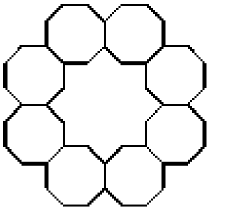
17. Eight identical regular octagons are placed edge to edge in a ring in such a way that a symmetrical star shape is formed by the interior edges. If each octagon has sides of length 1, what is the area of the star?



A $5 + 10\sqrt{2}$ B $8\sqrt{2}$ C $9 + 4\sqrt{2}$ D $16 - 4\sqrt{2}$ E $8 + 4\sqrt{2}$

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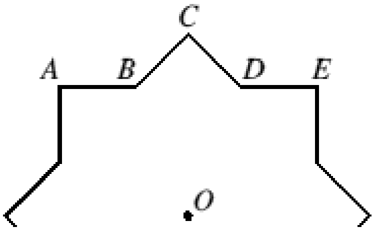
17. E Let A, B, C, D, E be five vertices of the star, as shown. Then $AB = BC = CD = DE = 1$. Each exterior angle of a regular octagon is $360° \div 8$, that is $45°$, so $\angle CBD = \angle CDB = 45°$.



Hence $\angle BCD$ is a right angle and we deduce from the symmetry of the figure that each interior angle of the star is either $90°$ or $225°$. The length of BD is $\sqrt{2}$, so the area of the star is the area of a square of side $2 + \sqrt{2}$ plus the area of four congruent triangles with sides $1, 1, \sqrt{2}$.

The required area, therefore, is $(2 + \sqrt{2})^2 + 4\left(\frac{1}{2} \times 1 \times 1\right)$, that is $6 + 4\sqrt{2} + 2$, that is $8 + 4\sqrt{2}$.

Possible alternative ending: Dissect the star into 8 congruent kites such as $OBCD$. As for a rhombus, the area of a kite is half the product of its diagonals. In this case that is $\frac{1}{2}OC \times BD = \frac{1}{2}(1 + \sqrt{2}) \times \sqrt{2} = \frac{1}{2}(\sqrt{2} + 2)$. Required area is $4(\sqrt{2} + 2)$.