Time Limit: 60 minutes.
Instructions: This test contains 10 short answer questions. All answers must be expressed in simplest form unless specified otherwise. Only answers written inside the boxes on the answer sheet will be considered for grading.
No Calculators.

1. Let Γ_1 and Γ_2 be circles with radii 8 and 6, respectively, such that their centers are 12 apart. Let P be one of the intersection points of Γ_1 and Γ_2. A line is drawn through P such that it intersects Γ_1 again at Q and Γ_2 again at R, and chords PQ and PR have equal length. Find the square of the length of PQ.

   Answer: 130

2. A square has sides of length 2. Set S is the set of all line segments that have length 2 and whose endpoints are on adjacent sides of the square. The midpoints of the line segments in set S enclose a region A. Find the area of A.

   Answer: $4 - \pi$

3. A rectangle inscribed in a larger rectangle is called "free" if it is possible to rotate (even slightly) the smaller rectangle about its center within the boundaries of the larger rectangle. Of all rectangles that can be inscribed free in a 6×8 rectangle, let the smallest perimeter be P. Find P^2.

   Answer: 448

4. If the sides of a triangle are $2x + 3$, $x^2 + 3x + 3$, and $x^2 + 2x$, and $x > 0$, find the greatest interior angle of a triangle (in degrees).

   Answer: 120

5. Find the area of a square ABCD containing a point P such that PA = 3, PB = 7, and PD = 5.

   Answer: 58

6. In $\triangle ABC$, BB' and CC' are medians. D is on BB' such that the intersection point of AD and BB', M, is the midpoint of BB'. N is the intersection of AD and CC'. What is $\frac{|C'N|}{|NC|}$?

   Answer: 1/4

7. In $\triangle ABC$, the medians AD and CE have lengths 18 and 27, respectively, and $AB = 24$. Extend CE to intersect the circumcircle of ABC at F. Find the the square of the area of $\triangle AFB$.

   Answer: 3520

8. Two circles, Γ_1, Γ_2 are tangent internally at P, and a chord, AB, of the larger circle Γ_1 is tangent to the smaller circle Γ_2 at C. Chords PB and PA intersect Γ_2 again at E and D, respectively. If $|AB| = 15$, while $|PE| = 2$ and $|PD| = 3$, find $|AC|$.

   Answer: 9

9. Let $\triangle ABC$ be a nonobtuse triangle such that $AB > AC$ and $\angle B = 45°$. Let O be the circumcenter of ABC and let I be the incenter of ABC. Suppose that $\sqrt{2}|OI| = |AB| - |AC|$. Determine the sum of the values of $\sin^2 A$.

   Answer: $\sqrt{2}$

10. Let $\triangle ABC$ be nonobtuse. Let P_4 be a square, P_m be a m-sided regular polygon, and let P_n be a n-sided regular polygon, where P_4, P_m, P_n each share a side with the triangle ABC, and none of the four shapes overlap. The centers of P_4, P_m, P_n form an equilateral triangle. Find $m + n$.

    Answer: 16