of each type.

Sharpest VF. *Odd n : $n = 2k+1, J = k$, Ex. (29,14); Even n : $n = 4k, J = 2k-1$, Ex. (28,13); $n = 4k+2, J = 2k-1$, Ex. (30,13).*

End of **first VF Line**: $k = n/2 - 1/2$ **14** $k = n/2 - 1$ **13** $k = n/2 - 2$ **13**

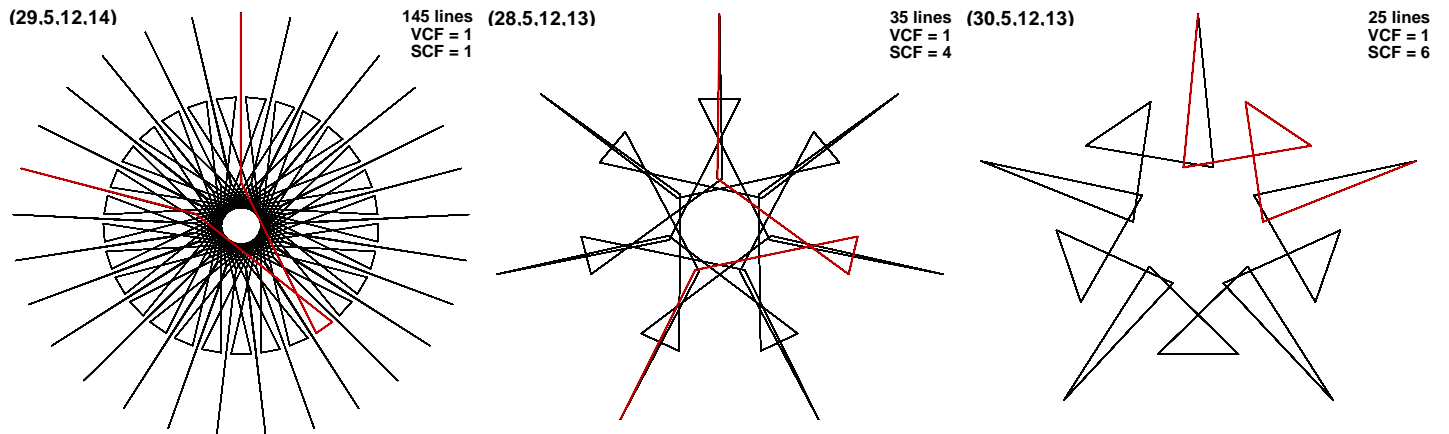
End of **second VF Line**: $2k = n - 1$ **28** $2k = n - 2$ **26** $2k = n - 4$ **26**

End of **third VF Line**: $3k = n/2 - 3/2$ **13** $3k = n/2 - 3$ **11** $3k = n/2 - 6$ **9**



Closed Donut Hole. The structural deviation from the vertical line seen in the end of **blue VF lines** (first 3 VF lines in red). Following the strategy provided for the [odd \$n, S = 3, P = 4\$ rule](#) based on a deviation of half a vertex, We see the same rule applies for the other situations if we consider the unit deviation from vertical of 1 (for $n = 4k$) or 2 (for $n = 4k+2$) vertices. For each, $S = 3, P = 4$ has first line one third of way from first to second endpoint of the VF. *The resulting image has a sharpest central needle with closed donut hole and first line just to the right of the vertical diameter.* These image types are discussed elsewhere for [odd \$n, n = 4k\$](#) and [n = 4k+2](#). Of course, the even images have SCF > 1 so the image has fewer than n needles, even though the VF is an n -point star.

Open Donut Hole. We have a similar result for open donut hole sharpest central needles regardless of whether n is even or odd using the third line of the VF. Think in terms of sum of deviations from the vertical diameter created by the start and end of the third line of the VF. There are two “parts” on the left and three “parts” on the right for each if a “part” is half a vertex, 1 vertex, or 2 vertices from left to right above. A point 2/5 of the way from the second to third vertex frame endpoint will be to the left of the vertical diameter and above the center; the resulting image has an open donut hole. Setting $S = 5$ and $P = 12$ has SCF > 1 for even n . This was discussed for $n = 4k$ [elsewhere](#), but here are $S = 5$ and $P = 12$ open donut hole images for the n and J values shown above. In each instance, **the 5-line first cycle is shown in red.**



Had we used $n = 32$ rather than 28 as the $4k$ example, 8 paddles are between the 8 needles, and a [compass image](#) results.