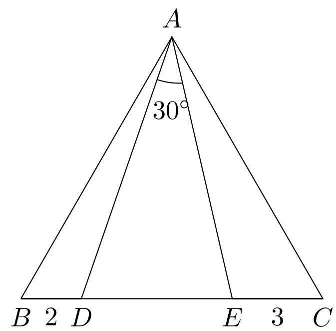
1. Jeffrey starts out at $(0,0)$ facing in some direction. Each second, Jeffrey walks forward 1 unit, and then turns counterclockwise by 45°. When Jeffrey returns to his starting point, what is the area of the shape he has made.

2. Pentagon $ABCDE$ is inscribed in a circle of radius 1. If $\angle DEA \cong \angle EAB \cong \angle ABC$, $m\angle CAD = 60^\circ$, and $BC = 2DE$, compute the area of $ABCDE$.

3. Let circle O have radius 5 with diameter $\overline{AE}$. Point F is outside circle O such that lines $\overline{FA}$ and $\overline{FE}$ intersect circle O at points B and D, respectively. If $FA = 10$ and $m\angle FAE = 30^\circ$, then the perimeter of quadrilateral $ABDE$ can be expressed as $a + b\sqrt{2} + c\sqrt{3} + d\sqrt{6}$, where a, b, c, and d are rational. Find $a + b + c + d$.

4. Let $\triangle ABC$ be equilateral. Two points D and E are on side BC (with order B, D, E, C), and satisfy $\angle DAE = 30^\circ$. If $BD = 2$ and $CE = 3$, what is BC?



5. Let $ABCD$ be a cyclic quadrilateral with $AB = 6$, $BC = 12$, $CD = 3$, and $DA = 6$. Let E, F be the intersection of lines AB and CD, lines AD and BC respectively. Find EF.

6. Two parallel lines l_1 and l_2 lie on a plane, distance d apart. On l_1 there are an infinite number of points $A_1, A_2, A_3, \cdots$, in that order, with $A_nA_{n+1} = 2$ for all n. On l_2 there are an infinite number of points $B_1, B_2, B_3, \cdots$, in that order and in the same direction, satisfying $B_nB_{n+1} = 1$ for all n. Given that A_1B_1 is perpendicular to both l_1 and l_2, express the sum $\sum_{i=1}^{\infty} \angle A_iB_iA_{i+1}$ in terms of d.

7. In an unit square $ABCD$, find the minimum of $\sqrt{2}AP + BP + CP$ where P is a point inside $ABCD$.

8. We have a unit cube $ABCDEFGH$ where $ABCD$ is the top side and $EFGH$ is the bottom side with E below A, F below B, and so on. Equilateral triangle BDG cuts out a circle from the cube's inscribed sphere. Find the area of the circle.

9. Given $\triangle ABC$. Let A' lie on BC such that $BA' = \frac{1}{4}A'C$, B' lie on AC such that $AB' = B'C$, and C' lie on AB such that $2AC' = BC'$. Let D be the point of intersection between AA' and CC', E the point of intersection between AA' and BB', and F the point of intersection between BB' and CC'. What is $\frac{area(\triangle DEF)}{area(\triangle ABC)}$?

10. Given a triangle ABC with $a = 5$, $b = 7$, and $c = 8$, find the side length of the largest equilateral triangle PQR such that A, B, C lie on QR, RP, PQ respectively.