3338. *Proposed by Toshio Seimiya, Kawasaki, Japan.*

A convex cyclic quadrilateral $ABCD$ has an incircle with centre I. Let P be the intersection of AC and BD. Prove that $AP : CP = AI^2 : CI^2$.

3339. *Proposed by Toshio Seimiya, Kawasaki, Japan.*

Let Γ_1 and Γ_2 be two non-intersecting circles each lying in the exterior of the other. Let ℓ_1 and ℓ_2 be the common external tangents to Γ_1 and Γ_2. Let ℓ_1 meet Γ_1 and Γ_2 at A and B, respectively, and let ℓ_2 meet Γ_1 and Γ_2 at C and D, respectively. Let M and N be the mid-points of AB and CD, respectively, and let P and Q be the intersections of NA and NB with Γ_1 and Γ_2, respectively, different from A and B. Prove that CP, DQ, and MN are concurrent.

3340. *Proposed by Toshio Seimiya, Kawasaki, Japan.*

The bisector of $\angle BAC$ intersects the circumcircle of $\triangle ABC$ at a second point D. Suppose that $AB^2 + AC^2 = 2AD^2$. Prove that the angle of intersection of AD and BC is 45°.

3341. *Proposed by Arkady Alt, San Jose, CA, USA.*

For any triangle ABC with sides of lengths a, b, and c, prove that $\sqrt{3}(R_a + R_b + R_c) \leq a + b + c$, where R_a, R_b, and R_c are the distances from the incentre of $\triangle ABC$ to the vertices A, B, and C, respectively.

3342. *Proposed by Arkady Alt, San Jose, CA, USA.*

Let r and R be the inradius and circumradius of $\triangle ABC$, respectively. Prove that

$$2\sum_{\text{cyclic}} \sin\frac{A}{2}\sin\frac{B}{2} \leq 1 + \frac{r}{R}\,.$$

3343. *Proposed by Stan Wagon, Macalester College, St. Paul, MN, USA.*

If the factorials are deleted in the Maclaurin series for $\sin x$, one obtains the series for $\arctan x$. Suppose instead that one alternates factorials in the series. Does the resulting series have a closed form? That is, can one find an elementary expression for the function whose Maclaurin series is

$$x - \frac{x^3}{3} + \frac{x^5}{5!} - \frac{x^7}{7} + \frac{x^9}{9!} - \frac{x^{11}}{11} + \cdots\ ?$$

3344. *Proposed by Hung Pham Kim, student, Stanford University, Palo Alto, CA, USA.*

Let n be a positive integer, $n \geq 4$, and let $a_1, a_2, \ldots, a_n$ be positive real numbers such that $a_1 + a_2 + \cdots + a_n = n$. Prove that

$$\frac{1}{a_1} + \frac{1}{a_2} + \cdots + \frac{1}{a_n} - n \geq \frac{3}{n}\left(a_1^2 + a_2^2 + \cdots + a_n^2 - n\right).$$