1. Unit square $ZINC$ is constructed in the interior of hexagon $CARBON$. What is the area of triangle $BIO$?

2. If two altitudes of a triangle have length 12 and 4, what integral lengths can the third altitude attain?

3. Rectangle $ABCD$ is folded in half so that the vertices $D$ and $B$ coincide, creating the crease $EF$, with $E$ on $AD$ and $F$ on $BC$. Let $O$ be the midpoint of $EF$. If triangles $DOC$ and $DCF$ are congruent, what is the ratio $BC : CD$?

4. The square $DEFG$ is contained in equilateral triangle $ABC$, with $E$ on $AC$, $G$ on $AD$, and $F$ as the midpoint of $BC$. Find $AD$ if $DE = 6$.

5. An ant is on the bottom edge of a right circular cone with base area $\pi$ and slant length 6. What is the shortest distance that the ant has to travel to loop around the cone and come back to its starting position?

6. A right cylinder is inscribed in a right circular cone with height 2 and radius 2 so that the cylinder’s bottom base sits on the cone’s base. What is the maximum possible surface area of the cylinder?

7. $AD$ is the angle bisector of the right triangle $ABC$ with $\angle ABC = 60^\circ$ and $\angle BCA = 90^\circ$. $E$ is chosen on $AB$ so that the line parallel to $DE$ through $C$ bisects $AE$. Find $\angle EDB$ in degrees.

8. Circles $P$, $Q$, and $R$ are externally tangent to one another. The external tangent of $P$ and $Q$ that does not intersect $R$ intersects $P$ and $Q$ at $P_Q$ and $Q_p$, respectively. $Q_R, R_Q, R_P$, and $P_R$ are defined similarly. If the radius of $Q$ is 4 and $Q_P P_Q \parallel R_Q R_R$, compute $R_P P_R$. 