Problem 1. Evaluate

$$\int_2^4 \frac{\sqrt{\ln(9-x)}}{\sqrt{\ln(9-x)} + \sqrt{\ln(x+3)}}\, dx.$$

Problem 2. For what pairs (a, b) of positive real numbers does the improper integral

$$\int_b^\infty \left(\sqrt{\sqrt{x+a} - \sqrt{x}} - \sqrt{\sqrt{x} - \sqrt{x-b}} \right)\, dx$$

converge?

Problem 3. Find the volume of the region of points (x, y, z) satisfying

$$(x^2 + y^2 + z^2 + 8)^2 \le 36(x^2 + y^2).$$

Problem 4. Let $p(x) = 2 + 4x + 3x^2 + 5x^3 + 3x^4 + 4x^5 + 2x^6$. For $0 < k < 5$ define

$$I_k = \int_0^\infty \frac{x^k}{p(x)}\, dx.$$

For which k is I_k smallest?