

**1973-2023 INDEX of PROBLEMS & SOLUTIONS**  
VOLUMES 1-54.5  
for  
**THE COLLEGE MATHEMATICS JOURNAL**  
**(Including the TWO YEAR COLLEGE MATHEMATICS JOURNAL)**

prepared by  
Charles K. Cook, emeritus  
University of South Carolina Sumter  
Sumter, South Carolina

Notes:

1. All entries are in the format:

**Problem Number.**

**Proposer, Volume.Issue Number(Year)Page** of publication

**Topic of problem** as interpreted by the indexer

**Solution Title** determined by the Problem Editors **Volume.Issue Number(Year)Page**

2. The Two Year College Mathematics Journal began publishing in 1970, but the problem section did not begin until Volume 4 in 1973.
3. Please report any errors or omissions to the indexer at <charliecook29150@aim.com>.
4. \*\*\*\*\* indicates problems for which a Solution is pending.

**THE CMJ PROBLEM & SOLUTION INDEX**

1.  
Proposer: Martin Berman 4.1(1973)73  
Topic: Probability that 1 of 3 integers from  $\{1, \dots, N\}$  is the arithmetic mean of the other 2  
Solution: Triplets in arithmetic progression 4.3(1973)82
2.  
Proposer: Bertram Kabak 4.1(1973)73  
Topic: Trig identity depending on 3 numbers whose sum is  $\pi$   
Solution: Trigonometry identity 4.3(1973)83
3.  
Proposer Norman Schaumberger 4.1(1973)73  
Topic: Algebra-trig inequality  
Solution: Bounds for  $(\sec 1/\sqrt{x})^{2x}$  4.3(1973)84
4.  
Proposer: Ian Whitlock 4.1(1973)73  
Topic: Basis for elements which are the product of integers from another basis  
Solution: The existence of a basis 5.1(1973)70
5.  
Proposer Warren Page 4.1(1973)73  
Topic: Evaluating powers of the Fibonacci  $Q^2$  Matrix  
Solution: The determinant of the powers of a matrix 5.1(1973)71

6.  
Proposer: Alexander Zujus 4.2(1973)85  
Topic: Trig equation involving 8<sup>th</sup> powers of sine and cosine  
Solution: A trigonometric equation 5.1(1973)72
7.  
Proposer: Sam Greenspan 4.2(1973)85  
Topic: Necessary & sufficient condition for a subgroup to be normal  
Solution: A characterization of a normal subgroup 5.2(1973)66
8.  
Proposer: Allan Kaufman 4.2(1973)85  
Topic: Two-variable arctangent equation  
Solution: An impossible trigonometric relationship 5.2(1973)67
9.  
Proposer: Alexander Zujus 4.3(1973)81  
Topic: Polynomial divisibility  
Solution: Divisibility by a minimal polynomial 5.3(1974)50
10.  
Proposer: Warren Page 4.3(1973)81  
Topic: Summation inequality  
Solution: Upper bound for a convergent series 5.3(1974)51
11.  
Proposer: Peter A. Lindstrom 4.3(1973)81  
Topic: Proving that odd rows in Pascal's triangle have only odd entries  
Solution: Some odd rows in Pascal's triangle 5.3(1974)52
12.  
Proposer: Sidney Penner 4.3(1973)81  
Topic: Prove that a quadrilateral under certain conditions is a rectangle  
Solution: The slopes of the sides of a rectangle 5.3(1974)53
13.  
Proposer: Martin Berman 4.3(1973)82  
Topic: Construct a sequence of triangles in a triangle with area sum that of the triangle  
Solution: Right triangle decomposition 5.4(1974)38
14.  
Proposer: Warren Page 5.1(1974)69  
Topic: Summation identity for ratios of determinants  
Solution: Vandermonde determinant series 5.4(1974)39
15.  
Proposer: Norman Schaumberger 5.1(1974)69  
Topic: Evaluating a sum of secants of angles  
Solution: Secants of angles in arithmetic progression 5.4(1974)40

16.  
 Proposer: Stephen R. Conrad 5.1(1974)69  
 Topic: GCD of a sequence of binomial coefficients  
 Solution: Combinatorial difference table 5.4(1974)41
17.  
 Proposer: Joseph Silverman 5.1(1974)69  
 Topic: Finding the locus of a point on a line from the x-axis to a parabola  
 Solution: Line segments cut by a parabola 6.1(1975)33
18.  
 Proposer: Martin Berman 5.1(1974)70  
 Topic: Finding the limit of a complex sequence with a real initial value  
 Solution: Halves and square roots 6.1(1975)33
19.  
 Proposer: Kenneth Fogarty 5.2(1974)65  
 Topic: Seeking a function such that  $f(\sin\theta) = \sin 2\theta$   
 Solution: An analogy carried too far 6.1(1975)34
20.  
 Proposer: Alexander Zujus 5.2(1974)65  
 Topic: Proving a 3-variable inequality  
 Solution: An inequality 6.1(1975)34
21.  
 Proposer: Stephen R. Conrad 5.2(1974)65  
 Topic: If  $m < n$ , do sets of  $n$  consecutive integers contain 2 with products divisible by  $mn$ ?  
 Solution: Sets of  $n$  consecutive integers 6.2(1975)32
22.  
 Proposer: Sidney Penner 5.2(1974)65  
 Topic: Finding points in a plane not on any rational circle  
 Solution: Rational circles 6.2(1975)32
23.  
 Proposer: Henry Frisz 5.2(1974)65  
 Topic: Divergence of a given rational sequence  
 Solution: An unusual divergent series 6.2(1975)33
24.  
 Proposer: Stephen R. Conrad 5.3(1974)50  
 Topic: Evaluation of a double sum  
 Solution: A binomial coefficient identity 6.2(1975)34
25.  
 Proposer: Martin Berman 5.3(1974)50  
 Topic: Necessary & sufficient conditions for divisibility of a 2-variable binomial  
 Solution: A Divisibility Problem 6.3(1975)35

26.  
 Proposer: T. A. Eisenberg 5.3(1974)50  
 Topic: Finding the limit of a sequence of a ratio of products  
 Solution: A popular limit 6.3(1975)35
27.  
 Proposer: Norman Schaumberger 5.3(1974)50  
 Topic: Identity for the circumcircle of a rectangle  
 Solution: On the circumcircle of a rectangle 6.3(1975)36
28.  
 Proposer: Aron Pinker 5.3(1974)50  
 Topic: Finding Solutions to an equation of a sum of fifth roots of a binomial  
 Solution: Real zeroes of a monotone function 6.3(1975)37
29.  
 Proposer: Warren Page 5.4(1974)38  
 Topic: Finding a 3-digit integer by interchanging the digits of 2-digit numbers  
 Solution: Decimal digit shifting 6.4(1975)25
30.  
 Proposer: Martin Berman 5.4(1974)38  
 Topic: Necessary & sufficient conditions that 3 integers are lengths & altitudes of a triangle  
 Solution: A Triangle Inequality 6.4(1975)25
31.  
 Proposer: Peter A. Lindstrom 5.4(1974)38  
 Topic: Divisibility of a function of 2 odd integers by their arithmetic mean  
 Solution: Divisibility 6.4(1975)26
32.  
 Proposer: Sidney Penner 5.4(1974)38  
 Topic: Proving a parabola results from lines intersecting the graph of a given function  
 Solution: Diameter characterization of the parabola 6.4(1975)27
33.  
 Proposer: Norman Schaumberger 6.1(1975)32  
 Topic: Non-rational distances from the corners of an inscribed square to the circle exist  
 Solution: Irrational chords 7.1(1976)29
34.  
 Proposer: Bob Jewett 6.1(1975)32  
 Topic: Proving 2 combinations of a set of 4 relatively prime numbers are relatively prime  
 Solution: Multimodularity 7.1(1976)30
35.  
 Proposer: Richard Miller 6.1(1975)32  
 Topic: Proving roots of a certain polynomial are pure imaginary  
 Solution: An application of Lucas' theorem 7.1(1976)31

36.  
Proposer: Alexander Zujus 6.1(1975)32  
Topic: Divisibility of a polynomial of positive integers by another  
Solution: A division problem 7.1(1976)31
37.  
Proposer: Louis Alpert 6.2(1975)31  
Topic: The product of 4 consecutive integers of an A.P. is the difference of 2 squares  
Solution: A difference of squares 7.2(1976)50
38.  
Proposer: Warren Page 6.2(1975)31  
Topic: Finding all polynomials satisfying a given condition  
Solution: Linear polynomials 7.2(1976)51
39.  
Proposer: Norman Schaumberger 6.2(1975)31  
Topic: Inequality involving the arithmetic and geometric means of 2 numbers  
Solution: A mean inequality 7.2(1976)52
40.  
Proposer: Stephen R. Conrad 6.2(1975)31  
Topic: Proving that a given ring is commutative  
Solution: A commutative problem 7.2(1976)52
41.  
Proposer: Harry Schor 6.2(1975)31  
Topic: Necessary & sufficient proof that the limit of a given sequence exists  
Solution: Repetitious exponentiation 7.2(1976)53
42.  
Proposer: Bernard Eisenberg 6.3(1975)34  
Topic: All blue triangles from red & blue segments joining the vertices of a hexagon  
Solution: Complete bichromatic hexagons 7.3(1976)48
43.  
Proposer: Bernard C. Anderson 6.3(1975)34  
Topic: Distributive non commutative binary operation on a set of real numbers  
Solution: A non commutative binary operation 7.3(1976)48
44.  
Proposer: Benjamin Burrell 6.3(1975)34  
Topic: Convergence or divergence of a reciprocal series  
Solution: A divergent series 7.3(1976)49
45.  
Proposer: Robert Sulek & Lester Suna 6.3(1975)35  
Topic: Inequality for sums of sequential ratios  
Solution: A symmetric inequality 7.3(1976)49

46.  
 Proposer: Louis Alpert 6.3(1975)35  
 Topic: Linearity of a given function  
 Solution: An average characterization of linear functions 7.4(1976)34
47.  
 Proposer: Bertram Kabak 6.4(1975)24  
 Topic: Summation identity for given sines and cosines of a given sequence  
 Solution: A law of sines and cosines 7.4(1976)34
48.  
 Proposer: Warren Page 6.4(1975)24  
 Topic: Summation inequality for binomial powers of a given function  
 Solution: The best Fibonacci number 7.4(1976)35
49.  
 Proposer: Alan Wayne 6.4(1975)24  
 Topic: Maximum value of ratio of sines and cosines  
 Solution: A ratio of radii 7.4(1976)36
50.  
 Proposer: Aron Pinker 6.4(1975)25  
 Topic: A special product from a given sequence is a square  
 Solution: Digits of squares 8.1(1977)43
51.  
 Proposer: Joseph Rothschild 6.4(1975)25  
 Topic: Finding the limit of the log of the sum of 2 positive sequences  
 Solution: Sum and maximum 8.1(1977)44
52.  
 Proposer: Steven Kahn 6.4(1975)25; Corrected: 7.2(1976)49  
 Topic: Existence of 2 numbers whose product of the derivatives of a function is 1  
 Solution: A geometric mean value theorem 8.1(1977)44
53.  
 Proposer: Sidney Penner 6.4(1975)25  
 Topic: A circle containing a rational point must also contain a lattice point  
 Solution: Lattice points on a circle 8.1(1977)46
54.  
 Proposer: John P. Hoyt 7.1(1976)28  
 Topic: Probability of an inequality from an arrangement of n integers  
 Solution: A counting problem 8.2(1977)96
55.  
 Proposer: Louis Rotando 7.1(1976)28  
 Topic: Finding all bases that guarantee a logarithmic equation has one, two or no Solutions  
 Solution: Can a number be equal to its logarithm? 8.2(1977)97

56.  
 Proposer: Joseph Rothschild 7.1(1976)28  
 Topic: Solving a 3<sup>rd</sup> order nonhomogeneous difference equation  
 Solution: Difference equation 8.2(1977)98
57.  
 Proposer: Martin Berman 7.1(1976)28  
 Topic: Probability of a 2-variable congruence equation for a fixed modulus  
 Solution: Probability and quasi-inverses 8.2(1977)100
58.  
 Proposer: J. Orten Gadd 7.1(1976)28  
 Topic: Primes and a cubic equation  
 Solution: Integer zeros of a polynomial 8.3(1977)178
59.  
 Proposer: Robert Sulek & Lester Suna 7.1(1976)29  
 Topic: Proving polynomial inequalities  
 Solution: Positive polynomials 8.3(1977)179
60.  
 Proposer: Richard Johnsonbaugh 7.1(1976)29  
 Topic: Finding values for which a sequence of variables converges  
 Solution: Convergence of  $(x_n / n^\epsilon)$  8.3(1977)180
61.  
 Proposer: Peter A. Lindstrom 7.2(1976)49  
 Topic: Sum of altitude lengths of triangles constructed inside a given triangle  
 Solution: Sum of a series of altitudes 8.3(1977)180
62.  
 Proposer: N. J. Kuenzi 7.2(1976)49  
 Topic: Finding initial values of a recurrent sequence which guarantee convergence  
 Solution: Null sequence 8.4(1977)241
63.  
 Proposer: Norman Schaumberger 7.2(1976)49  
 Topic: Finding powers of tangents guaranteeing convergence in a sum of tangent powers  
 Solution: Comparison of series 8.4(1977)241
64.  
 Proposer: Aron Pinker 7.2(1976)49  
 Topic: Finding a minimal square inscribed in an integer-sided right triangle  
 Solution: The inscribed square on the hypotenuse 8.4(1977)241
65.  
 Proposer: Kenneth V. Turner, Jr. 7.2(1976)50  
 Topic: Left and right divisors of zero in a finite ring  
 Solution: Zero divisors in finite rings 8.4(1977)243

66.  
 Proposer: B. Bernstein 7.2(1976)50  
 Topic: Finding the closed form of a convergent series  
 Solution: Summation 8.4(1977)243
67.  
 Proposer: Richard Johnsonbaugh 7.3(1976)47  
 Topic: Divisibility of a sum of polynomials by a quadratic trinomial  
 Solution: A divisibility test 8.5(1977)293
68.  
 Proposer: Sidney Penner 7.3(1976)47  
 Topic: Necessary & sufficient condition that an integral function has a certain form  
 Solution: The last triangular multiple of an integer 8.5(1977)293
69.  
 Proposer: V. N. Murty 7.3(1976)47  
 Topic: Independence of a certain sum of bracket functions  
 Solution: Greatest integer function identity 8.5(1977)294
70.  
 Proposer: Norman Schaumberger 7.3(1976)47  
 Topic: Finding the minimal value of an integer yielding 3 inequalities  
 Solution: Rational number approximation of  $n!$  8.5(1977)295
71.  
 Proposer: Peter A. Lindstrom 7.3(1976)47  
 Topic: Possible values of 2-variable functional equations  
 Solution: Addition laws property 9.1(1978)41
72.  
 Proposer: Clyde A. Bridger 7.3(1976)48  
 Topic: Identity involving the sines and sides of a triangle  
 Solution: A triangle equality 9.1(1978)42
73.  
 Proposer: Allan Wm. Johnson, Jr. 7.4(1976)33  
 Topic: Expressing 1 as the finite sum of integral reciprocals of multiples of a given integer  
 Solution: Unit fractions 9.1(1978)43
74.  
 Proposer: Harley Flanders 7.4(1976)33  
 Topic: Equality of distances from sides of right triangles constructed within a given triangle  
 Solution: Rotations in a tri-rectangular tetrahedron 9.1(1978)44
75.  
 Proposer: Norman Schaumberger 7.4(1976)33  
 Topic: Finding integer-sided triangles with trisectable angles  
 Solution: Angles that can be trisected 9.1(1978)45



76.  
 Proposer: Peter A. Lindstrom 7.4(1976)33  
 Topic: Finding the limit of a product of  $n^{\text{th}}$  roots of a nonnegative expression  
 Solution: Riemann product 9.2(1978)96
77.  
 Proposer: R.S. Luthar 7.4(1976)33  
 Topic: Finding polynomials satisfying an algebraic equation  
 Solution: Polynomial Solution of a difference equation 9.2(1978)96
78.  
 Proposer: Sidney Penner 7.4(1976)33  
 Topic: Tiling a checkerboard with right trominoes  
 Solution: Tiling checkerboards with trominoes 9.2(1978)98
79.  
 Proposer: Martin Berman 8.1(1977)42  
 Topic: Establishing the ratio of the areas of a triangle and an internally constructed one  
 Solution: Area of a Cevian triangle 9.2(1978)99
80.  
 Proposer: Steve Kahn 8.1(1977)42  
 Topic: If an equation with 7 cubed variables has a Solution, then 3 divides their product  
 Solution: Sum of cubes 9.2(1978)100
81.  
 Proposer: Gino T. Fala 8.1(1977)42  
 Topic: Proving a binary operation commutative  
 Solution: Binary operations on rational numbers 9.3(1978)177
82.  
 Proposer: Norman Schaumbeger 8.1(1977)42  
 Topic: Establishing a sum of reciprocals involving the  $n^{\text{th}}$  roots of unity  
 Solution: Partial fractions decomposition 9.3(1978)177
83.  
 Proposer: Joe Allison 8.1(1977)43  
 Topic: Evaluating a logarithmic definite integral  
 Solution: Integration of a series 9.3(1978)178
84.  
 Proposer: R. S. Luthar 8.2(1977)95  
 Topic: Divisibility of a prime number expression by the bracket function of another  
 Solution: Application of Wilson's theorem 9.3(1978)180
85.  
 Proposer: Bertram Kabak 8.2(1977)95  
 Topic: Inequality and equality involving a triangle, its circumcircle, radius and inradius  
 Solution: Inequality for the radii of a triangle 9.3(1978)181

86.  
 Proposer: Kay Dundas 8.2(1977)95  
 Topic: Boxes of maximal volume from cutting rational square corners off a rectangle  
 Solution: Integer calculus box construction 9.4(1978)237
87.  
 Proposer: Norman Schaumberger 8.2(1977)95  
 Topic: Inequality involving sums of ratios of 4 real numbers  
 Solution: Application of the method of deficient means 9.4(1978)238
88.  
 Proposer: Alan Wayne 8.2(1977)96  
 Topic: An alphanumeric puzzle  
 Solution: Volcanic addition 9.4(1978)239
89.  
 Proposer: Warren Page 8.2(1977)96  
 Topic: Dealing and stacking a  $3n$ -deck with one marked card  
 Solution: Magic card 9.4(1978)240
90.  
 Proposer: Charles W. Trigg 8.3(1977)177  
 Topic: Plateau squares in the octonary number system  
 Solution: Plateau squares 9.4(1978)241
91.  
 Proposer: Sidney Penner 8.3(1977)177  
 Topic: Non-empty sets in an arbitrary subset of natural numbers  
 Solution: Partition of exponent parity 9.5(1978)298
92.  
 Proposer: Wm. R. Klinger 8.3(1977)177  
 Topic: Proving a certain function continuous at 1 is continuous on the nonnegative x-axis  
 Solution: Infectious continuity 9.5(1978)298
93.  
 Proposer: Dan Aulicino 8.3(1977)177  
 Topic: Decimal representations with blocks of zeroes  
 Solution: Blocks of digits 9.5(1978)299
94.  
 Proposer: Martin Berman 8.3(1977)177  
 Topic: Necessary & sufficient conditions of the existence of a triangle given a side and the sum of 2 others and an angle  
 Solution: Sufficiency of Newton's formulas 9.5(1978)300
95.  
 Proposer: R.S. Luthar 8.3(1977)178  
 Topic: Solve  $2^x + 1 = y^2$  in positive integers  
 Solution: Solution of  $p^x + 1 = y^p$  9.5(1978)301

96.  
Proposer: Milton H. Hoehn 8.4(1977)240  
Topic: Expected value of the sum of distances between  $n$  arbitrary points on a unit segment  
Solution: Random points on a line segment 10.1(1979)53
97.  
Proposer: Richard L. Francis 8.4(1977)240  
Topic: Existence of perfect cubes of a certain form  
Solution: Cubic quandry 10.1(1979)54
98.  
Proposer: Norman Schaumberger 8.4(1977)240  
Topic: Inequalities involving the sides, area and perimeter of a triangle  
Solution: Triangle inequalities 10.1(1979)55
99.  
Proposer: Alan Wayne 8.4(1977)240  
Topic: Proving that a generalized Binet-type formula is an integer  
Solution: Quadratic formula integers 10.1(1979)55
100.  
Proposer: Sidney Penner 8.4(1977)240  
Topic: Packing a box with rectangular bricks and a cube  
Solution: Brickery trickery 10.1(1979)56
101.  
Proposer: Louis Alpert 8.5(1977)292  
Topic: Solving a functional equation  
Solution: Quadratic mean value theorem 10.2(1979)128
102.  
Proposer: Mangho Ahuja & Leonard Palmer 8.5(1977)292  
Topic: Solving a functional equation  
Solution: Functions found 10.2(1979)129
103.  
Proposer: Richard Johnsonbaugh 8.5(1977)292  
Topic: Finding independent pairs in coin flipping heads on first try and first  $k$  tries  
Solution: The superfluous successful toss 10.2(1979)130
104.  
Proposer: Roger W. Pease 8.5(1977)292  
Topic: Best strategy for financing a car  
Solution: Fiscal folly 10.2(1979)131
105.  
Proposer: Norman Schaumberger 8.5(1977)293  
Topic: Finding rational points from a set of distinct points on a circle  
Solution: Rational vertices of regular odd-gons 10.3(1979)211

106.  
 Proposer: James W. Murdock 9.1(1978)40  
 Topic: Seeking non-zero values of a 2-variable rational function  
 Solution: Functional equation for  $1/x$  10.3(1979)212
107.  
 Proposer: Abe Simowitz 9.1(1978)40  
 Topic: Is the inradius of a Pythagorean triangle a multiple of the GCD of the 3 sides?  
 Solution: The diameter  $a + b - c$  of Pythagorean triplets 10.3(1979)214
108.  
 Proposer: Arnold Lapidus 9.1(1978)40  
 Topic: Does a polar angle distance function equal the sine of the angle?  
 Solution: Sinusoidal sides of a  $\Delta$ -biangle 10.3(1979)215
109.  
 Proposer: Bertram Kabak 9.1(1978)40  
 Topic: Formula for the area of a triangle in terms of its sides and circumradius  
 Solution: Areas of co-cyclic triangles 10.3(1979)216
110.  
 Proposer: K. R. S. Sastry 9.1(1978)41  
 Topic: Equal products of distances from altitudes, angle bisectors and incenter of a triangle  
 Solution: Ortho-incentric triangles 10.3(1979)217
111.  
 Proposer: Michael W. Ecker 9.2(1978)95  
 Topic: Finding the range of the density of subset of natural numbers  
 Solution: Densities of subsets of the natural numbers 10.4(1979)294
- 112..  
 Proposer: Richard Johnsonbaugh 9.2(1978)95  
 Topic: Find the least positive integer for which a given function is monotonic increasing  
 Solution: Radical ratios 10.4(1979)295
113.  
 Proposer: Sidney Penner 9.2(1978)95  
 Topic: Red, white and blue subsets of  $(1/3) \times$  triangular numbers  
 Solution: Tricolored sets of integers 10.4(1979)296
114.  
 Proposer: Larry Hoehn 9.2(1978)95  
 Topic: Find all Solutions of  $8^x (3x + 1) = 4$   
 Solution: Equations with unique Solutions 10.4(1979)297
115.  
 Proposer: Thomas E. Elsner 9.2(1978)95  
 Topic: Find positive integral coefficients which allow a system of trig equations a Solution  
 Solution: Disparity in a vibrating system 10.4(1979)298

116.  
 Proposer: V. N. Murty 9.3(1978)176  
 Topic: Evaluate a finite sum of binomial powers  
 Solution: Inclusion and exclusion applied to occupancy 10.5(1979)360
117.  
 Proposer: Norman Schaumberger 9.3(1978)176  
 Topic: Sums of squares of distances from points on a circle centered on the intersection of the diagonals of a parallelogram and its corners  
 Solution: Least squares property of the centroid 10.5(1979)361
118.  
 Proposer: Norman Gore 9.3(1978)176  
 Topic: Equal perimeters and sums of sines of 2 triangles inscribed in a circle  
 Solution: Perimeters of inscribed triangles 10.5(1979)362
119.  
 Proposer: Thomas E. Elsner 9.3(1978)176  
 Topic: Greatest error in the trisection of a specific angle  
 Solution: Error analysis of an approximate trisection 10.5(1979)363
120.  
 Proposer: K. R. S. Sastry 9.3(1978)177  
 Topic: Expressing sines and cosines of various combinations of 2 angles  
 Solution: Trigonometric addition laws 10.5(1979)366
121.  
 Proposer: Richard L. Francis 9.4(1978)236  
 Topic: No Fermat prime is the difference of 2 fifth powers of positive integers  
 Solution: Fermat primes puzzler 11.1(1980)62
122.  
 Proposer: Lance Littlejohn 9.4(1978)236  
 Topic: Euler's constant is the limit of a sequence of derivatives of a given function  
 Solution: Euler's constant 11.1(1980)63
123.  
 Proposer: V. N. Murty 9.4(1978)236  
 Topic: Necessary & sufficient condition for an inequality in 2 variables  
 Solution: Another arithmetic mean inequality 11.1(1980)64
124.  
 Proposer: Norman Schaumberger 9.4(1978)236  
 Topic: Evaluating the sum of reciprocals of infinite sets of binomial coefficients  
 Solution: Example of finite integration 11.1(1980)65
125.  
 Proposer: Milton H. Hoehn 9.4(1978)236  
 Topic: Solving an equation of tangent functions  
 Solution: Trigonometric equation 11.2(1980)132

126.  
 Proposer: R. C. Buck 9.5(1978)297  
 Topic: Solving a system of equations in 2 variables  
 Solution: Inconsistent quadratic system 11.2(1980)133
127.  
 Proposer: Sidney Penner & Norman Schaumberger 9.5(1978)297  
 Topic: Find all rational Solutions of  $y^x = xy$   
 Solution: Rational Solution of  $y^x = xy$  11.2(1980)134
128.  
 Proposer: Mangho Ahuja 9.5(1978)297  
 Topic: Evaluating a trig expression  
 Solution: Sum of a progression of cosines 11.2(1980)135
129.  
 Proposer: Warren Page 9.5(1978)297  
 Topic: New lattice point from a set of lattice points in  $m$ -space  
 Solution: Lattice point principle 11.2(1980)137
130.  
 Proposer: Aron Pinker 9.5(1978)297; Corrected 10.3(1979)210  
 Topic: Inequalities involving the area, perimeter and sides of a triangle  
 Solution: Sharpening of Heron's inequality 11.2(1980)138
131.  
 Proposer: Alan Wayne 10.1(1979)52  
 Topic: A triangle with area equal to the product of its perimeter and primes to be determined  
 Solution: When is half the inradius of an isosceles triangle prime? 11.3(1980)209
132.  
 Proposer: R. S. Luthar 10.1(1979)53  
 Topic: Finding a common point in a set of planes  
 Solution: Concurrent planes 11.3(1980)210
133.  
 Proposer: Barbara Turner 10.1(1979)53  
 Topic: Necessary & sufficient condition that 2 given sequences of real numbers diverge  
 Solution: Paired geometric progressions 11.3(1980)211
134.  
 Proposer: Norman Schaumberger 10.1(1979)53  
 Topic: Inequalities for surface area, volume, and diagonal of a rectangular parallelepiped  
 Solution: Interpolating  $((ab + bc + ca)/3)^{1/2}$  between  $(a + b + c)/3$  and  $(abc)^{1/3}$  11.3(1980)212
135.  
 Proposer: Gino T. Fala 10.1(1979)53  
 Topic: Probability that a randomly chosen number from a set is divisible by a given integer  
 Solution: Probability of divisibility 11.3(1980)213

136.  
 Proposer: Michael W. Ecker 10.2(1979)127  
 Topic: Expected number of throws to get a 5 on the 5<sup>th</sup> toss of a pair of dice  
 Solution: Mean of the geometric distribution 11.4(1980)276
137.  
 Proposer: Martin Berman 10.2(1979)127  
 Topic: Determine if a binomial-type quantity is an integer  
 Solution: Factorial fantasy 11.4(1980)277
138.  
 Proposer: Warren Page 10.2(1979)127  
 Topic: Determining if a number exists in base 10 which is a perfect  $n$ th power in other bases  
 Solution: Persistent powers 11.4(1980)278
139.  
 Proposer: Gregory P. Wene 10.2(1979)127  
 Topic: Determining the size of a matrix,  $M$ , so  $M$  or  $M - I$  is invertible, or  $M$  is idempotent  
 Solution: Spectrum of a proper idempotent 11.4(1980)278
140.  
 Proposer: Norman Schaumberger 10.2(1979)128  
 Topic: Find a point inside a triangle with sums of squares of distances to its sides minimal  
 Solution: Generalization of a property of the symmedian point 11.4(1980)279
141.  
 Proposer: Thomas E. Elsner 10.3(1979)210  
 Topic: Proving the existence of a minimal non-arithmetic sequence  
 Solution: Non-arithmetic sequences 11.5(1980)337
142.  
 Proposer: Alan Wayne 10.3(1979)210  
 Topic: An alphanumeric puzzle  
 Solution: Quartet uncoupled 11.5(1980)337
143.  
 Proposer: K. R. S. Sastry 10.3(1979)211  
 Topic: A trig identity involving the medians of a triangle  
 Solution: Inner product formula for cotangent 11.5(1980)338
144.  
 Proposer: R. S. Luthar 10.3(1979)211  
 Topic: Finding a function that satisfies a given inequality  
 Solution: Holder condition of order  $1 + \varepsilon$  11.5(1980)339
145.  
 Proposer: Sidney Penner 10.3(1979)211  
 Topic: Finding the number of moves needed for a checkerboard tour  
 Solution: Euler line on a checkerboard 11.5(1980)340

146.  
 Proposer: M. S. Klamkin 10.4(1979)293  
 Topic: The smallest  $n$ -gon inscribed in a regular  $n$ -gon has vertices as midpoints of its sides  
 Solution: Least area property of medial  $n$ -gons 12.1(1981)64
147.  
 Proposer: Charles W. Trigg 10.4(1979)293  
 Topic: Rearranging digits in a given square array  
 Solution: Square dance 12.1(1981)64
148.  
 Proposer: Martin Berman 10.4(1979)294  
 Topic: Coincidence of the centroids of a triangle and that of 3 segments in the triangle  
 Solution: Centroid of the boundary of a triangle 12.1(1981)65
149.  
 Proposer: V. N. Murty 10.4(1979)294  
 Topic: Validity of an inequality involving powers of sums of integers and their reciprocals  
 Solution: Convexity of  $(x + 1/x)^a$  12.1(1981)66
150.  
 Proposer: Aron Pinker 10.4(1979)294  
 Topic: Can a determinant with positive entries be zero?  
 Solution: Invertibility of matrices in  $Q[M]$  12.1(1981)67
151.  
 Proposer: Peter A. Lindstrom 10.5(1979)359  
 Topic: Equality of integrals from 1 to  $x$  and from  $y$  to  $xy$   
 Solution: The  $g$  that solves  $\int_1^x g(t)dt = \int_y^{xy} g(t)dt$  12.2(1981)155
152.  
 Proposer: Daniel Gallin 10.5(1979)359  
 Topic: Best lower bound for the probability of  $n$  events  
 Solution: Probability of simultaneously occurring events 12.2(1981)157
153.  
 Proposer: K. R. S. Sastry 10.5(1979)359  
 Topic: Determining the area of a given parallelogram  
 Solution: Squaring a parallelogram 12.2(1981)158
154.  
 Proposer: V. N. Murty 10.5(1979)360  
 Topic: Inequality using 4 real numbers whose determinant is 1  
 Solution: Inequality for triangles and for trace  $AB$  12.2(1981)159
155.  
 Proposer: Norman Schaumberger 10.5(1979)360  
 Topic: Finding the limit of the mean of  $n$  elements whose product is 1  
 Solution: Distinct elements with equal means 12.2(1981)162



156.  
 Proposer: Aron Pinkin 11.1(1980)61  
 Topic: Product inequality and area identity of triangles constructed within a given triangle  
 Solution: Harmonic division of real coordinates 12.3(1981)213
157.  
 Proposer: Warren Page 11.1(1980)61; Corrected 11.4(1980)275  
 Topic: Inequality relating to 2 sequences of positive real numbers  
 Solution: The inequality  $(1/n \sum (y_i - y_{\text{avg}})^2)^{1/2} < 1/2 (\max y_i - \min y_i)$  12.3(1981)214
158.  
 Proposer: V. N. Murty & J.M. Maynard 11.1(1980)61  
 Topic: 2 variable inequality for positive numbers  
 Solution: It's a sinh 12.3(1981)215
159.  
 Proposer: Norman Schaumberger 11.1(1980)62  
 Topic: Evaluating a sum of arctangents of reciprocal quantities  
 Solution: Generalization of  $\tan^{-1}(1/2) + \tan^{-1}(1/3) = \pi/4$  12.3(1981)216
160.  
 Proposer: R. S. Luthar 11.1(1980)62  
 Topic: N&S condition on sums of sines of angles of 2 triangles inscribed in a circle  
 Solution: Inscribed triangles revisited 12.3(1981)218
161.  
 Proposer: Michael W. Ecker 11.2(1980)131  
 Topic: Existence of a nonzero row-skew-symmetric matrix  
 Solution: Row-skew symmetric matrices 12.4(1981)275
162.  
 Proposer: Walter Bluger 11.2(1980)131  
 Topic: Finding the minimum number acute triangles which partition a square  
 Solution: Acute minimal triangulation of a square 12.4(1981)276
163.  
 Proposer: Wm. R. Klinger 11.2(1980)131; Corrected 12.2(1981)154  
 Topic: Summation inequalities determined from a finite sequence  
 Solution: The inequality  $\sum (\Sigma a^r / \Sigma a^s) \Sigma a^{r-s}$  13.1(1992)66
164.  
 Proposer: V. N. Murty 11.2(1980)132  
 Topic: Evaluating a definite logarithmic integral  
 Solution: Calculation of  $\int_0^1 (\ln x) \ln(1-x) dx$  12.4(1981)277
165.  
 Proposer: Bertram Kabak & Norman Schaumberger 11.2(1980)132  
 Topic: Inequalities relating to distances between interior points of a triangle  
 Solution: Inequalities for interior points of a triangle 12.5(1981)337

166.  
 Proposer: V. N. Murty 11.3(1980)208  
 Topic: Establishing some algebraic - exponential inequalities  
 Solution: Polynomial bounds for a meromorphic function 12.5(1981)339
167.  
 Proposer: Michael W. Ecker 11.3(1980)208  
 Topic: Truth values of statements concerning numbers in a list  
 Solution: Truth values for self-descriptive sentences 12.5(1981)343
168.  
 Proposer: Anonymous 11.3(1980)209  
 Topic: Finding a unique Solution to the equation,  $a^x = x^n$  for  $a > 0$   
 Solution: Unique Solution of  $a^x = x^n$  12.5(1981)343
169.  
 Proposer: Alan Wayne 11.3(1980)209  
 Topic: Find an integer whose square has consecutive digits whose product is divisible by 7  
 Solution:  $N^2$  terminating in  $7N$  12.5(1981)344
170.  
 Proposer: Sidney Penner 11.3(1980)209  
 Topic: Delete the minimum number of squares from a checkerboard leaving a unique configuration of remaining squares  
 Solution: Uniquely modified checkerboard 12.5(1981)345
171.  
 Proposer: Thoms E. Elsner 11.4(1980)275  
 Topic: Inequalities involving a canted washer with an internal centroid  
 Solution: Centroid of canted washer 13.1(1982)67
172.  
 Proposer: V. N. Murty 11.4(1980)276  
 Topic: Establishing sums of convergent sequences minus their limits  
 Solution: The series  $\sum_{j=1} \sum_{k=j+1} (-1)^k / (km + b)$  13.1(1982)67
173.  
 Proposer: Lance Littlejohn 11.4(1980)276  
 Topic: Proving that an upper triangular matrix is nilpotent  
 Solution: Powers of a triangular matrix 13.1(1982)69
174.  
 Proposer: Alan Wayne 11.4(1980)276  
 Topic: Solve a fifth degree polynomial equation  
 Solution: Cyclic quintic 13.1(1982)70
175.  
 Proposer: Norman Schaumberger 11.4(1980)276  
 Topic: Necessary & sufficient condition that a certain triangle is equilateral  
 Solution: Condition for equilateral triangles 13.1(1982)71

176.  
 Proposer: Michael W. Ecker 11.5(1980)336  
 Topic: Evaluate the determinant of a given matrix  
 Solution: Determinant of (poly(i,j)) 13.2(1982)148
177.  
 Proposer: Alvin J. Paullay & Sidney Penner 11.5(1980)336  
 Topic: Show that a triangular 2-colored array of pennies has 3 of the same color whose centers form an equilateral triangle  
 Solution: Array of head-and-tail discs 13.2(1982)150
178.  
 Proposer: Roger L. Creech 11.5(1980)336  
 Topic: Probability that a segment inside a circle is shorter than the radius  
 Solution: Probability of a subradial distance 13.2(1982)151
179.  
 Proposer: Alan Wayne 11.5(1980)336  
 Topic: Alphanumeric puzzles  
 Solution: Two division cryptarithms 13.2(1982)152
180.  
 Proposer: V. N. Murty 11.5(1980)336  
 Topic: Solving a bracket function equation  
 Solution: Greatest integer function identity 13.2(1982)153
181.  
 Proposer: Thomas E. Moore 12.1(1981)63  
 Topic: Prove that a Fermat number is not a product of 2 Mersenne numbers  
 Solution: Can a Fermat number be a Mersenne product? 13.3(1982)208
182.  
 Proposer: Martin Berman 12.1(1981)63  
 Topic: Determine the expected number of inversions in a set of counters  
 Solution: Expected number of inversions 13.3(1982)208
183.  
 Proposer: Milton P. Eisner 12.1(1981)63  
 Topic: Necessary & sufficient condition for triples in arithmetic progressions  
 Solution: Casting out arithmetic triples 13.3(1982)209
184.  
 Proposer: J. L. Brenner 12.1(1981)64  
 Topic: Proving or disproving trigonometric inequalities  
 Solution: Trigonometric implication 13.3(1982)210
185.  
 Proposer: Norman Schaumberger 12.1(1981)64  
 Topic: Finding rational Solutions of an algebraic equation  
 Solution: Rational Solutions of  $x^x + y^y = (x + y)^y$  13.3(1982)212

186.  
 Proposer: Stewart M. Venit 12.2(1981)155  
 Topic: A unique square matrix of any size having 3 given properties  
 Solution: \*\*\*\*\*
187.  
 Proposer: Norman Schaumberger 12.2(1981)155  
 Topic: Find the side of an equilateral triangle from distances from a fixed point to vertices  
 Solution: Distance to a vertex to an equilateral triangle 13.4(1982)278
188.  
 Proposer: Sidney Kravitz 12.2(1981)155  
 Topic: Calculating quantities using a fixed number of keystrokes on a calculator  
 Solution: Alternatives on a hand held calculator 13.4(1982)282
189.  
 Proposer: Charles W. Trigg 12.2(1981)155  
 Topic: 4-term arithmetic progressions of 3-digit primes  
 Solution: Arithmetic progression of primes with permuted digits 13.5(1982)334
190.  
 Proposer: Zalman Usiskin 12.2(1981)155  
 Topic: Solving a trig equation of tangent functions  
 Solution: Tangent product 13.5(1982)335
191.  
 Proposer: Michael Ecker 12.3(1981)212  
 Topic: Approximated rational fractions by decimals  
 Solution: Arithmetical errors of the types  $1/a = \cdot a$  and  $a/b = \cdot ab$  13.5(1982)336
192.  
 Proposer: V. N. Murty 12.3(1981)213  
 Topic: Limit of the  $n^{\text{th}}$  root of the geometric mean of binomial coefficients  
 Solution: Geometric mean of binomial coefficients 13.5(1982)337
193.  
 Proposer: K. R. S. Sastry 12.3(1981)213  
 Topic: Equations involving the inradius and circumradius of a triangle  
 Solution: Inversion of a circle in a circle through its center 13.5(1982)339
194.  
 Proposer: Norman Schaumberger 12.3(1981)213  
 Topic: Inequality involving  $e$  and  $\pi$   
 Solution: Is  $(\pi^\pi e^e)^{1/2}$  13.5(1982)340
195.  
 Proposer: Barney Bissinger 12.3(1981)213  
 Topic: Solving a trig equation of tangent functions  
 Solution:  $\tan x = \tan 2x \tan 3x \tan 4x$  13.5(1982)341

196.  
 Proposer: Kenneth Fogarty 12.4(1981)275  
 Topic: Can a non-median angle bisector in a triangle contain the centroid?  
 Solution: Envelope of lines bisecting a triangle 14.1(1983)65
197.  
 Proposer: Thomas E. Elsner 12.4(1981)275  
 Topic: Number of square matrices satisfying 3 conditions  
 Solution: Minimal matrices with vanishing adjoint 14.1(1983)68;  
 Rock bottom 15.4(1984)347
198.  
 Proposer: Aron Pinker & John Biggs 12.4(1981)275  
 Topic: Equality involving internal segments in a right triangle  
 Solution: Nested right triangles 14.1(1983)69
199.  
 Proposer: F. David Hammer 12.4(1981)275  
 Topic: Possible identity of a sum of polynomial quantities times a binomial coefficient  
 Solution: Nth difference of a polynomial 14.1(1983)69
200.  
 Proposer: Chris Jantzen 12.4(1981)275  
 Topic: Number of dice needed to maximize the probability of rolling n 6's in one toss  
 Solution: Optimal number of Trials in a binomial experiment 14.1(1983)70
201.  
 Proposer: Norman Schaumberger 12.5(1981)336  
 Topic: A series of inequalities involving reciprocals of cubic integers  
 Solution: Eliminating the remainder of a series 15.3(1984)267
202.  
 Proposer: V. N. Murty 12.5(1981)336  
 Topic: Inequality involvint the mean and variance of 2 subsets of real numbers  
 Solution: \*\*\*\*\*
203.  
 Proposer: Alan Wayne 12.5(1981)337  
 Topic: Finding optimal regular polygons inscribed in a larger regular polygon  
 Solution: \*\*\*\*\*
204.  
 Proposer: Norman L. Swanson 12.5(1981)337  
 Topic: Solving for integers that satisfy a factorial equation  
 Solution: What is strange About  $6!7!=10!?$  14.2(1983)173
205.  
 Proposer: Jerry Metzger 12.5(1981)337  
 Topic: Finding the path of a dog chasing a rabbit  
 Solution: The path of a dog pursuing a rabbit 14.2(1983)174

206.  
 Proposer: Stewart M. Venit 13.1(1982)64  
 Topic: Finding eigenvalues of one matrix and verifying properties of another  
 Solution: Matrix medley 14.2(1983)176
207.  
 Proposer: Milton H. Hoehn 13.1(1982)65  
 Topic: Evaluating a sum of squared cosines  
 Solution:  $\sum \cos^2 \{(2k - 1)\pi / 2n\} = n/4$  14.2(1983)178
208.  
 Proposer: M. S. Klamkin 13.1(1982)65  
 Topic: Explain why the sum of 2 roots of a given quartic equation is 4  
 Solution: Depression of a biquadratic given the sum of two roots 14.3(1983)261
209.  
 Proposer: Aron Pinker 13.1(1982)65  
 Topic: Proving algebraic-logarithmic inequalities  
 Solution: The logarithmic mean 14.4(1983)353
210.  
 Proposer: Sydney Bulman-Fleming & Edward T. H. Wang 13.1(1982)65  
 Topic: Find the maximum cardinality of a set of  $n \geq 3$  integers such that  $n_i + n_j > n_k$   
 Solution: Subsets of  $\{1,2,\dots,n\}$  satisfying  $i + j > k$  14.3(1983)262
211.  
 Proposer: Edward T. H. Wang 13.2(1982)147  
 Topic: If  $n \geq 4$  and  $2 \leq k \leq n-2$ ,  $C(n,k)$  is never prime. Is it a prime power?  
 Solution: The number of prime divisors of  $C(n,k)$  14.3(1983)264
212.  
 Proposer: Michael W. Ecker 13.2(1982)147  
 Topic: Product of  $1 - x^k$  where  $w$  is any  $n$ th root of unity  
 Solution: Generalization of  $(\sin \pi/5)(\sin 2\pi/5) = \sqrt{5}/4$  14.3(1983)265
213.  
 Proposer: Chico Problem Group 13.2(1982)147  
 Topic: Questions about limits involving a function and its continuous 1st and 2<sup>nd</sup> derivative  
 Solution:  $\lim (as x \rightarrow \infty) f(x) = 0$  versus  $\lim (as x \rightarrow \infty) f'(x) = 0$  14.4(1983)356
214.  
 Proposer: Charles W. Trigg 13.2(1982)148  
 Topic: Magic square problem  
 Solution: Magic four squares squares 14.4(1983)356
215.  
 Proposer: V. N. Murty 13.2(1982)148  
 Topic: Closed form for the sum of products of ratios of factorials  
 Solution: Vandermonde identity with repetitions 14.5(1983)439
216.  
 Proposer: Milton P. Eisner 13.3(1982)206  
 Topic: Expected value involving matching pairs of socks  
 Solution: \*\*\*\*\*

217.  
 Proposer: Norman Schaumberger 13.3(1982)206  
 Topic: Inequalities involving square roots and products of rational fractions  
 Solution: Bounds for  $\Gamma(x)\Gamma(x + \frac{1}{2})$  14.5(1983)441
218.  
 Proposer: V. N. Murty 13.3(1982)207  
 Topic: Sum of a tangent and sine function  
 Solution: Does  $\tan(3\pi/11 + 4\sin(2\pi/11)) = \sqrt{11}$ ? 14.4(1983)358
219.  
 Proposer: A. C. Segal 13.3(1982)207  
 Topic: Sequence of products of cosines approximating  $\pi$  and its error bound  
 Solution: Vieta's infinite product for  $\pi$  15.1(1984)69
220.  
 Proposer: Milton P. Eisner 13.3(1982)207  
 Topic: Choice of 2 payment plans for receiving d dollars  
 Solution: Plan A or plan B 15.1(1984)70
221.  
 Proposer: Simeon M. Berman 13.3(1982)207  
 Topic: Inequality involving the elements of a positive definite matrix  
 Solution: An inequality for positive definite forms 15.1(1984)71
222.  
 Proposer: Stanley Rabinowitz 13.3(1982)207  
 Topic: Probability involving the roll of 4 n-sided dice  
 Solution: \*\*\*\*\*
223.  
 Proposer: Warren Page 13.3(1982)207  
 Topic: Location of the roots of an equation involving the sum of linear reciprocals  
 Solution: Logarithmic derivative of a polynomial 15.1(1984)72
224.  
 Proposer: V. N. Murty 13.4(1982)276  
 Topic: Inequality involving the mean and standard deviation of a set of numbers  
 Solution: Set mean minus subset mean 15.1(1984)73
225.  
 Proposer: Norman Schaumberger 13.4(1982)277  
 Topic: Equation and 3 inequalities involving the functions of angles of a triangle  
 Solution: Inequalities for a triangle 15.2(1984)164
226.  
 Proposer: Walter Bluger 13.4(1982)277  
 Topic: Maximum number of  $1 \times 2 \times 4$  bricks in cube with sides of length 7  
 Solution: \*\*\*\*\*
227.  
 Proposer: K. R. S. Sastry 13.4(1982)277  
 Topic: Necessary & sufficient conditions concerning the sides of a convex quadrilateral  
 Solution: Orthodiagonal quadrilaterals 15.2(1984)165

228.  
 Proposer: Gary F. Birkenmeier 13.4(1982)277  
 Topic: Finding integral Solutions of an algebraic equation  
 Solution:  $(Z^x - 1)(Z^y - 1) = Z^w + 1$  15.2(1984)166
229.  
 Proposer: Boon-Yian Ng 13.4(1982)277  
 Topic: Inequality involving products ratios of integral expressions  
 Solution: Is  $C(n,r)/n^r$  less than  $C(n+1,r)/(n+1)^r$ ? 15.2(1984)168
230.  
 Proposer: Sydney Bulman-Fleming & Edward T. H. Wang 13.4(1982)277  
 Topic: Question concerning the mean of a set of average values of a set of numbers  
 Solution: Mean values of subsets of a finite set 15.3(1984)269
231.  
 Proposer: Jan List Boal & Jean H. Bevis 13.5(1982)333  
 Topic: In any number base there is only one palindrome with an even number of digits  
 Solution: Palindromic primes 15.3(1984)270
232.  
 Proposer: K. R. S. Sastry 13.5(1982)333  
 Topic: Forming a larger triangle from 5 existing perfect triangles  
 Solution: Two triangles: each divided perfectly 15.3(1984)271
233.  
 Proposer: M. Selby 13.5(1982)334  
 Topic: Inequality involving the sides of a triangle  
 Solution: Inequality for the sides of a triangle 15.3(1984)272
234.  
 Proposer: Bertram Kabak 13.5(1982)334  
 Topic: Equation involving the areas of triangles formed from sides of a parallelogram  
 Solution: Areas of oriented triangles on a directed line segment 15.4(1984)348
235.  
 Proposer: Norman Schaumberger 13.5(1982)334  
 Topic: Inequality involving 4 real numbers and their sum  
 Solution: Generalization of  $a/b + b/a \geq 2$  15.4(1984)349
236.  
 Proposer: V. N. Murty 13.5(1982)334  
 Topic: Evaluation an improper logarithmic integral  
 Solution: Evaluation of  $\int_{\{from 0 to \infty\}} \ln((1+x)/(1-x))^2 dx$  15.4(1984)351
237.  
 Proposer: Thomas E. Elsner 13.5(1982)334  
 Topic: 4 color problem involving pennies in a plane  
 Solution: \*\*\*\*\*
238.  
 Proposer: V. N. Murty 14.1(1983)64  
 Topic: Inequality involving the sides of a right triangle  
 Solution: Scalene triangle inequality 15.4(1984)352



239.  
 Proposer: Norman Schaumberger 14.1(1983)64  
 Topic: The product of 4 distinct non-zero integers can or cannot be a 4<sup>th</sup> power  
 Solution: Thanks again, Euler 15.5(1984)446
240.  
 Proposer: K. R. S. Sastry 14.1(1983)64  
 Topic: Circumcircles, escribed circles and tangents to a triangle  
 Solution: Circles and centers of triangles 15.5(1984)446
241.  
 Proposer: Claire Krukenberg & Lawrence Ringenberg 14.1(1983)65  
 Topic: Finding a closed form for the sum of a series of reciprocal products  
 Solution: On  $\sum \{ \text{from } m = n \text{ to } \infty \} (m(m+1) \dots (m+p))^{-1}$  15.5(1984)448
242.  
 Proposer: Arnold Lapidus 14.1(1983)65  
 Topic: Evaluate a determinant using only its trace and traces of its powers  
 Solution: Newton's formulae 15.5(1984)450
243.  
 Proposer: Robert E. Shafer 14.2(1983)173  
 Topic: Proving that the numerator of a sum of fractions is divisible by  $2^{2^n}$   
 Solution: Divisibility property of  $\sum \{ \text{from } 1 \text{ to } 2^n \} 1/(2k-1)$  16.1(1985)80
244.  
 Proposer: Michael Filaseta 14.2(1983)173  
 Topic: Identity for a finite sum of the squares of products of cosecants and cotangents  
 Solution: Cotangent series 16.1(1985)78
245.  
 Proposer: Norman Schaumberger 14.2(1983)173  
 Topic: For which powers does a sum of ratios of odd products to even products converge?  
 Solution: Elementary proof that  $\sum ((1 \cdot 3 \cdot 5 \dots (2n-1))/(2 \cdot 4 \cdot 6 \dots 2n))^2$  diverges 16.1(1985)78
246.  
 Proposer: Jerry M. Metzger 14.2(1983)173  
 Topic: Sequences with arithmetic mean equaling the geometric mean of the 1<sup>st</sup> and last term  
 Solution: Sequences with  $a_1 + a_2 + \dots + a_k = k \sqrt{a_1 a_k}$  16.1(1985)80
247.  
 Proposer: Mangho Ahuja 14.2(1983)173  
 Topic: Largest integer not a sum of nonnegative multiples of 2 primes in terms of the primes  
 Solution: Representation of integers by linear forms 16.2(1985)154
248.  
 Proposer: M. S. Klamkin 14.2(1983)173  
 Topic: Terms of ratios and sums of 2 sequences of arithmetic and geometric progressions  
 Solution: Ratios and sums of progressions 16.2(1985)155

249.  
 Proposer: K. R. S. Sastry 14.3(1983)260  
 Topic: Necessary & sufficient condition for a given geometric mean to exist inside a triangle  
 Solution: Triangles ABC with  $AB + AC \leq \sqrt{2} BC$  16.2(1985)157
250.  
 Proposer: Jerry M. Metzger 14.3(1983)260  
 Topic: For what k is  $10^k - 1$  a perfect cube?  
 Solution: When Is  $10^k - 1$  a cube? 16.2(1985)159
251.  
 Proposer: Norman Schaumberger 14.3(1983)260  
 Topic: Inequality for functions of the 3 sides of a triangle  
 Solution: Consolidation of triangle inequalities 16.2(1985)159
252.  
 Proposer: Michael W. Ecker 14.3(1983)260  
 Topic: Find a set of integers so that the sum of any subset does not equal a given integer  
 Solution: On binary representation of integers 16.2(1985)160
253.  
 Proposer: M. S. Klamkin 14.3(1983)261  
 Topic: N & S inequality on the cotangents of angles of a triangle that make it equilateral  
 Solution: The inequality  $3\sum \cot A \geq \sum \cot (A/2)$  16.3(1985)224
254.  
 Proposer: R. S. Luthar 14.3(1983)261  
 Topic: Finding a function satisfying 3 conditions for  $x > 0$   
 Solution:  $\sqrt{x} (dy/dx) - (y/2\sqrt{x}) = \log x$  16.3(1985)226
255.  
 Proposer: F. Lee Cook 14.4(1983)352  
 Topic: Algebraic inequality  
 Solution: Comparison of  $\sum \{ \text{from } 1 \text{ to } n \} k^r$  and  $\int \{ \text{from } 1 \text{ to } n+1 \} x^r dx$  16.3(1985)227
256.  
 Proposer: Armel Mercer 14.4(1983)352  
 Topic: A polynomial function, a Maclaurin series and Stirling numbers of the 2<sup>nd</sup> kind  
 Solution: \*\*\*\*\*
257.  
 Proposer: Gengzhe Chang 14.4(1983)353  
 Topic: Necessary & sufficient condition for an inequality on 6 real number to be valid  
 Solution: Homogeneous inequality 16.3(1985)228
258.  
 Proposer: Leslie V. Glickman 14.4(1983)353  
 Topic: Binomial coefficient ratio identity  
 Solution: Combinatorial identity 16.3(1985)229

259.  
 Proposer: Sanjukta Hota & Kathy Williams 14.4(1983)353  
 Topic: Inequalities involving roots and products of rational expressions  
 Solution: Estimation of a product 16.3(1985)230
260.  
 Proposer: Suresh Ailawadi 14.5(1983)439  
 Topic: Evaluating a trigonometric integral  
 Solution: Symmetry method for definite integrals 16.4(1985)305
261.  
 Proposer: M. S. Klamkin 14.5(1983)439  
 Topic: Explaining the numerical approximations of the tangent of  $89.99\dots$   
 Solution: Tangent of  $(90 - \varepsilon)^0$  16.4(1985)306
262.  
 Proposer: Kenneth Fogarty 14.5(1983)439  
 Topic: Plane separating a tetrahedron into 2 solids of equal volume  
 Solution: Planes through a median of a tetrahedron 16.4(1985)307
263.  
 Proposer: Charles W. Trigg 14.5(1983)439  
 Topic: Finding figurate numbers which are the sum of three 3-digit primes  
 Solution: Prime sums for K-gons 16.4(1985)308
264.  
 Proposer: R. S. Luthar 14.5(1983)439  
 Topic: Inequality involving the area and perimeter of a triangle  
 Solution: Isoperimetric inequality for triangles 16.4(1985)309
265.  
 Proposer: M. S. Klamkin 15.1(1984)68  
 Topic: Extreme values of the sum of sines of the angles of a triangle  
 Solution: Triangle inequalities 16.4(1985)310
266.  
 Proposer: Sydney Bulman-Fleming & Edward T. H. Wang 15.1(1984)68  
 Topic: Finding the number of intersections of an exponential and a polynomial graph  
 Solution: Numbers which equal their logarithms 16.4(1985)311
267.  
 Proposer: Robert E. Shafer 15.1(1984)68  
 Topic: Inequality involving sums of reciprocals of cubed binomials  
 Solution: Generalizations of  $\zeta(3) > \frac{1}{4} (\zeta(2))^3$  16.5(1985)417
268.  
 Proposer: Norman Schaumberger 15.1(1984)69  
 Topic: Trig identity involving sums of products of secants  
 Solution: Formula for the difference of two tangents 16.5(1985)419
269.  
 Proposer: Chico Problem Group 15.1(1984)69  
 Topic: Find an asymptotic formula for a sum of ratios of binomial coefficients  
 Solution: Asymptotic formula for the Nth difference of  $1/x$  16.5(1985)419

270.  
 Proposer: Martin LaBar 15.1(1984)69  
 Topic: Can a  $3 \times 3$  magic square be formed from 9 distinct integral squares?  
 Solution: \*\*\*\*\*
271.  
 Proposer: Robert E. Shafer 15.2(1984)163  
 Topic: Finding the maximum quantity in a certain set  
 Solution: Permutation of  $x^{(y^z)}$  16.5(1985)421
272.  
 Proposer: F. David Hammer 15.2(1984)163  
 Topic: Partitioning the integers into disjoint sets with range a Fibonacci sequence  
 Solution: Fibonacci notation for natural numbers 16.5(1985)422
273.  
 Proposer: R. Shantaram 15.2(1984)164  
 Topic: Equation involving the areas of faces of a tetrahedron  
 Solution: Cosine law for tetrahedra 17.1(1986)93
274.  
 Proposer: Edwart T. H. Wang 15.2(1984)164  
 Topic: Determining 2 matrices whose squares are zero but whose products are not  
 Solution: Commuting nilpotent matrices 17.1(1986)96
275.  
 Proposer: Norman Schaumberger 15.2(1984)164  
 Topic: Finding the limit of the  $n$ th root of a product of integers congruent to 1 mod 3 over  $n$   
 Solution:  $\lim_{n \rightarrow \infty} \frac{1}{n} [(\alpha + \beta)(2\alpha + \beta) \dots (n\alpha + \beta)]^{1/n}$  as  $n \rightarrow \infty$  17.1(1986)97
276.  
 Proposer: Norman Schaumberger 15.3(1984)266; Corrected: 16.3(1985)223  
 Topic: Finding zeroes of a polynomial having only positive integral zeroes and satisfying summation conditions on its coefficients  
 Solution: The polynomial is  $(x - 2)^{2n}$  17.5(1986)443
277.  
 Proposer: Fr. Gabe Costa 15.3(1984)267  
 Topic: Evaluate the sum of squared reciprocals of square free positive integers  
 Solution: Subseries of  $\sum n^{-2}$  17.1(1986)98
278.  
 Proposer: M. S. Klamkin 15.3(1984)267  
 Topic: Determine  $(A - I)^{-1}$  for a matrix,  $A$ , satisfying a cubic matrix equation  
 Solution: Inverse of the matrix  $A - I$  17.2(1986)185
279.  
 Proposer: K. R. S. Sastry 15.3(1984)267  
 Topic: Necessary & sufficient condition that a concyclic trapezoid is isosceles  
 Solution: Trapezoids which have inscribed circles 17.2(1986)187

280.  
 Proposer: J. Howard S. Kane & C. Searcy 15.3(1984)267  
 Topic: Prove that  $e$  is the limit of a ratio of consecutive terms of a given sequence  
 Solution: Rate of divergence of  $\sum 1/n$  17.2(1986)188
281.  
 Proposer: Charles W. Trigg 15.4(1984)346  
 Topic: Palindromic triangular numbers in base 9  
 Solution: Palindromic triangular numbers in base nine 17.2(1986)188
282.  
 Proposer: M. S. Klamkin 15.4(1984)346  
 Topic: Altering a familiar trig identity  
 Solution: Functional equation  $(f(x) \cdot f(y)) / (g(x) \cdot g(y)) = (f(x) - f(y)) / (g(x) - g(y))$  17.3(1986)250
283.  
 Proposer: Terry Shell 15.4(1984)347  
 Topic: Finding the number of dice necessary to maximize the probability of getting  $n$  6's  
 Solution: How many dice minimize this probability? 17.3(1986)251
284.  
 Proposer: Gary Walls 15.4(1984)347  
 Topic: Finding values that guarantee convergence of an improper integral  
 Solution: Sums of partial integrals 17.3(1986)251
285.  
 Proposer: K. R. S. Sastry 15.4(1984)347  
 Topic: Necessary & sufficient condition concerning a triangle's excircle and inscribed circle  
 Solution: Incircle and excircle revisited 17.3(1986)252
286.  
 Proposer: Bertram Kabak 15.5(1984)445  
 Topic: Necessary & sufficient condition for a triangle to be equilateral  
 Solution: Equilateral triangle trigonometry 17.3(1986)253
287.  
 Proposer: Harry Sedinger 15.5(1984)445  
 Topic: Convergence of a sequence from a function of the integer and fractional part of  $x > 1$   
 Solution: Sequence with algebraic limit 17.3(1986)254
288.  
 Proposer: R. S. Luthar 15.5(1984)445  
 Topic: Trigonometric - exponential integral  
 Solution:  $\int (\tan^2 x - \tan x)e^{-x} dx$  17.4(1986)361
289.  
 Proposer: Norman Schamberger 15.5(1984)446  
 Topic: Trigonometric sine inequality  
 Solution: Comparability of  $\sin(\sqrt{xy})$  and  $\sqrt{(\sin x \cdot \sin y)}$  17.4(1986)362
290.  
 Proposer: Gengzhe Chang 15.5(1984)446  
 Topic: Limit of a sequence defined by an integral multiplied by a binomial coefficient  
 Solution: Limit of a sum of binomial probabilities 17.4(1986)364

291.  
 Proposer: Heinz-Jürgen Seiffert 16.1(1985)74  
 Topic: Integral inequality  
 Solution: Inequality for convex functions 17.5(1986)444
292.  
 Proposer: Peter Sisler 16.1(1985)74  
 Topic: Algebraic summation identity  
 Solution: Series for  $\log x$  on the interval  $0 < x \leq 2$  17.5(1986)446
293.  
 Proposer: Norman Schaumberger 16.1(1985)75  
 Topic: Comparing ratios of sums of trig functions  
 Solution: Inequality for trigonometric series 17.5(1986)447
294.  
 Proposer: Russell Euler 16.1(1985)75  
 Topic: Polar coordinate product identity  
 Solution: Factorization of  $|z^p - 1|^2$  17.5(1986)448
295.  
 Proposer: Verne R. Sanford 16.1(1985)75  
 Topic: Necessary & sufficient condition that  $(f/g)' = f'/g'$  holds in some interval  
 Solution: When does  $(h/g)' = h'/g'$ ? 18.1(1987)70
296.  
 Proposer: Edilio Escalone F. 16.2(1985)153  
 Topic: Finding functions that satisfy a mean value type equation  
 Solution: Solution of  $f(x) - g(y) = (x - x y)h(x + y)$  18.4(1987)341
297.  
 Proposer: M. S. Klamkin 16.2(1985)153  
 Topic: Show that a function of homogeneous functions is also homogeneous  
 Solution: Functionally dependent homogeneous functions 18.1(1987)72
298.  
 Proposer: Roger B. Nelson 16.2(1985)153  
 Topic: Equivalence and congruence classes of triangles in a regular n-gon  
 Solution: Number of triangles equals number of partitions 18.1(1987)72
299.  
 Proposer: Arnold Lapidus 16.2(1985)154  
 Topic: Optimal strategy sought in a coin tossing game  
 Solution: Game of the first occurring head-tail sequence 18.1(1987)74
300.  
 Proposer: K. R. S. Sastry 16.2(1985)154  
 Topic: Necessary & sufficient condition involving a triangle's sides and an angle bisector  
 Solution: Triangles with a double angle 18.1(1987)76
301.  
 Proposer: Stephen Plett 16.3(1985)223  
 Topic: Number of nonsymmetrical ways to label a cube  
 Solution: Counting colorful cubes 18.2(1987)161

302.  
 Proposer: Gao Ling 16.3(1985)223  
 Topic: Necessary & sufficient condition for an inequality involving areas and semi-perimeters of 2 triangles  
 Solution: Inequality for parts of two triangles 18.2(1987)163
303.  
 Proposer: Weixuan Li & Edward T. H. Wang 16.3(1985)224  
 Topic: Algebraic inequality involving 4 real numbers  
 Solution: Inequalities for rearrangements of powers 18.2(1987)164
304.  
 Proposer: Hüseyin Demir 16.3(1985)224  
 Topic: Necessary & sufficient condition for a circle to be inscribed in a convex quadrilateral  
 Solution: Inscriptable quadrilaterals 18.2(1987)165
305.  
 Proposer: Norman Schaumberger 16.3(1985)224  
 Topic: Finding real numbers that satisfy a given algebraic inequality  
 Solution: Pigeon holes for ten cubes 18.2(1987)166
306.  
 Proposer: Sudhir Kumer Goel 16.4(1985)304  
 Topic: Evaluating the limit of a product of roots of an even powered binomial  
 Solution: Definite integral 18.3(1987)249
307.  
 Proposer: Chico Problem Group 16.4(1985)304  
 Topic: Finding the limit of a function of the number of digits in  $n_k!$   
 Solution: When does  $n!$  Have  $n$  digits? 18.3(1987)250
308.  
 Proposer: M. S. Klamkin 16.4(1985)304  
 Topic: Evaluate all 3<sup>rd</sup> order derivatives of 3<sup>rd</sup> powers of a trig expression  
 Solution: Faà di Bruno's formula is applied 18.3(1987)250
309.  
 Proposer: Clark Kimberling 16.4(1985)306  
 Topic: Do all triangles have a tangency point?  
 Solution: Tangency points of a triangle 18.3(1987)251
310.  
 Proposer: Robert E. Shafer 16.4(1985)306  
 Topic: Bounding the error in estimating the sum of a function converging to  $\pi$   
 Solution: Slow road to pi 18.3(1987)252
311.  
 Proposer: Mike Chamberlain 16.5(1985)416  
 Topic: Finding values for which a sequence of trigo integrals converge  
 Solution: Limit  $q^p \beta(p,q) = \Gamma(p)$  as  $q \rightarrow \infty$  18.4(1987)343

312.  
 Proposer: Francisco J. Navarro-Bermudez 16.5(1985)416  
 Topic: Characterize differentiable functions satisfying a kind of mean value theorem  
 Solution: Mean value theorem for polynomials 18.4(1987)344
313.  
 Proposer: M. S. Klamkin 16.5(1985)416  
 Topic: Is the origin a minimum point of a surface tangent to the x-y plane?  
 Solution: Normal selections at a saddle point 18.5(1987)426
314.  
 Proposer: Peter A. Lindstrom 16.5(1985)417  
 Topic: Find all differentiable functions satisfying a chain-type product rule  
 Solution: \*\*\*\*\*
315.  
 Proposer: Dale Meinhold 16.5(1985)417  
 Topic: Finding the expected value for the number of die tosses to obtain all 6 faces  
 Solution: Hexahedral waiting time 18.5(1987)427
316.  
 Proposer: M. S. Klamkin 17.1(1986)92  
 Topic: Summation inequality involving 5 given positive quantities  
 Solution:  $\{\text{Cyclic}\} \sum (a_1 a_2 a_3 / a_4 a_5)^4 \geq \{\text{cyclic}\} \sum a_1 a_2^2 a_3$  18.1(1987)428
317.  
 Proposer: Huseyin Demir 17.1(1986)92  
 Topic: Independence of areas of a parallelogram, a star pentagon and another pentagon  
 Solution: Star polygons inscribed in a parallelogram 18.5(1987)428
318.  
 Proposer: Harvey J. Fletcher 17.1(1986)92  
 Topic: Finding initial values of a sequence to guarantee convergence  
 Solution: Convergence of  $X_{n+1} = b - c/X_n$  18.5(1987)429
- 319,  
 Proposer: Richard J. Johnsonbaugh 17.1(1986)93  
 Topic: Show that 2 given sequence are monotonic and find their limits  
 Solution: Monotonicity of  $(x^{x+1} / (x+1)^x)^x / \Gamma(x+1)$  18.5(1987)431
320.  
 Proposer: Norman Schaumberger 17.1(1986)93  
 Topic: Inequality involving ratios of natural number expressions  
 Solution: Bounds for  $\{n / (n+1)\}^{1/(n+1)}$  19.1(1988)82
321.  
 Proposer: M. S. Klamkin 17.2(1986)184  
 Topic: Prove that an algebraic ratio is between 1 and 2  
 Solution: Bounds for  $\{(x - 1/2)^{x-1/2} (x + 1/2)^{x+1/2}\} / x^{2x}$  19.1(1988)84
322.  
 Proposer: Anon 17.2(1986)184  
 Topic: Finding a generalization of a function from a Pascal program  
 Solution: Simplifying a function defined in Pascal 19.1(1988)86



323.  
 Proposer: Eugene Levine 17.2(1986)185  
 Topic: Solving a 20<sup>th</sup> degree polynomial equation  
 Solution:  $(x^2 - 9x - 1)^{10} + 99x^{10} = 10x^9 (x^2 - 1)$  19.1(1988)87
324.  
 Proposer: Florentine Smarandache 17.2(1986)185  
 Topic: Find all integers whose fixed multiple of Euler's  $\phi$ -function divide the integer  
 Solution: When is  $n/\phi(n)$  an integer  $\leq 3$ ?  $> 3$ ? 19.2(1988)187
325.  
 Proposer: Larry Hoehn 17.2(1986)185  
 Topic: Finding the arithmetic mean of 2 sides of a convex quadrilateral  
 Solution: Cyclic quadrilaterals and broken chords 19.2(1988)188
326.  
 Proposer: David Sack 17.3(1986)249  
 Topic: Largest subset serving as the domain for a function defined by an infinite series  
 Solution: Domain of convergence of  $\sum \{ \text{from } n=2 \text{ to } \infty \} n^{-p} (\log n)^{-q}$  19.2(1988)189
327.  
 Proposer: Warren B. Ordon 17.3(1986)249  
 Topic: Find the limit of the reciprocal of a triangular number times a given sum  
 Solution: Limit of Riemann sums 19.2(1988)190
328.  
 Proposer: F. Smarandache 17.3(1986)249  
 Topic: Necessary & sufficient condition that  $p$  and  $p + 2$  are prime  
 Solution: Prime pairs and Wilson's theorem 19.2(1988)191
329.  
 Proposer: Edward T. Wang 17.3(1986)250  
 Topic: Finding the limit of a sequence defined on the median of 2 rational numbers  
 Solution: Limit of mediants 19.2(1988)192
330.  
 Proposer: M. S. Klamkin 17.3(1986)250  
 Topic: Extreme value of a sum of 3 fractions in 3 variables  
 Solution: Extreme values of  $\sum x^2 / (x + yx)$  19.3(1988)291
331.  
 Proposer: Robert E. Shafer 17.4(1986)360  
 Topic: Inequalities for the area, semi-perimeter and tangents of the angles in a triangle  
 Solution: Inequalities for sides of a triangle 19.3(1988)292
332.  
 Proposer: M. S. Klamkin 17.4(1986)360  
 Topic: Maximum value of the circumradius of a circle with an inscribed quadrilateral  
 Solution: Maximum circumradius of a variable triangle 19.3(1988)294
333.  
 Proposer: Vis Upatrisringa 17.4(1986)361  
 Topic: Complex number identity for  $\sin^2 \theta$   
 Solution: Hyperbola in the complex plane squared 19.4(1988)371

334.  
 Proposer: Clark Kimberling 17.4(1986)361  
 Topic: Find a Euclidean construction for the limit of a point sequence defined in a triangle  
 Solution: Contracting infinite sequence of triangles 19.4(1988)372
335.  
 Proposer: Arthur C. Segal 17.4(1986)361  
 Topic: Finding a closed form for an infinite alternating sum of a ratio of polynomials  
 Solution: Series of values of a rational function 20.1(1989)69
336.  
 Proposer: Robert E. Shafer 17.5(1986)442  
 Topic: Inequalities involving a function defined for reciprocals of positive numbers  
 Solution: Inequality proved by the Laplace transform 19.5(1988)449
337.  
 Proposer: M. S. Klamkin 17.5(1986)442  
 Topic: Inequality involving sums of fractions of 4 positive numbers  
 Solution: If  $\prod a = 1$ , then  $\sum a^3 \geq \text{Max} \{ \sum a, \sum 1/a \}$  19.5(1988)450
338.  
 Proposer: Norman Schaumberger 17.5(1986)443  
 Topic: Limit of ratios of sums from subsequences of the harmonic sequence  
 Solution: The probability of a number being square free 19.4(1988)373
339.  
 Proposer: Geoffrey A. Kandall 17.5(1986)443  
 Topic: Equality involving ratios of distance from the sides of a triangle and 3 interior points  
 Solution: Ratio of ratios for three concurrent lines 20.1(1989)75
340.  
 Proposer: James Foster 17.5(1986)443  
 Topic: Probability for consecutive heads in a coin toss experiment  
 Solution: Heads before tails 20.1(1989)75
341.  
 Proposer: Martin Gardner 18.1(1987)69  
 Topic: Determining a criterion for a starting pattern for winning a peg removable puzzle  
 Solution: Jumping pegs 20.1(1989)78
342.  
 Proposer: Otto Bintz 18.1(1987)69  
 Topic: Finding the average squareness of all natural numbers  
 Solution: Average squareness of natural numbers 20.2(1989)164
343.  
 Proposer: M. S. Klamkin 18.1(1987)69  
 Topic: Algebraic division problem  
 Solution: Polynomial division 20.2(1989)166
344.  
 Proposer: Craig Bailey & Bruce Richter 18.1(1987)70  
 Topic: Finding positions of sets in lexicographic order  
 Solution: Lexicographic ordering of k-subsets of an n-set 20.2(1989)167

345.  
 Proposer: Sydney Balman-Fleming 18.1(1987)70  
 Topic: Find long sequences of natural numbers, none of which is a sum of 2 squares  
 Solution: Sequences of integers not representable as a sum of two squares 20.2(1989)168
346.  
 Proposer: Peter Andrews & Edward T. H. Wang 18.2(1987)160  
 Topic: What point in or on a triangle maximizes the sum of distances from its vertices?  
 Solution: Opposite of the Fermat point 20.2(1989)169
347.  
 Proposer: Larry Hoehn 18.2(1987)160  
 Topic: Product of ratios involving mutually trisecting cevians in a triangle  
 Solution: Generalization of Ceva's theorem 20.2(1989)170
348.  
 Proposer: Norman Schaumberger 18.2(1987)160  
 Topic: Inequalities involving powers of 3 and a ratio of factorials  
 Solution: Comparison of the probabilities  $[(kn)! / (n!)^k]k^{-nk}$  20.2(1989)171
349.  
 Proposer: John W. Lindsay & William Watkins 18.2(1987)161  
 Topic: Uniqueness of representation of integers in number base -2  
 Solution: Negative bases 20.3(1989)257
350.  
 Proposer: Florentine Smarandache 18.2(1987)161  
 Topic: Solve a system of 2 equations in 3 variables  
 Solution: Two Diophantine equations 20.3(1989)258
351.  
 Proposer: R. S. Luthar 18.3(1987)248  
 Topic: Inequality involving the sides of a right triangle  
 Solution: Right triangle inequality 20.3(1989)259
352.  
 Proposer: Dave Ohlsen 18.3(1987)248  
 Topic: Equality involving permutations and the greatest integer function  
 Solution:  $\sum P_k^n = [n!e]$  20.3(1989)260
353.  
 Proposer: Clark Kimberling 18.3(1987)248  
 Topic: Proof that a triangle has an interior point on 3 congruent circles tangent to its sides  
 Solution: Congruent bitangent circles in a triangle 20.3(1989)261
354.  
 Proposer: Alvin Tirman 18.3(1987)248  
 Topic: Is a certain triangle inside an integral right triangle also integral?  
 Solution: Nested integer-sided right triangles 20.3(1989)262
355.  
 Proposer: Robert E. Shafer 18.3(1987)249  
 Topic: Divisibility of the sum of powers of odd integers by even and odd powers of 2  
 Solution: Factors of 2 in  $\sum \{ \text{from } k=1 \text{ to } 2^n \} (2k-1)^s$  20.3(1989)263

356.  
 Proposer: Sydney Bulman-Fleming 18.4(1987)340  
 Topic: Inequalities involving the sequence of prime numbers  
 Solution: Application of Bertrand's postulate 20.3(1989)265
357.  
 Proposer: Chico Problem Group 18.4(1987)341  
 Topic: The Euler-Mascheroni constant and functions satisfying equality of integrals  
 Solution: Construction of a class of continuous functions 21.4(1990)335
358.  
 Proposer: Florentine Smarandache 18.4(1987)341  
 Topic: Find values of  $n$  which make a function involving  $n$  and the  $\sqrt{2}$  integral  
 Solution: Perfect squares in a sequence 21.4(1990)336
359.  
 Proposer: Gregg Patrino 18.4(1987)341  
 Topic: Inequality involving factorials and products of powers of integers  
 Solution: A.G.M. Inequality applied to binomial coefficients 20.4(1989)344
360.  
 Proposer: J. H. Webb 18.4(1987)341  
 Topic: Inequalities involving natural numbers and their square roots as exponents  
 Solution:  $n^{\sqrt{n+1}}$  versus  $(n+1)^{\sqrt{n}}$  20.4(1989)345
361.  
 Proposer: Mohammad K. Azarian 18.5(1987)425  
 Topic: Inequality involving sums of sines and cosines of reciprocals of natural numbers  
 Solution: Telescoping series 20.4(1989)346
362.  
 Proposer: Bruce Deardon 18.5(1987)425  
 Topic: Diophantine equation in 2 variables with integral coefficients  
 Solution: Quadratic Diophantine equations in two letters 20.4(1989)346
363.  
 Proposer: Thomas P. Dence 18.5(1987)425  
 Topic: Maximum cardinality of the set of equal values for 2 different real-valued functions  
 Solution: An uncountable number of intersections 21.1(1990)66
364.  
 Proposer: Thomas M. Green 18.5(1987)426  
 Topic: Locus of a point having exactly 2 normals to a parabola  
 Solution: Evolute of a parabola 20.4(1989)348
365.  
 Proposer: Mary Spruill Kilgore 18.5(1987)425  
 Topic: The incenters of triangles formed from vertices of a cyclic quadrilateral form a rectangle  
 Solution: Incentral rectangle of a cyclic quadrilateral 20.4(1989)349

366.  
 Proposer: Ambati Jeya Krishna 19.1(1988)81  
 Topic: Inequalities involving sides inradius and circumradius of a triangle  
 Solution: Reappearance of a triangle triple inequality 20.4(1989)352
- 367  
 Proposer: Robert E. Shafer 19.1(1988)81  
 Topic: Evaluating the alternating sum of binomial coefficients  
 Solution: Chebyshev polynomials of the second kind 20.4(1989)353
368.  
 Proposer: M. S. Klamkin 19.1(1988)81  
 Topic: Generalize a 2-variable complex number identity to 3 variables  
 Solution: Parallelopiped law for complex numbers 20.5(1989)443
369.  
 Proposer: Martin Feuerman 19.1(1988)82  
 Topic: Finding an invertible  $2 \times 2$  matrix from a non-invertible one with no saddle point  
 Solution: Saddle point condition for invertibility 20.5(1989)445
370.  
 Proposer: Norman Schaumberger 19.1(1988)82  
 Topic: Product inequality involving the powers of 3 positive numbers  
 Solution: Application of the extended Chebyshev inequality 20.5(1989)445
371.  
 Proposer: Zun Shan & Edward T. H. Wang 19.2(1988)186  
 Topic: Solving a 2-variable system of 2 cubic equations  
 Solution: Nonlinear system with symmetry 20.5(1989)447
372.  
 Proposer: Eugene Levine 19.2(1988)186  
 Topic: Inequality involving  $n$  points on a unit circle  
 Solution: Mean length of all chords through a point of a circle 20.5(1989)448
373.  
 Proposer: Robert E. Shafer 19.2(1988)186  
 Topic: Finding 9 points on a sphere with 4 equidistant nearest neighbors  
 Solution: Nine points on a sphere 21.1(1990)66
374.  
 Proposer: Murray S. Klamkin 19.2(1988)186  
 Topic: Necessary & sufficient condition involving an in-&-circumcircle and sides of a quadrilateral  
 Solution: Quadrilaterals having incircles and perpendicular diagonals 20.5(1989)448
375.  
 Proposer: Norman Schaumberger 19.2(1988)187  
 Topic: Summation-product inequality for a sequence of 4 positive numbers  
 Solution:  $\sum a_i^{27} / \prod a_i$  21.1(1990)68

376.  
 Proposer: R. S. Luthar 19.3(1988)290  
 Topic: Equality of sums involving points on the sides of a triangle  
 Solution: Reciprocals of triangle sides 20.5(1989)449
377.  
 Proposer: M. S. Klamkin 19.3(1988)290  
 Topic: Finding the maximum value of an 8<sup>th</sup> degree polynomial  
 Solution: Chebyshev polynomial 20.5(1989)450
378.  
 Proposer: Edward T. H. Wang 19.3(1988)291  
 Topic: Evaluate the determinant with entries being multi-selection numbers  
 Solution: The determinant of a multi-selection matrix 21.3(1990)247
379.  
 Proposer: Mohammad K. Azarian 19.3(1988)291  
 Topic: Trigonometric summation inequality  
 Solution: A trigonometric inequality 21.3(1990)248
380.  
 Proposer: Stephen Plett 19.3(1988)291  
 Topic: Partitioning natural numbers into 3 numbers representing the sides of a triangle  
 Solution: Triangular partitions 21.4(1990)337
381.  
 Proposer: Mohammad K. Azarian 19.4(1988)370  
 Topic: Least upper bound on the limit involving the square root of a double sum  
 Solution: A bounded double sum 21.1(1990)69
382.  
 Proposer: Parviz Khajeh-Khalili 19.4(1988)370  
 Topic: Summation inequality for the cosines of angles of an inscribed quadrilateral  
 Solution: A trigonometric inequality for quadrilaterals 21.1(1990)69
383.  
 Proposer: Murray S. Klamkin 19.4(1988)370  
 Topic: Proving a statement about the difficulty establishing a triangle inequality  
 Solution: A not-so-difficult triangle inequality 21.1(1990)70
384.  
 Proposer: Thomas P. Dence 19.4(1988)371  
 Topic: Algebraic inequality  
 Solution:  $2 \leq x \leq y$  implies  $y^{x+1} \leq xy^y$  21.1(1990)701
385.  
 Proposer: Kazem . Sedati 19.4(1988)371  
 Topic: Establishing the value of a product of cosines  
 Solution:  $\cos(\pi/14) \cos(3\pi/14) \cos(5\pi/14) = \sqrt{7/8}$  21.1(1990)71
386.  
 Proposer: Eugene Levine 19.5(1988)448  
 Topic: Equality involving the sum of large digits in powers of 2  
 Solution: A sum of large digits 21.2(1990)151

387.  
 Proposer: Larry Hoehn 19.5(1988)448  
 Topic: Proving a ratio of powers of sums and differences of natural numbers is integral  
 Solution: Division by a square 21.2(1990)152
388.  
 Proposer: Morris Wald 19.5(1988)448  
 Topic: Probability that 3 positive integers  $< 1001$  are sides of a triangle  
 Solution: Triangles from random integers 21.2(1990)153389.  
 Proposer: M. S. Klamkin 19.5(1988)449  
 Topic: Finding real factors of a quadratic binomial of 3 variables  
 Solution: Differences of cubes 21.2(1990)154
390.  
 Proposer: Roger B. Nelsen 19.5(1988)449  
 Topic: Smallest right triangle having an integral square inscribed on the hypotenuse  
 Solution: Squares in a Pythagorean triangle
391.  
 Proposer: Murray S. Klamkin 20.1(1989)68  
 Topic: Non-linear Diophantine equation in 3 variables  
 Solution: A rational Diophantine equation 21.2(1990)155
392.  
 Proposer: Robert Jones 20.1(1989)68  
 Topic: Algebraic- trigonometric inequality  
 Solution: An inequality for the sine 21.2(1990)156
393.  
 Proposer: Ginger Bolton 20.1(1989)68  
 Topic: Possible summation of products equality  
 Solution: A sum of products 21.2(1990)156
394.  
 Proposer: John F. Loase 20.1(1989)69  
 Topic: For a polynomial,  $f$ , is  $f(k)$  the  $k^{\text{th}}$  digit in the decimal expansion of  $\sqrt{2}$ ?  
 Solution: Polynomial generation of  $\sqrt{2}$  21.3(1990)249
395.  
 Proposer: Murray S. Klamkin 20.1(1989)69  
 Topic: Inequality for the areas of a triangle and the one formed by extended altitudes  
 Solution: An area inequality for two triangles 21.3(1990)249
396.  
 Proposer: Alan Wayne 20.2(1989)163  
 Topic: Alphanumeric puzzle  
 Solution:  $46933 = \text{Gauss}$  21.3(1990)250
397.  
 Proposer: Eugene Levine 20.2(1989)163  
 Topic: Determinant of a matrix formed by adding 1 to the elements of another matrix  
 Solution: The determinant of a sum 21.3(1990)251

398

Proposer: Brian Anderson & Barry Brunson 20.2(1989)163

Topic: Does the sum of distances from equally spaced points on a circle to a diameter depend on the diameter selected?

Solution: The independence of a circular sum 21.3(1990)252

399.

Proposer: Norman Schaumberger 20.2(1989)164

Topic: Evaluate a sum of arctangents

Solution: An old arctangent series reappears 21.3(1990)253

400.

Proposer: Murray Klamkin 20.2(1989)164

Topic: Equality of simplexes formed from antipodal points on an n-dimensional sphere

Solution: Simplicial volumes 21.4(1990)337

401.

Proposer: Alan Wayne 20.3(1989)256

Topic: Curve traced by highest point of water from a moving hose

Solution: The path of water 21.4(1990)338

402.

Proposer: Norman Schaumberger 20.3(1989)256

Topic: Equality of sums of 5<sup>th</sup> and 7<sup>th</sup> roots of quantities involving square roots of 5

Solution: Sums of roots 21.4(1990)339

403.

Proposer: Howard Reinhardt 20.3(1989)256

Topic: Bounds on the average number of children in families in a certain community

Solution: Average children 21.4(1990)340

404.

Proposer: Murray Klamkin 20.3(1989)256

Topic: Prove a sequence of ratios of powers of natural numbers is increasing

Solution: An increasing sequence 21.4(1990)340

405.

Proposer: Bill Wardlaw 20.3(1989)257

Topic: Necessary & sufficient condition for an inner product inequality of n-dim vectors

Solution: A scalar product inequality 21.5(1990)424

406.

Proposer: Murray Klamkin 20.4(1989)343

Topic: Inequality involving ratios of 3 positive numbers

Solution: A Muirhead inequality 21.5(1990)424

407.

Proposer: Murray Klamkin 20.4(1989)343

Topic: Evaluating an algebraic integral

Solution: Integration by (almost any) substitution 21.5(1990)425



408.  
 Proposer: Clark Kimberling 20.4(1989)343  
 Topic: Concurrent lines and the excenters of a triangle  
 Solution: A case of concurrent lines 21.5(1990)426
409.  
 Proposer: S. A. Banawan 20.4(1989)344  
 Topic: Evaluate an alternating sum of binomial coefficients over a quadratic  
 Solution: A binomial identity reappears 21.5(1990)427
410.  
 Proposer: Harry Sedinger 20.4(1989)344  
 Topic: Characterizing certain sequences of odd integers  
 Solution: An old sum 21.5(1990)428
411.  
 Proposer: Murray Klamkin 20.5(1989)442  
 Topic: Elementary symmetric functions on what must be a unique set  
 Solution: Power series and symmetric polynomials 21.5(1990)429
412.  
 Proposer: Edward F. Vitek 20.5(1989)442  
 Topic: Find the limit of a sequence of ratios of positive numbers and their logarithms  
 Solution: A bounded monotone sequence converges 21.5(1990)429
413.  
 Proposer: K. R. S. Sastry 20.5(1989)442  
 Topic: Two equalities arising from 2 lines and reflected rays  
 Solution: Similar trapezoids 22.1(1991)71
414.  
 Proposer: Norman Schaumberger 20.5(1989)443  
 Topic: Squeezing  $\ln 2$  between 2 sums  
 Solution: An inequality of  $\ln 2$  22.1(1991)71
415.  
 Proposer: Eugene Levine 20.5(1989)443  
 Topic: Evaluate the infinite product of the ratio of 2 algebraic quantities  
 Solution: An infinite product for  $\sqrt{2}$  22.1(1991)72
416.  
 Proposer: Joanne Harris 21.1(1990)65  
 Topic: Exponential inequality  
 Solution: An exponential inequality 22.1(1991)73
417.  
 Proposer: K. R. S. Sastry 21.1(1990)65  
 Topic: Questions concerning distances from the incenter and an excenter of a triangle  
 Solution: Of triangles and trapezoids 22.1(1991)74
418.  
 Proposer: Norman Schaumberger 21.1(1990)65  
 Topic: Inequalities on products of integral powers and the exponential function  
 Solution: Bounds for  $\prod \{ \text{from } k = 1 \text{ to } n \} k^k$  22.1(1991)74

419.  
 Proposer: Neville Robbins 21.1(1990)66  
 Topic: Necessary & sufficient condition that a cosine function is rational  
 Solution: A rational cosine 22.1(1991)75
420.  
 Proposer: Edward T. H. Wang 21.1(1990)66  
 Topic: Inequalities involving binomial coefficients, powers of 2 and the square root of 2  
 Solution: Bounds for central binomial coefficients 22.1(1991)76
421.  
 Proposer: Stanley Rabinowitz 21.2(1990)150  
 Topic: Equality of 2 sides of a triangle depending on its median and 2 inscribed circles  
 Solution: An isosceles triangle 22.2(1991)168
422.  
 Proposer: M. Riazi-Kermani 21.2(1990)150  
 Topic: Probability that the roots of a quadratic equation are real  
 Solution:  $d^2/d\alpha^2 \Pr \{ \text{the roots of } x^2 + ax + b = 0, |a|, |b| \leq \alpha, \text{ are real} \}$  22.2(1991)168
423.  
 Proposer: Mohammad K. Azarian 21.2(1990)150  
 Topic: Improper integral involving logarithms of 2 algebraic functions  
 Solution: A divergent improper integral 22.2(1991)169
424.  
 Proposer: Robert E. Shafer 21.2(1990)150  
 Topic: Hyperbolic cosine and sine inequality  
 Solution: An inequality for the hyperbolic sine and cosine 22.2(1991)170
425.  
 Proposer: David Vaughan & Edward T. H. Wang 21.2(1990)150  
 Topic: Finding extrema for an algebraic function of products and sums  
 Solution: Extremes of a product 22.2(1991)171
426.  
 Proposer: Norman Schaumberger 21.3(1990)246  
 Topic: Equality of distances formed from a circle passing through a vertex and 2 sides  
 Solution: Triangle and circle 22.3(1991)256
427.  
 Proposer: Mohammad K. Azarian 21.3(1990)246  
 Topic: Squeezing the graph of a logarithmic function between 2 lines  
 Solution: A bound for a logarithm 22.3(1991)256
428.  
 Proposer: David Doster 21.3(1990)246  
 Topic: Divisibility of a sum by powers of 2 and a necessary & sufficient condition for division by 5  
 Solution: Divisibility of a sum 22.3(1991)257

429.  
 Proposer: Florentin Smarandache 21.3(1990)247  
 Topic: Finding the order of a member of a particular group  
 Solution: The order of an element of a group 22.3(1991)256
430.  
 Proposer: Chico Problem Group 21.3(1990)247  
 Topic: Angle that permits a set of conditions for a construction in an isosceles triangle  
 Solution: Triangles within a triangle 22.3(1991)260
431.  
 Proposer: R. S. Luthar 21.4(1990)334  
 Topic: Trig inequality involving tangents, sines and cosecants  
 Solution: A trigonometric inequality 22.4(1991)344
432.  
 Proposer: Chico Problem Group 21.4(1990)334  
 Topic: Divisors of the divisor of a “rep-unit”  
 Solution: Factoring “rep-unit” factors 22.4(1991)345
433.  
 Proposer: Nicholas Passell 21.4(1990)334  
 Topic: Limit of an algebraic function multiplied by an integer satisfying an inequality  
 Solution:  $\lim_{x \rightarrow 0^+} xN_x = \pi/4$  22.4(1991)346
434.  
 Proposer: Eugene Levine 21.4(1990)335  
 Topic: Evaluate an alternating sum of ratios of powers of  $\pi$  and certain factorials  
 Solution: Rational alternating sum 22.4(1991)346
435.  
 Proposer: J. H. Webb 21.4(1990)335  
 Topic: Diophantine equation in 3 variables  
 Solution: The death of another Diophantine equation 22.4(1991)347
436.  
 Proposer: Michael B. Handlesman 21.5(1990)423  
 Topic: Most probable value and the expected value in a coin tossing experiment  
 Solution: Distributing “heads” minus “tails” 22.5(1991)444
437.  
 Proposer: Bill Wardlaw 21.5(1990)423  
 Topic: Cardinality of a set of decimals with restrictions on their digits  
 Solution: Counting and characterizing certain rationals 22.5(1991)446
438.  
 Proposer: K. R. S. Sastry 21.5(1990)424  
 Topic: Equality of radii of the inradii and exradii of 2 incircles of triangles within another  
 Solution: Inradii and exradii 22.5(1991)447
439.  
 Proposer: Ken Gamon 21.5(1990)424  
 Topic: Existence of 2 numbers satisfying an absolute value condition  
 Solution: Unbounded Solutions to a Diophantine equation 22.5(1991)447

440.  
 Proposer: Mohammad K. Azarian 21.5(1990)424  
 Topic: Evaluating a sum of an algebraic expression depending on 2 indices of summation  
 Solution: Evaluating a double limit 22.5(1991)448
441.  
 Proposer: Bill Wardlaw 22.1(1991)70  
 Topic: Conditions that an element is in a given field if a matrix depending on it is singular  
 Solution: The singularity of matrices 23.1(1992)70
442.  
 Proposer: Samuel A. Truitt, Jr. 22.1(1991)70  
 Topic: Values that determine if a give sequence is strictly increasing or decreasing  
 Solution: The ups and downs of convergence 23.1(1992)71
443.  
 Proposer: Eugene Levine 22.1(1991)70  
 Topic: Evaluate a finite sum involving cosines  
 Solution: A positive root approach to a sum 23.1(1992)72
444.  
 Proposer: J. B. Romero 22.1(1991)71  
 Topic: Inequality involving the perimeters and sides of 2 right or obtuse triangles  
 Solution: A geometric inequality 23.1(1992)73
445.  
 Proposer: Editors of CMJ 22.1(1991)71  
 Topic: Minimum dimension that permits a square matrix of order  $n$  with complex entries  
 Solution: The  $Q$ -order of a matrix 23.1(1992)74
446.  
 Proposer: Norman Schaumberger 22.2(1991)167  
 Topic: Inequality involving sine functions of 3 variables  
 Solution: Another triangle inequality 23.2(1992)163
447.  
 Proposer: Francis J. Flanigan 22.2(1991)167  
 Topic: Characterizing coefficients of a polynomial which allows it no positive roots  
 Solution: Real polynomials with a single negative coefficient 23.2(1992)163
448.  
 Proposer: Dumitru Acu 22.2(1991)167  
 Topic: Inequality involving the product of 3 matrices  
 Solution: An inequality of determinants 23.2(1992)164
449.  
 Proposer: Irl C. Bivens 22.2(1991)168  
 Topic: A group has a subgroup with members which deny another subgroup members  
 Solution: A counter-closed subset of a group 23.2(1992)165
450.  
 Proposer: R. Daniel Hurwitz 22.2(1991)168  
 Topic: Hyperspheres tangent to ceilings and walls in the corner of a rectangular room  
 Solution: Two spheres in a corner 23.2(1992)166

451.  
 Proposer: Mohammad K. Azarian 22.3(1991)255  
 Topic: Trig inequality involving sines, cosines, secants and cosecants  
 Solution: AM-GM strikes again 23.3(1992)248
452.  
 Proposer: David G. Hartz 22.3(1991)255  
 Topic: Sums of k positive integers yield perfect squares for what k?  
 Solution: Sums as  $m^{\text{th}}$  powers 23.3(1992)249
453.  
 Proposer: Zeev Barel 22.3(1991)255  
 Topic: Find cluster points in an infinite walking pattern  
 Solution: A vacillating mathematician 23.3(1992)250
454.  
 Proposer: Leonard Palmer 22.3(1991)256  
 Topic: Necessary & sufficient condition on a matrix that 2 relatively prime members imply  
 2 others are too  
 Solution: J: relatively prime  $\rightarrow$  relatively prime 23.3(1992)251
455.  
 Proposer: R. S. Tiberio 22.3(1991)256  
 Topic: What triangles have a concurrent median, altitude and angle bisector from 3 angles?  
 Solution: A triangle with concurrent median, altitude, and angle bisector 23.3(1992)252
456.  
 Proposer: David M. Bloom 22.4(1991)343  
 Topic: Necessary & sufficient condition for divisibility in a base N expansion of a proper  
 fraction  
 Solution: A base-N expansion 23.4(1992)341
457.  
 Proposer: Frank Schmidt 22.4(1991)343  
 Topic: Inequality involving a vector function and a given matrix  
 Solution: A coordinate-counting function 23.4(1992)342
458.  
 Proposer: Ioan Sadoveanu 22.4(1991)343  
 Topic: Algebraic inequality in n variables  
 Solution:  $x_1^{n+1} + x_2^{n+1} + \dots + x_n^{n+1} \geq x_1 x_2 \dots x_n (x_1 + x_2 + \dots + x_n)$  23.4(1992)344
459.  
 Proposer: D. A. Moran 22.4(1991)344  
 Topic: Location of the critical point of a cubic polynomial with 3 real zeroes  
 Solution: Location of critical points of a cubic 23.4(1992)345
460.  
 Proposer: William V. Webb 22.4(1991)344  
 Topic: 2-variable difference equation  
 Solution:  $Y_{n+1} = ay_n^x$  23.4(1992)347

461.  
 Proposer: Alex Necochea 22.5(1991)443  
 Topic: Necessary & sufficient condition for a trigonometric inequality  
 Solution: An inequality for the cosine and inverse sine 23.5(1992)436
462.  
 Proposer: Jiro Fukuta 22.5(1991)443  
 Topic: Minimizing the area and perimeter of a hexagon inscribed in a triangle  
 Solution: Minimum area and perimeter 23.5(1992)437
463.  
 Proposer: Jean-Marie Monier 22.5(1991)443  
 Topic: Calculating matrix products given the entries in the product of 3 unknown matrices  
 Solution: Idempotent matrix products 23.5(1992)438
464.  
 Proposer: Frank Schmidt 22.5(1991)444  
 Topic: Summation inequality involving the sgn function of permutations in a group  
 Solution: A sum of signs of permutations 23.5(1992)439
465.  
 Proposer: Norman Schaumberger 22.5(1991)444  
 Topic: Inequality involving a sequence of positive numbers  
 Solution: An inequality with powers of positive numbers 23.5(1992)439
466.  
 Proposer: Ginger Bolton 23.1(1992)69  
 Topic: Finding the area of a quadrilateral  
 Solution: The area of a lattice quadrilateral 24.1(1993)96
467.  
 Proposer: Stanley Rabinowitz 23.1(1992)69  
 Topic: Given the ratios of the cosines of angles in a triangle, find ratios of the sides  
 Solution:  $\cos A : \cos B : \cos C = 2:9:12 \Rightarrow a:b:c = 6:5:4$  24.1(1993)97
468.  
 Proposer: Murray Klamkin & Andy Liu 23.1(1992)69  
 Topic: Inequalities involving logarithms and a sequence of improper integrals  
 Solution: Bounds on  $\int_{1}^{\infty} dx/(1+x^{n+1})$  24.1(1993)97
469.  
 Proposer: K. R. S. Sastry 23.1(1992)70  
 Topic: Arithmetic progression of length 49 and square sums of squares  
 Solution: A sum of 49 squares 24.1(1993)99
470.  
 Proposer: William Wardlaw 23.1(1992)70  
 Topic: Finding if a trigonometric limit exists  
 Solution:  $\lim 1/(n \sin n)$  does not exist 24.1(1993)99
471.  
 Proposer: David Doster 23.2(1992)162  
 Topic: Lebesgue measure of a set yielding an inequality of bracket functions  
 Solution: The measure of a set 24.2(1993)184

472.  
 Proposer: Ioan Sadoveanu 23.2(1992)162  
 Topic: Limits of ratios of members of a decreasing set of real numbers  
 Solution: Limits of ratios of positive real numbers 24.2(1993)185
473.  
 Proposer: K. R. S. Sastry 23.2(1992)162  
 Topic: Necessary & sufficient condition that a triangle is self-median  
 Solution: A characteristic of self-median triangles 24.2(1993)186
474.  
 Proposer: Zhang Zaiming 23.2(1992)163  
 Topic: Find the determinant of a given matrix  
 Solution: A “determinant” for Pascal’s triangle 24.2(1993)188
475.  
 Proposer: Seung-Jin Bang 23.2(1992)163  
 Topic: Equality of 2 infinite sums of reciprocals of natural numbers  
 Solution:  $\sum (1 + 1/2 + \dots + 1/(n+1)) 1/(n(n+1)) = 2$  from  $\{n = 1 \text{ to } \infty\}$  24.2(1993)189
476.  
 Proposer: Juan Bosco 23.3(1992)247  
 Topic: Diophantine equation in 3 variables  
 Solution: A somewhat symmetric Diophantine equation 24.3(1993)272
477.  
 Proposer: Norman Schaumberger 23.3(1992)247  
 Topic: Trig identity involving sines of 3 angles  
 Solution: Another trigonometric identity 24.3(1993)272
478.  
 Proposer: K. R. S. Sastry 23.3(1992)247  
 Topic: Determining a cubic polynomial to guarantee zeroes in arithmetic progression  
 Solution: Arithmetic progression of roots 24.3(1993)274
479.  
 Proposer: David Hamilton & Pat Stewart 23.3(1992)247  
 Topic: Determining if a given matrix is invertible  
 Solution: A class of nonsingular matrices 24.3(1993)275
480.  
 Proposer: Ioan Sadoveanu 23.3(1992)248  
 Topic: Necessary & sufficient condition that certain triangle is equilateral  
 Solution: Altitudes of an Equilateral Triangle 24.3(1993)275
481.  
 Proposer: Leonard Gillman 23.4(1992)340  
 Topic: Find an example satisfying restrictions on lower and upper Riemann sums  
 Solution:  $L_n > L_{n+1}$  and  $U_n < U_{n+1}$  24.4(1993)378
482.  
 Proposer: Ioan Sadoveanu 23.4(1992)340  
 Topic: Prove equality on products of distances from points on the incircle of a triangle  
 Solution: An incircle invariant 24.4(1993)379

483.  
 Proposer: Murray Klamkin 23.4(1992)340  
 Topic: Determine the general term of a sequence of powers given  $n$  initial conditions  
 Solution: Determinant of a power sum 24.4(1993)380
484.  
 Proposer: S. A. Patil & D. S. Hawkins 23.4(1992)341  
 Topic: Probability of real roots for a cubic with randomly chosen coefficients in  $[0,1]$   
 Solution: The probability that the roots of a cubic are real 24.4(1993)382
485.  
 Proposer: Norman Schaumberger 23.4(1992)341  
 Topic: Tower power inequalities on 2 positive numbers  
 Solution: An inequality for composite powers 24.4(1993)384
486.  
 Proposer: Jyotirmoy Sarkar 23.5(1992)435  
 Topic: Equality of ratios of distances constructed in a triangle  
 Solution: Constant ratios in a triangle 24.5(1993)475
487.  
 Proposer: Greg Neumer 23.5(1992)435  
 Topic: Finding values which permit a limit for a recurring sequence  
 Solution: For what  $x_0$  does  $x_{n+1} = 1/(x_n + 1)$  converge? 24.5(1993)476
488.  
 Proposer: Murray Klamkin & Andy Liu 23.5(1992)435  
 Topic: Probability of 2 walkers meeting in a random walk exercise  
 Solution: A random walk on a square lattice 24.5(1993)477
489.  
 Proposer: Ioan Sadoveanu 23.5(1992)436  
 Topic: Determine the convergence and bounds on the limit of a given sequence  
 Solution:  $e \leq \lim u_n \leq 1 + e$  24.5(1993)478
490.  
 Proposer: Jiro Fukuta 23.5(1992)436  
 Topic: Find the extrema for the area of a quadrilateral inscribed in a circle  
 Solution: Extremal inscribed quadrilateral 24.5(1993)479
491.  
 Proposer: Michael Handelsman 24.1(1993)95  
 Topic: Find a polynomial given the derivative of its ratio with  $x^n$   
 Solution: Polynomial palindromes 25.1(1994)65
492.  
 Proposer: Norman J. Finizio & James T. Lewis 24.1(1993)95  
 Topic: Finding the number of balanced arrangements of  $\{1, 2, \dots, 2n\}$   
 Solution: Balanced circular arrangements 25.1(1994)66
493.  
 Proposer: K. R. S. Sastry 24.1(1993)95  
 Topic: What points guarantee the sum of ratios of distance in a pentagon to be a constant?  
 Solution: A constant from a pentagon 25.1(1994)66



494.  
 Proposer: Frank Schmidt 24.1(1993)96  
 Topic: Find a formula for the number of matrices with a fixed set of eigenvalues  
 Solution: Counting eigenvalues over  $Z/2Z$  25.1(1994)67
495.  
 Proposer: William R. Klinger 24.1(1993)96  
 Topic: Critical points harmonically dividing the roots of a cubic polynomial  
 Solution: An impossible harmonic division 25.1(1994)69
496.  
 Proposer: Robert J. Blodgett 24.2(1993)183  
 Topic: Determine positive integers whose digits reverse if added to itself in any base  
 Solution: Double-reversing numbers 25.2(1994)158
497.  
 Proposer: Edward Aboufadel 24.2(1993)183  
 Topic: Quickly solve Arnold's limit problem concerning a ratio of sine and tangents  
 Solution:  $\lim_{x \rightarrow 0} \{(\sin(\tan x) - \tan(\sin x))/(\sin^{-1}(\tan^{-1}x) - \tan^{-1}(\sin^{-1}x))\}$  25.2(1994)159
498.  
 Proposer: David Callan 24.2(1993)184  
 Topic: Find row sums in a Pascal-like triangle  
 Solution: A Pascal-like triangle 25.2(1994)161
499.  
 Proposer: Frank Schmidt 24.2(1993)184  
 Topic: Do there exist an infinite number of finite graphs satisfying 3 given conditions?  
 Solution: An infinite class of planar graphs 25.2(1994)162
500.  
 Proposer: Michael Fatliff 24.2(1993)184  
 Topic: Inequalities involving partial quotients of simple continued fractions  
 Solution: An ordering of partial quotients 25.2(1994)163
501.  
 Proposer: K. R. S. Sastry 24.3(1993)271  
 Topic: Necessary & sufficient condition that the semi-perimeter of a right triangle is a triangular number  
 Solution: A Triangle Semi-Perimeter 25.3(1994)241
502.  
 Proposer: Zhang Zaiming 24.3(1993)271  
 Topic: Finding values that guarantee the equality of 2 sums of integers  
 Solution: Pell's equation - once again 25.3(1994)241
503.  
 Proposer: Louis R. Bragg & Jerrold W. Grossman 24.3(1993)271  
 Topic: Finding the different triangles with limited integral length of sides  
 Solution: Counting "Diophantine" triangles 25.3(1994)243

504.  
 Proposer: Gloria Olive 24.3(1993)272  
 Topic: Expressing products of primes as the sum of consecutive positive integers  
 Solution: Factorizations and sums 25.3(1994)244
505.  
 Proposer: Parviz Khajeh-Khalili 24.3(1993)272  
 Topic: Show that a sequence of logarithms is decreasing and find its limit  
 Solution: Area above and below a hyperbola 25.3(1994)245
- 506  
 Proposer: Heinz-Jürgen 24.4(1993)377  
 Topic: Equality of 2 sums, one involving products of sums  
 Solution: A sum of a product of a sum and a product 25.4(1994)335
507.  
 Proposer: Jiro Fukuta 24.4(1993)377  
 Topic: Inequality involving the lengths of sides of a quadrilateral  
 Solution: An inequality for the perimeter of a quadrilateral 25.4(1994)336
508.  
 Proposer: K. R. S. Sastry 24.4(1993)377  
 Topic: Find all Pythagorean triangles with n-gonal sides and a common rank  
 Solution: Polygonal Pythagorean triples 25.4(1994)337
509.  
 Proposer: Norman Schaumberger 24.4(1993)378  
 Topic: Diophantine equation in 5 variables  
 Solution: A Diophantine equation with successive powers 25.4(1994)338
510.  
 Proposer: Murray S. Klamkin 24.4(1993)378  
 Topic: Comparing 2 multiple integrals of sines and cosines  
 Solution: Trigonometric integral inequalities 25.4(1994)338
511.  
 Proposer: Zhang Zaiming 24.5(1993)472  
 Topic: Inequality involving the sides and areas of 2 triangles  
 Solution: An inequality for two triangles 25.5(1994)463
512.  
 Proposer: Richard Carpenter & Homer White 24.5(1993)472  
 Topic: Find the determinant of a given matrix  
 Solution: A determinant of subscript products 25.5(1994)464
513.  
 Proposer: Frank J. Flanigan 24.5(1993)473  
 Topic: Finding the constant term guaranteeing a cubic equation has 3 integral roots  
 Solution: Cubics with no integer roots 25.5(1994)465
514.  
 Proposer: David Doster 24.5(1993)473  
 Topic: Finding the limit of a sequence of quotients of 2 other sequences  
 Solution:  $\lim_{n \rightarrow \infty} \{p_n / q_n\} = \sqrt[3]{2}$  25.5(1994)465

515.  
 Proposer: Larry Hoehn 24.5(1993)473  
 Topic: Necessary & sufficient condition that a given quadrilateral is a parallelogram  
 Solution: A parallelogram characterization 25.5(1994)466
516.  
 Proposer: Ioan Sadoveanu 25.1(1994)64  
 Topic: Given the roots of one polynomial, solve another  
 Solution: Roots of related polynomials 26.1(1995)67
517.  
 Proposer: Kazem S. Sadati 25.1(1994)64  
 Topic: If squared sides of a triangle are in arithmetic progressions, so are the cotangents  
 Solution: Cotangents in arithmetic progression 26.1(1995)68
518.  
 Proposer: K. R. S. Sastry 25.1(1994)64  
 Topic: Find a triple of triangular numbers analogous to a Pythagorean triple and having a  
           Sum also a triangular number  
 Solution: Pythagorean triples of triangular numbers 26.1(1995)69
519.  
 Proposer: Jane Friedman 25.1(1994)65  
 Topic: Express even powers of Fibonacci numbers as a linear combination of Lucas numbers  
 Solution: A linear combination of Lucas numbers 26.1(1995)70
520.  
 Proposer: Murray S. Klamkin 25.1(1994)65  
 Topic: Determine all positive integer pairs satisfying certain geometric progressions  
 Solution: Integer-valued geometric progressions 26.1(1995)71
521.  
 Proposer: Ioan Sadoveanu 25.2(1994)157  
 Topic: Show a polynomial is constant given a root of another polynomial  
 Solution: A constant polynomial 26.2(1995)158
522.  
 Proposer: Frank Schmidt 25.2(1994)157  
 Topic: Find the average weight of a vector over all bases in a vector space  
 Solution: Averaging vector weights 26.2(1995)159
523.  
 Proposer: Edward T. H. Wang 25.2(1994)157  
 Topic: Find all natural numbers satisfying a binomial coefficient divisibility requirement  
 Solution: Divisibility of binomial coefficients 26.2(1995)160
524.  
 Proposer: Norman Schaumberger 25.2(1994)158  
 Topic: Inequalities involving 3 positive numbers  
 Solution: The a, b, c's of inequalities 26.2(1995)161

525.  
 Proposer: Edwin Buchman 25.2(1994)158  
 Topic: Probability involving eating 2 kinds of candy  
 Solution: Probabilities for a candy jar 26.2(1995)162
526.  
 Proposer: Frank Schmidt 25.3(1994)240  
 Topic: Inequalities involving a real symmetric idempotent matrix  
 Solution: Bounds for matrix sums 26.3(1995)245
527.  
 Proposer: Murray S. Klamkin 25.3(1994)240  
 Topic: Find the minimum degree of a 4-variable polynomial with a divisibility criterion  
 Solution: The minimum degree of a symmetric polynomial 26.3(1995)246
528.  
 Proposer: Gloria Olive 25.3(1994)240  
 Topic: Evaluating a sum involving Stirling numbers of the first kind  
 Solution: A Stirling series for  $1/x$  26.3(1995)246
529.  
 Proposer: Jiro Fukuta 25.3(1994)241  
 Topic: Find the locus of points of an interior point to a rectangle with distance requirements  
 Solution: Hyperbola in a rectangle 26.3(1995)248
530.  
 Proposer: K. R. S. Sastry 25.3(1994)241  
 Topic: Find an integer depending of a multiple of its 4 proper divisors  
 Solution: An equality for divisors 26.3(1995)249
531.  
 Proposer: Murray S. Klamkin 25.4(1994)334  
 Topic: Given 3 angles between consecutive vertices of a quadrilateral, find the 4th  
 Solution: Solving a quadrilateral 26.4(1995)330
532.  
 Proposer: Mike Chamberlain & Mark D. Meyerson 25.4(1994)334  
 Topic: Finding the maximum distance between a viewer and a tilted billboard  
 Solution: Tilting of billboards 26.4(1995)331
533.  
 Proposer: K. R. S. Sastry 25.4(1994)334  
 Topic: Find all natural numbers having the product of the sum of the first  $n$  squares and the next  $n$  squares which yield a perfect square  
 Solution: Square products of sums of squares 26.4(1995)333
534.  
 Proposer: Broderick Oluyede 25.4(1994)335  
 Topic: Inequality involving products of sums of 2 sequences of positive numbers  
 Solution: An inequality for positive sums 26.4(1995)333

535.  
 Proposer: Harry Sedlinger 25.4(1994)335  
 Topic: There exist an infinite number of right triangles whose semi-perimeter is triangular  
 Solution: Triangular semi-perimeters ad infinitum 26.4(1995)334
536.  
 Proposer: Murray S. Klamkin 25.5(1994)462  
 Topic: Finding minimum values of algebraic expressions involving 4 positive numbers  
 Solution: Three minima, with constraints 26.5(1995)406
537.  
 Proposer: Herbert Gülicher 25.5(1994)462  
 Topic: Concurrency of lines involving the cevian and distances in a triangle  
 Solution: Concurrent constructions 26.5(1995)407
538.  
 Proposer: Murray S. Klamkin 25.5(1994)462  
 Topic: Maximum area of a quadrilateral given angles between consecutive vertices  
 Solution: The maximum area of a quadrilateral 26.5(1995)407
539.  
 Proposer: Neven Jurić 25.5(1994)463  
 Topic: Number of ways to form equilateral triangles in an n-dimensional cube  
 Solution: Equilateral triangles in a cube 26.5(1995)409
540.  
 Proposer: Stephen Penrice 25.5(1994)463  
 Topic: Limit involving the expected position of a numbered ball in a permutation  
 Solution: An urn model for permutations 26.5(1995)410
541.  
 Proposer: Victor Oxman 26.1(1995)66  
 Topic: Constructing a line tangent to an ellipse from a point on a line off the ellipse  
 Solution: Tangent ellipses 27.1(1996)75
542.  
 Proposer: Jorge-Nuno O. 26.1(1995)66  
 Topic: Congruence identity involving Euler's totient function  
 Solution: Summing powers mod m 27.1(1996)75
543.  
 Proposer: K. R. S. Sastry 26.1(1995)66  
 Topic: Necessary & sufficient condition that 2 parallelograms are congruent  
 Solution: Congruent self-diagonal parallelograms 27.1(1996)76
544.  
 Proposer: Murray Klamkin 26.1(1995)67  
 Topic: Evaluate a finite sum of polynomials divided by factorials  
 Solution: An easy sum? No, just easily summed 27.1(1996)77

545.  
 Proposer: Jiro Fukuta 26.1(1995)67  
 Topic: Necessary & sufficient condition for the existence of a quadrilateral that admits a Circumcircle  
 Solution: An inscribed quadrilateral 27.1(1996)78
546.  
 Proposer: K. R. S. Sastry 26.21(1995)157  
 Topic: Prove that a certain triangle is isosceles  
 Solution: An isosceles triangle problem 27.2(1996)150
547.  
 Proposer: Curtis Cooper & Robert E. Kennedy 26.2(1995)157  
 Topic: Identities involving the gcd and lcm of 2 numbers and the order of 10 mod k  
 Solution: Order mod 10 27.2(1996)150
548.  
 Proposer: Michael Golomb 26.2(1995)157  
 Topic: Necessary & sufficient condition for a unique square circumscribing a parallelogram  
 Solution: Circumscribing a square about a parallelogram 27.2(1996)151
549.  
 Proposer: Alta Kellogg 26.2(1995)158  
 Topic: Are there any graphs which are both self-complementary and self-dual?  
 Solution: Self-dual and self-complementary graphs 27.2(1996)152
550.  
 Proposer: Norman Schaumberger 26.2(1995)158  
 Topic: Evaluate the sum of a series of reciprocals of products of 3 odd integers  
 Solution: A Sum of  $(\ln 3) / 16$  27.2(1996)154
551.  
 Proposer: K. R. S. Sastry 26.3(1995)244  
 Topic: The median of a Heronian triangle does not equal the length of any side  
 Solution: An impossibility result for Heronian triangles 27.3(1996)232
552.  
 Proposer: Hongwei Chen & Parviz Khajeh-Khalili 26.3(1995)244  
 Topic: Find all  $C^2$  functions satisfying a given functional equation  
 Solution: A functional equation of quadratics 27.3(1996)232
553.  
 Proposer: Michael Golomb 26.3(1995)244  
 Topic: The sum of projections from a certain n-gon to a line is independent of the line  
 Solution: Invariant projections 27.3(1996)233
554.  
 Proposer: Juan-Bosco Romero Márquez 26.3(1995)244  
 Topic: Bounds for the nth root of the product of row sums of a matrix  
 Solution: Bounds for a matrix row-sum product 27.3(1996)234

555.  
 Proposer: Can Anh Minh 26.3(1995)245  
 Topic: Upper bound for a product and a sum involving the 1<sup>st</sup> 1995 integers  
 Solution: Last year's inequality 27.3(1996)235
556.  
 Proposer: Frank Schmidt 26.4(1995)329  
 Topic: Find a matrix whose product with its transpose is a multiple of the identity matrix  
 Solution: Orthogonal-like matrices 27.4(1996)313
557.  
 Proposer: K. R. S. Sastry 26.4(1995)329  
 Topic: Find primitive Pythagorean triangles sharing properties with (3,4,5) and (5,12,13)  
 Solution: A plethora of pairs of primitive Pythagorean triples 27.4(1996)314
558.  
 Proposer: Jiro Fukuta 26.4(1995)329  
 Topic: For any triangle only one triplet has distances from vertices obeying 3 conditions  
 Solution: A corollary of Ceva's theorem 27.4(1996)315
559.  
 Proposer: Richard Johnsonbaugh 26.4(1995)329 Corrected: 27.4(1996)315  
 Topic: Necessary & sufficient condition for denominations of coins of be orderly  
 Solution: Orderly currencies 28.4(1997)316
560.  
 Proposer: Filip Sajdak 26.4(1995)330  
 Topic: Inequality involving 1995 and the 3 number theoretic functions  $\sigma(n)$ ,  $\tau(n)$ , and  $\pi(n)$   
 Solution: An inequality with three arithmetic functions 27.4(1996)316
561.  
 Proposer: Carlton Kellog 26.5(1995)405  
 Topic: Convergence of a sequence of reciprocals of Euler's totient function  
 Solution: Must  $\sum 1/\varphi(a_n)$  converge when  $\sum 1/a_n$  converges? 27.5(1996)405
562.  
 Proposer: Murray S. Klamkin 26.5(1995)405  
 Topic: Evaluation of a given  $(n+2) \times (n+2)$  symmetric determinant  
 Solution: A symmetric determinant 27.5(1996)406
563.  
 Proposer: Frank Schmidt 26.5(1995)405  
 Topic: Finding coefficients for surjective functions of 2 and 3 variables  
 Solution: Linear combinations of squares 27.5(1996)407
564.  
 Proposer: Can Anh Minh 26.5(1995)406  
 Topic: Condition that a convex quadrilateral is cyclic or a trapezoid  
 Solution: Angle tangents in a quadrilateral 27.5(1996)407

565.  
 Proposer: K. R. S. Sastry 26.5(1995)406  
 Topic: Find a rectangular box with volume equaling the sum of the edges and surface area  
 Solution: New perfect boxes 27.5(1996)408
566.  
 Proposer: K. R. S. Sastry 27.1(1996)74  
 Topic: Integral coefficients in a cubic yielding linear factors with integral coefficients  
 Solution: A characterization for integral roots 28.1(1997)68
567.  
 Proposer: Heinz-Jürgen Seiffert 27.1(1996)74  
 Topic: Inequalities in two variables involving the hyperbolic sine function  
 Solution: An hyperbolic sine mean 28.1(1997)69
568.  
 Proposer: Frank Schmidt 27.1(1996)74  
 Topic: Characterize all bipartite graphs with chromatic polynomials having real roots  
 Solution: Trees have real roots? 28.1(1997)70
569.  
 Proposer: Can Anh Minh 27.1(1996)75  
 Topic: Upper bound for the largest denominator in a unit sum of unit fractions  
 Solution: A maximum denominator 28.1(1997)71
570.  
 Proposer: Murray S. Klamkin 27.1(1996)75  
 Topic: A triangle with angle bisectors intersecting an altitude is isosceles  
 Solution: An isosceles triangle problem - again 28.1(1997)72
571.  
 Proposer: Frank Schmidt 27.2(1996)149  
 Topic: Find all cyclotomic polynomials whose coefficients are all nonzero  
 Solution: Cyclotomic polynomials with nonzero coefficients 28.2(1997)146
572.  
 Proposer: George Baloglou 27.2(1996)149  
 Topic: Trigonometric - hyperbolic inequality  
 Solution:  $\tanh \theta \leq \tan \theta$  for  $-\pi/4 < \theta < \pi/4$  28.2(1997)147
573.  
 Proposer: Lewis Lum 27.2(1996)149  
 Topic: Congruence classes for a set with subset members having sums never congruent to 0  
 Solution: Restricted sums modulo n 28.2(1997)148
574.  
 Proposer: Robert Patenaude 27.2(1996)149  
 Topic: Locus of the foci of an ellipse inscribed in a non-square rectangle  
 Solution: The loci of foci 28.2(1997)148



575.  
 Proposer: Parviz Khajeh-Khalili 27.2(1996)149  
 Topic: Identity involving sums and the Riemann zeta function  
 Solution: Zeta sums 28.2(1997)149
576.  
 Proposer: Peter Daffer 27.3(1996)231  
 Topic: Convergence of a sum of n-fold compositions of a function with itself  
 Solution: Almost everywhere divergence 28.3(1997)232
577.  
 Proposer: K. R. S. Sastry 27.3(1996)231  
 Topic: Identity involving the vertices and angles of a convex heptagon  
 Solution: Ratios in a right heptagon 28.3(1997)233
578.  
 Proposer: Robert Patenaude 27.3(1996)231  
 Topic: Find the lengths of the sides of a given triangle  
 Solution: Triangles with one angle twice another 28.3(1997)233
579.  
 Proposer: Juan Ryan & Steve Pennell 27.3(1996)231  
 Topic: Find the line minimizing the sum of distances to the line from 3 given points  
 Solution: Least absolute deviation 28.3(1997)235
580.  
 Proposer: M. L. Glasser 27.3(1996)232  
 Topic: Definite integral involving the logarithm function  
 Solution: An integral whose value is  $(\ln 2)^2 / n$  28.3(1997)235
581.  
 Proposer: Farshid Arjomandi 27.4(1996)312  
 Topic: Solve a system of equations in n variables  
 Solution: A system of power equations 28.4(1997)317
582.  
 Proposer: Can A. Minh 27.4(1996)312  
 Topic: Evaluate the limit of a sum depending on sines  
 Solution: A sine series with a linear limit 28.4(1997)318
583.  
 Proposer: Murray Klamkin 27.4(1996)312  
 Topic: Is a parabola the only curve satisfying a property about tangents to the curve?  
 Solution: A characterization of parabolas 28.4(1997)319
584.  
 Proposer: Monte J. Zenger 27.4(1996)313  
 Topic: Find rationals with product of numerator and denominator repeating in its decimal  
 Solution: A characterization of  $1/3$  and  $2/3$  28.4(1997)320

585.  
 Proposer: K. R. S. Sastry 27.4(1996)313  
 Topic: Triangles with relatively prime sides and one side square and another nonintegral  
 Solution: Triangles with relatively prime sides 28.4(1997)321
586.  
 Proposer: K. R. S. Sastry 27.5(1996)404  
 Topic: A triangle must be equilateral if one formed by extending its sides is also  
 Solution: Triangles within triangles 28.5(1997)407
587.  
 Proposer: Herbert Gülicher 27.5(1996)404  
 Topic: Necessary & sufficient condition that the determinant of a given matrix is zero  
 Solution: A determinant of mostly 1's 28.5(1997)408
588.  
 Proposer: Can A. Minh 27.5(1996)404  
 Topic: Inequality involving the cotangents of the angles of a triangle  
 Solution: Squared tangents 28.5(1997)408
589.  
 Proposer: Tom Farmer 27.5(1996)404  
 Topic: A given harmonic sequence must be dense and contain no integers  
 Solution: Density of harmonic sums 28.5(1997)409
590.  
 Proposer: F. Sajdak 27.5(1996)405  
 Topic: Inequality involving the cardinality of a set of number theoretic functions  
 Solution: Many  $n$ 's with  $(\varphi(n), \tau(n), \sigma(n)) = 1$  28.5(1997)410
591.  
 Proposer: Wu Wei Chao 28.1(1997)67  
 Topic: Inequality and a limit involving polynomial functions  
 Solution: A bound and limit for quadratic iteration 29.1(1998)67
592.  
 Proposer: F. J. Flanigan 28.1(1997)67  
 Topic: Find complex functions with an infinite number of balanced values  
 Solution: Balanced values of complex functions 29.1(1998)68
593.  
 Proposer: James Duemmel 28.1(1997)68  
 Topic: Probability that the eigenvalues of a real  $2 \times 2$  matrix are nonreal  
 Solution: Eigenvalues of a random matrix 29.1(1998)69
594.  
 Proposer: Paul Bracken 28.1(1997)68  
 Topic: Validity of an algebraic inequality  
 Solution: A binomial inequality 29.1(1998)70

595.  
 Proposer: Juan-Bosco Romeo Márquez 28.1(1997)67  
 Topic: Limit of the ratio of differences of 2 medians and 2 angle bisectors of a triangle  
 Solution: A geometric limit 29.1(1998)71
596.  
 Proposer: David Doster 28.2(1997)145  
 Topic: Summation identity involving the number theoretical number of divisors function  
 Solution: Counting odd divisors of odd integers 29.2(1998)153
597.  
 Proposer: Murray S. Klamkin 28.2(1997)145  
 Topic: Find linear functions divisible by 19 given linear function of their coefficients  
 Solution: A family of congruences 29.2(1998)154
598.  
 Proposer: Kenichiro 28.2(1997)145  
 Topic: Evaluate the sum of powers of some of the roots of unity  
 Solution: From roots of unity to the Möbius function 29.2(1998)154
599.  
 Proposer: Juan-Bosco Romeo Márquez 28.2(1997)145  
 Topic: Necessary & sufficient condition that a specific triangle is a right triangle  
 Solution: A geometric equality 29.2(1998)155
600.  
 Proposer: Georgia M. Benkart, Mark D. Meyerson & William P. Wardlaw 28.2(1997)146  
 Topic: Prove that there may or may not be an invertible element in a certain ring with 1  
 Solution: Unit multiples 29.2(1998)156
601.  
 Proposer: William P. Wardlaw 28.3(1997)231  
 Topic: The numerator in the sum of consecutive terms in the harmonic sequence is odd  
 Solution: A old numerator 29.3(1998)243
602.  
 Proposer: Yi-chuan Pan 28.3(1997)231  
 Topic: Prove that a sequence formed from Pell numbers is always square  
 Solution: A Pell sequence of squares 29.3(1998)244
603.  
 Proposer: Juan-Bosco Romeo Márquez 28.3(1997)231  
 Topic: Inequalities involving  $n^{\text{th}}$  roots of ratios of functions of 2 positive numbers  
 Solution: Consequences of convexity 29.3(1998)245
604.  
 Proposer: Jiro Fukuta 28.3(1997)231  
 Topic: Prove that the product of lengths from 2 points on the diagonals of a quadrilateral is independent of the points selected  
 Solution: An invariant product 29.3(1998)246

605.  
 Proposer: A. P. Stone 28.3(1997)232  
 Topic: Find nearly isosceles Pythagorean quadruples  
 Solution: Nearly isosceles Pythagorean quadruples 29.3(1998)247
606.  
 Proposer: G. Trenkler, S. O. Troschke & J. Gross 28.4(1997)315  
 Topic: Finding 2 matrices with equal traces  
 Solution: Characterizing a trace identity 29.4(1998)331
607.  
 Proposer: Noah Rosenberg 28.4(1997)315  
 Topic: Describing a set of points on a sequence of convex m-gons  
 Solution: Center of gravity 29.4(1998)332
608.  
 Proposer: Daniel E. Penney 28.4(1997)315  
 Topic: Determining convergence of an arrangement of the alternating harmonic series  
 Solution: A rearrangement of the alternating harmonic series 29.4(1998)334
609.  
 Proposer: Peter Schumer 28.4(1997)316  
 Topic: Existence of a number modulo a prime  $p$  which is the sum of 2 squares  
 Solution: Many sums of squares 29.4(1998)335
610.  
 Proposer: Ken Korbin 28.4(1997)316  
 Topic: Finding 3 term polynomials divisible by a given quadratic  
 Solution: A polynomial factor 29.4(1998)336
611.  
 Proposer: Frank J. Flanigan 28.5(1997)406  
 Topic: Find the arithmetic mean of the zeroes of a rational function  
 Solution: A mean of roots 29.5(1998)435
612.  
 Proposer: Amir Sharoni 28.5(1997)406  
 Topic: Find a function whose graph has a tangent of unit length in the first quadrant  
 Solution: Tangents to an asteroid 29.5(1998)436
613.  
 Proposer: Michael Scott McClendon 28.5(1997)406  
 Topic: Find the length of an altitude in an isosceles triangle with unit inradius  
 Solution: The altitude of an isosceles triangle 29.5(1998)437
614.  
 Proposer: Peter Schumer 28.5(1997)406  
 Topic: Are there many consecutive positive integers not expressible as a sum of squares?  
 Solution: Long strings of sums of squares 29.5(1998)438

615.  
 Proposer: Western Maryland College Problem Group 28.5(1997)407  
 Topic: Find points on and off an ellipse related to tangent lines from a given point  
 Solution: The orthoptic circle 29.5(1998)439
616.  
 Proposer: Michael Golomb 29.1(1998)66  
 Topic: Comparing areas in regions enclosed by convex curves  
 Solution: Quadrants in closed convex curves 30.1(1999)61
617.  
 Proposer: Kenichiro Kashihara 29.1(1998)66  
 Topic: Solving a Diophantine equation with one variable an exponent  
 Solution: A Diophantine equation 30.1(1999)62
618.  
 Proposer: Frank Schmidt 29.1(1998)66  
 Topic: Inequality involving alternating reciprocals of factorials  
 Solution: A deranged alternating exponential inequality
619.  
 Proposer: Götz Trenkler 29.1(1998)66  
 Topic: Finding a generalized inverse of a quasi-idempotent matrix  
 Solution: A generalized inverse for quasi-idempotent matrices 30.1(1999)65
620.  
 Proposer: Sam Speed 29.1(1998)67  
 Topic: Find the minimum value of the number of partitions of  $n$  added to its maximum  
 Solution: A “minimal” partition 30.1(1999)65
621.  
 Proposer: Jedd Beall, Lenny Jones, Mike Seyfried & Kathryn Seyfried 29.2(1998)152  
 Topic: Find positive integer pairs with the square of one’s digit sums equal the other integer  
 Solution: Squares as sums of digits 30.2(1999)144
622.  
 Proposer: Michael Golomb 29.2(1998)152  
 Topic: Properties about the number of beads distributed at the vertices of an  $n$ -gon  
 Solution: Balancing polygons 30.2(1999)145
623.  
 Proposer: Alexander Kheyfits 29.2(1998)152  
 Topic: Evaluating a double sum of reciprocals of integers  $> 1$   
 Solution: A series whose sum is  $\ln k$  30.2(1999)145
624.  
 Proposer: Harry Sedinger 29.2(1998)153  
 Topic: Existence of a point which maximizes the angle made from it to 2 points on a line  
 Solution: Maximum viewing angle 30.2(1999)146

625.  
 Proposer: Sining Zheng & Yuyue Song 29.2(1998)153  
 Topic: Finding power series having the radius of convergence of another power series  
 Solution: Extending the radius of congruence 30.2(1999)147
626.  
 Proposer: Juan Martín Mombelli 29.3(1998)242  
 Topic: Equation involving the number theoretic functions  $\tau(n)$ ,  $\sigma(n)$  and  $\varphi(n)$   
 Solution: Two and the arithmetic functions 30.3(1999)231
627.  
 Proposer: George Mackiw 29.3(1998)242  
 Topic: Divisibility of a given polynomial sum by powers of 2  
 Solution: Divisibility by powers of two 30.3(1999)231
628.  
 Proposer: Frank Schmidt 29.3(1998)242  
 Topic: Find  $n$  so that the symmetric group  $S_n$  is a subgroup of  $GL(2,n)$   
 Solution: Embedding  $S_n$  in  $GL(2,p)$  30.3(1999)232
629.  
 Proposer: David Beran 29.3(1998)242  
 Topic: Conditions on 2 angle bisectors of a triangle which guarantees it being isosceles  
 Solution: An isosceles triangle 30.3(1999)233
630.  
 Proposer: Michael Andreoli 29.3(1998)243  
 Topic: Expected number of corrected guesses in a card game  
 Solution: Guessing card colors 30.3(1999)234
631.  
 Proposer: K. R. S. Sastry 29.4(1998)330  
 Topic: Finding an odd integer which shares certain properties enjoyed by the integer 5  
 Solution: An unusual sum of squares 30.4(1999)319
632.  
 Proposer: Frank Schmidt 29.4(1998)330  
 Topic: Finding graphs which share certain properties enjoyed by a pentagon  
 Solution: A 4-regular, 3-chromatic, self-complementary graph 30.4(1999)320
633.  
 Proposer: Zun Shan & Edward T. H. Wang 29.4(1998)330  
 Topic: Seeking cyclic permutations of points on a circle  
 Solution: Permutations on a circle 30.4(1999)321
634.  
 Proposer: Juan Martín Mombelli 29.4(1998)331  
 Topic: Solving a 2 variable functional equation  
 Solution: Functions defined by an identity 30.4(1999)322

635.  
 Proposer: Seth Zimmerman 29.4(1998)331  
 Topic: Sums of squares of chords forming a right angle with a point inside a circle  
 Solution: Orthogonal chords in a circle 30.4(1999)323
636.  
 Proposer: K. R. S. Sastry 29.5(1998)434  
 Topic: Identity involving the number and sum of unitary divisors of natural numbers  
 Solution: A convolving sum 30.5(1999)407
637.  
 Proposer: Doug Ensley 29.5(1998)434  
 Topic: Finding the limit of a sequence of square roots  
 Solution: A quadratic recursion limit 30.5(1999)408
638.  
 Proposer: Manjul Bhargava 29.5(1998)434  
 Topic: Evaluate the sum of reciprocals of binomial coefficients  
 Solution: The sum of reciprocals of binomial coefficients 30.5(1999)409
639.  
 Proposer: Alan H. Rapoport 29.5(1998)435  
 Topic: Number of ways of aligning 25 people by height in a  $5 \times 5$  matrix array  
 Solution: A square Young tableau 30.5(1999)410
640.  
 Proposer: Michael Golomb 29.5(1998)435  
 Topic: Inequality involving non-square integers whose square begins with the integer  
 Solution: Square root leader 30.5(1999)421
641.  
 Proposer: Arthur L. Holshouser 30.1(1999)60  
 Topic: Finding functions with graphs satisfying properties about line symmetries  
 Solution: From one symmetry many 31.1(2000)63
642.  
 Proposer: Kwnichiro Kashihara 30.1(1999)60  
 Topic: Diophantine-type equation involving powers as sums of factorials  
 Solution: A sum of factorials 31.1(2000)65
643.  
 Proposer: William F. Trench 30.1(1999)60  
 Topic: Finding limits of sequences defined by double sums of a given positive sequence  
 Solution: Two double sums 31.1(2000)65
644.  
 Proposer: Lawrence Spence and Charles Vanden Eynden 30.1(1999)61  
 Topic: Finding certain polynomials expressible as the product of 2 such polynomials  
 Solution: Products of polynomials 31.1(2000)64

645.  
 Proposer: James Graham-Eagle 30.1(1999)61  
 Topic: Summing a series of terms from a logarithm sequence for odd integers  
 Solution: Stirling's approximation to the rescue 31.1(2000)67
646.  
 Proposer: Parviz Khalili 30.2(1999)143  
 Topic: Necessary & sufficient condition that the graph of a 5<sup>th</sup> degree polynomial has a point of symmetry  
 Solution: Quintic symmetry 31.2(2000)138
647.  
 Proposer: K. R. S. Sastry 30.2(1999)143  
 Topic: Number of triangles having certain properties on the area and sides of the triangle  
 Solution: A family of Heron triangles 31.2(2000)139
648.  
 Proposer: Ayoub B. Ayoub 30.2(1999)143  
 Topic: Condition for which an integer exists guaranteeing a Pythagorean triple  
 Solution: A family of Pythagorean triples 31.2(2000)140
649.  
 Proposer: Todd Will 30.2(1999)144  
 Topic: Existence of "power special" sequences of non-integer reals  
 Solution: Power special sequences 31.2(2000)138
650.  
 Proposer: Kenneth Korbin 30.2(1999)144  
 Topic: Express the side of a triangle in terms of radii of 2 inscribed circles  
 Solution: Radii of inscribed circles 31.2(2000)142
651.  
 Proposer: Frank Schmidt 30.3(1999)230  
 Topic: Existence of 3 matrices with trace  $> 0$  having mutual products with trace  $< 0$   
 Solution: Trace conditions 31.3(2000)220
652.  
 Proposer: Seth Zimmerman 30.3(1999)230  
 Topic: Maximum number of points in a plane with any 3 having 2 one unit apart  
 Solution: A graph in the plane 31.3(2000)221
653.  
 Proposer: Răzvan Tudoran 30.3(1999)230  
 Topic: Recurring sequence with the  $n^{\text{th}}$  term divisible by the  $n^{\text{th}}$  prime  
 Solution: A well known sequence 31.3(2000)223
654.  
 Proposer: Ice B. Risteski 30.3(1999)230  
 Topic: Dimensions of subspaces of a vector space over various fields  
 Solution: The dimension of a subspace over different fields 31.3(2000)224



655.  
Proposer: Charles Vanden Eynden 30.3(1999)231  
Topic: Finding values which guarantee a graph has a Hamilton circuit  
Solution: A Hamiltonian circuit on a box 31.3(2000)225
656.  
Proposer: Frank Schmidt 30.4(1999)318  
Topic: Convergence of a sum and other properties of a sequence of integrals  
Solution: A sequence of integrals 31.4(2000)316
657.  
Proposer: Zengxiang Tong 30.4(1999)318  
Topic: Primes that divide the numerator of finite sums of the alternating harmonic series  
Solution: A divisibility relation in the alternating harmonic series 31.4(2000)317
658.  
Proposer: Roger B. Nelsen 30.4(1999)318  
Topic: Possible independence criteria for random variables  
Solution: Independence and squaring 31.4(2000)318
659.  
Proposer: Pete Johnson & Dave Leach 30.4(1999)319  
Topic: GCD of the powers of a polynomial with a unique real root  
Solution: The roots of a polynomial equation 31.4(2000)318
660.  
Proposer: Ho-joo Lee 30.4(1999)319  
Topic: Coefficient of a cubic equation which allows a certain complex root  
Solution: A consequence of FLT 31.4(2000)319
661.  
Proposer: Michael S. McClendon 30.5(1999)406  
Topic: Ladder problem of calculus turning a non-rectangular corner  
Solution: Angled hallway ladder problem 31.5(2000)409
662.  
Proposer: Bradley A. Warner & Bradford Kline 30.5(1999)407  
Topic: Probability and expected value of number of rounds and flips in a coin tossing game  
Solution: Probabilities and expected values in a coin tossing game 31.5(2000)410
663.  
Proposer: Mizan R. Khan 30.5(1999)407  
Topic: Roots and number of roots of a bracket function equation of the gcd of 2 variables  
Solution: Solving a ceiling equation 31.5(2000)411
664.  
Proposer: Jiro Fukuta 30.5(1999)407  
Topic: The incenter is collinear with and is the midpoint of radical centers in a triangle  
Solution: The incenter as an average of radical centers 31.5(2000)413

665.  
 Proposer: Kenneth Korbin 30.5(1999)407  
 Topic: Smallest positive integer which is the sum of 2 triangular numbers in 48 ways  
 Solution: Sums of triangular numbers 31.5(2000)4104
666.  
 Proposer: David Callan 31.1(2000)62  
 Topic: Probabilities in the Car and Goat problem  
 Solution: Cars and goats revisited 32.1(2001)61
667.  
 Proposer: Mulatu Lemma 31.1(2000)63  
 Topic: Integrally dependent integral of a ratio of cosine functions  
 Solution: A trigonometric integral 32.1(2001)62
668.  
 Proposer: Joung-kuen & Ho-joo 31.1(2000)63  
 Topic: Prime numbers satisfying a 4-variable equation  
 Solution: A Diophantine equation with tens 32.1(2001)63
669.  
 Proposer: Lance E. Hemlow 31.1(2000)63  
 Topic: Properties relating to an indefinite arc length integral  
 Solution: Parametrizing some arclength integrals 32.1(2001)64
670.  
 Proposer: Juan-Bosco Romero Márquez 31.1(2000)63  
 Topic: Limit of an algebraic ratio involving the length of an angle bisector in a triangle  
 Solution: A limiting comparison of an angle bisector and an altitude 32.1(2001)67
671.  
 Proposer: Arthur L. Holshouser 31.2(2000)137  
 Topic: A subgroup in a nested sequence is almost normal to super groups in the nest  
 Solution: Almost normal subgroups 32.2(2001)142
672.  
 Proposer: K. R. S. Sastry 31.2(2000)137  
 Topic: Necessary & sufficient condition that the Gergonne point of a triangle's cevians be a midpoint  
 Solution: A Gergonne midpoint 32.2(2001)143
673.  
 Proposer: Zengxiang Tong 31.2(2000)137  
 Topic: Finding a power of 2 making a sum of powers of 2 a perfect square  
 Solution: A Diophantine equation with twos 32.2(2001)144
674.  
 Proposer: Roger B. Nelsen 31.2(2000)138  
 Topic: Probability, uniform distribution and triangle density of continuous random variables  
 Solution: Triangular and uniform distributions 32.2(2001)145

675.  
 Proposer: Monte J. Zerger 31.2(2000)138  
 Topic: Range of a sum of arctangents defined on a specific set depending on 3 variables  
 Solution: A sum of arctangents 32.2(2001)146
676.  
 Proposer: Rick Mabry 31.3(2000)219  
 Topic: Find the smallest rectangle that contains a family of limaçons  
 Solution: A viewing window for limaçons 32.3(2001)212
677.  
 Proposer: Geoffrey A. Kandall 31.3(2000)219  
 Topic: Find an algebraic function inverse for a function of hyperbolic functions  
 Solution: An inverse function 32.3(2001)213
678.  
 Proposer: David Atkinson 31.3(2000)219  
 Topic: Find a double finite sum of a sequence as a function of its largest subscript  
 Solution: A double sum 32.3(2001)213
679.  
 Proposer: Jerrold Grossman 31.3(2000)219  
 Topic: Probabilities of obtaining various amounts of 2's and 0's from a set of 2's and 0's  
 Solution: Spelling 2000 32.3(2001)215
680.  
 Proposer: Kent Holing 31.3(2000)220  
 Topic: Necessary & sufficient condition that the diameter of an incircle of a triangle be a  
                   given area quantity  
 Solution: An area and incircle characterization of right triangles 6(2001)216
681.  
 Proposer: Sergei Ovchinnikov 31.4(2000)314  
 Topic: Embedding finite metric spaces into a vector space with given metric  
 Solution: Embedding finite metric spaces 32.4(2001)298
682.  
 Proposer: John F. Kennison 31.4(2000)314  
 Topic: Optimal path for one moving particle in a plane to reach a point before another  
 Solution: An invisible ball carrier 32.4(2001)299
683.  
 Proposer: Allen R. Miller 31.4(2000)315  
 Topic: LUB and GLB of a function of 2 variables defined on the unit square  
 Solution: A function on the unit square 32.4(2001)300
684.  
 Proposer: Jiro Fukuta 31.4(2000)315  
 Topic: Ratios of lengths in a configuration of triangles  
 Solution: Ratios of areas and lengths 32.4(2001)301

685.  
 Proposer: Mario Martelli 31.4(2000)316  
 Topic: Values that guarantee finite positive limits in a sequence of definite integrals  
 Solution: The limit of a definite integral 32.4(2001)302
686.  
 Proposer: K. R. S. Sastry 31.5(2000)408  
 Topic: Questions concerning lengths of sides of FFF-triangles  
 Solution: Golden isosceles triangles 32.5(2001)382
687.  
 Proposer: Editors 31.5(2000)408  
 Topic: Divisibility and an open question concerning the alternating harmonic series  
 Solution: A divisibility relation in the alternating harmonic series, II 32.5(2001)383
688.  
 Proposer: Justin Smith 31.5(2000)409  
 Topic: Characterize sequences having a given limit to a sequence of roots of a polynomial  
 Solution: Some almost exponential limits 32.5(2001)384
689.  
 Proposer: Arthur L. Holshouser 31.5(2000)409  
 Topic: Any bounded metric space can be embedded in an antipodal metric space  
 Solution: Antipodal metric spaces 32.5(2001)385
690.  
 Proposer: Roger B. Nelsen 31.5(2000)409  
 Topic: Independent random variables and targets on a dart board  
 Solution: Dartboard probabilities 32.5(2001)386
691.  
 Proposer: Paul Peck 32.1(2001)60  
 Topic: Existence of a unit for elements in a ring  
 Solution: Units in a ring 33.1(2002)55
692.  
 Proposer: Erwin Just 32.1(2001)60  
 Topic: Existence of a generating set for a set of positive integers  
 Solution: (Non-)generating Sets 33.1(2002)56
693.  
 Proposer: Angelo DiDomenico 32.1(2001)60  
 Topic: Seeking a function defined on a sum of functions of triangular numbers  
 Solution: An identity involving triangular numbers 33.1(2002)56
694.  
 Proposer: Richard F. McCoart, Jr. 32.1(2001)61  
 Topic: Various questions concerning the binomial coefficients  
 Solution: Binomial coefficients mod  $p$  33.1(2002)57

695.  
Proposer: Andrew Cusumano 32.1(2001)61  
Topic: Prove convergence and find the limit of a finite sequence of harmonic-like sums  
Solution: Sequential convergence 33.1(2002)58
696.  
Proposer: Yi-chuan Pan 32.2(2001)141  
Topic: Double sum of squared binomial coefficients  
Solution: A double series 33.2(2002)151
697.  
Proposer: Philip D. Tiu 32.2(2001)141  
Topic: A smallest integer function and divisibility of a product of consecutive integers  
Solution: Dividing  $m!$  But not  $(m - 1)!$  33.2(2002)153
698.  
Proposer: Enrico Valdinoci 32.2(2001)141  
Topic: Existence of 4 planar points satisfying given conditions  
Solution: An impossible configuration 33.2(2002)154
699.  
Proposer: Habib Y. Far 32.2(2001)142  
Topic: Limit of a difference of roots of finite sums of powers of integers  
Solution: A limit involving sums of powers 33.2(2002)155
700.  
Proposer: Li Zhou 32.2(2001)142  
Topic: Inequality involving 3 positive numbers  
Solution: An inequality with fractions and powers 33.2(2002)156
701.  
Proposer: Edward T. H. Wang 32.3(2001)211  
Topic: Equations involving the ratio of 2 and 3 natural numbers  
Solution: Polynomial identities 33.3(2002)241
702.  
Proposer: Andrew Cusumano 32.3(2001)211  
Topic: A periodic diagonal sequence of a given sequence and the sum of digits in one cycle  
Solution: Negative powers of 2 and periodic sequences 33.3(2002)242
703.  
Proposer: Erwin Just 32.3(2001)211  
Topic: Existence of an accumulation point of a given set  
Solution: A single accumulation point 33.3(2002)244
704.  
Proposer: Roger B. Nelson 32.3(2001)212  
Topic: Properties of a continuous random variable symmetric about zero  
Solution: Symmetric random variables 33.3(2002)244

705.  
 Proposer: Ayoub B. Ayoub 32.3(2001)212  
 Topic: String of inequalities involving 2 non-negative numbers  
 Solution: A chain of inequalities 33.3(2002)246
706.  
 Proposer: Götz Trenkler 32.4(2001)297  
 Topic: Necessary & sufficient condition that a matrix is an orthogonal projector  
 Solution: An application for the trace operator 33.4(2002)326
707.  
 Proposer: Dennis Walsh 32.4(2001)297  
 Topic: Limit of the velocity and questions on the average acceleration of a moving particle  
 Solution: The motion of an exponential particle 33.4(2002)327
708.  
 Proposer: Alexander Faber 32.4(2001)298  
 Topic: Power of 2 that allows a sum of powers of 2 to be a perfect square  
 Solution: A Diophantine equation with twos revisited 33.4(2002)328
709.  
 Proposer: Vern E. Heeren 32.4(2001)298  
 Topic: Rational Solutions of arctangent equations  
 Solution: Rational Solutions to arctangent equations 33.4(2002)329
710.  
 Proposer: Herb Bailey 32.4(2001)298  
 Topic: Locus of a centroid of a triangle with sides and lines from angles in proportion  
 Solution: A generalized centroid 33.4(2002)330
711.  
 Proposer: Murray S. Klamkin 32.5(2001)381  
 Topic: Existence of polynomials with given properties  
 Solution: Polynomial fit 33.5(2002)411
712.  
 Proposer: Stan Lipovetsky 32.5(2001)381  
 Topic: Find number bases  $b$  allowing an even self-enumerating base  $b$  integer  
 Solution: Self-enumerating base  $b$  integers 33.5(2002)412
713.  
 Proposer: Parviz Khalili 32.5(2001)382  
 Topic: Limit of the ratio of the areas of 2 triangles formed from points on the graph of  $y=x^n$   
 Solution: Limiting ratios of areas 33.5(2002)413
714.  
 Proposer: Arthur L. Holshouser & Harold B. Reiter 32.5(2001)382  
 Topic: Adapting strategies in the game of Blocking Nim  
 Solution: Blocking Nim 33.5(2002)414

715.  
 Proposer: M. N. Deshpande 32.5(2001)382  
 Topic: Equality of products of distances from lines constructed in a triangle  
 Solution: A triangle identity 33.5(2002)416
716.  
 Proposer: Cecelia A. Weajley & William D. Weakley 33.1(2002)54  
 Topic: Uniquely determined values of a function defined on sets of real numbers  
 Solution: Reminiscent of inclusion-exclusion 34.1(2003)69
717.  
 Proposer: Erwin Just 33.1(2002)54  
 Topic: Find an increasing finite set of integers each dividing the sum of squares of each one  
 Solution: Divisibility and sums of powers 34.1(2003)70
718.  
 Proposer: Norman Schaumberger 33.1(2002)54  
 Topic: Inequality involving ratios and powers of 2 positive numbers  $> 1$   
 Solution: An application of concavity 34.1(2003)70
719.  
 Proposer: Wu WeiChao 33.1(2002)55  
 Topic: Necessary & sufficient condition that a function satisfies a 2-variable given equation  
 Solution: A projection in disguise 34.1(2003)71
720.  
 Proposer: Andrew Cusumano 33.1(2002)55  
 Topic: Limit of the difference of 2 ratios of sequences of integers  
 Solution: Not an easy “e”asy limit
721.  
 Proposer: Kent Holing 33.2(2002)150  
 Topic: Necessary & sufficient condition that a quadrilateral related to a triangle is cyclic  
 Solution: Untitled 34.2(2003)154
722.  
 Proposer: Juan-Bosco Romero Márquez 33.2(2002)150  
 Topic: A function of  $x$  depends on 3 exponents. Find values of the 3 that will guarantee a right or left hand limit of the function as  $x$  approaches 1, and find the limit.  
 Solution: Untitled 34.2(2003)155
723.  
 Proposer: David Bloom 33.2(2002)150  
 Topic: Proving certain properties of a given ring with unity  
 Solution: Untitled 34.2(2003)156
724.  
 Proposer: Wu Wei Chao 33.2(2002)151  
 Topic: Find a geometric characterization that a given sequence is periodic  
 Solution: Untitled 34.2(2003)157

725.  
 Proposer: Andrew Cusumano 33.2(2002)151  
 Topic: Find the limit of a sum as a function of the number of terms summed  
 Solution: Untitled 34.2(2003)158
726.  
 Proposer: Thomas J. Pfaff 33.3(2002)240  
 Topic: Limit of a summation sequence of cosecants if it exists  
 Solution: A limit involving the  $x/\sin(x)$  approximation 34.3(2003)240
727.  
 Proposer: Yves Nievergelt 33.3(2002)240  
 Topic: Rank 4 terms involving 2 variables in increasing order  
 Solution: Rational function inequalities 34.3(2003)241
728.  
 Proposer: Erwin Just 33.3(2002)240  
 Topic: Determining weights of coins in identical bags  
 Solution: A coin-weighing problem 34.3(2003)242
729.  
 Proposer: Roger B. Nelsen 33.3(2002)241  
 Topic: Inequality for the mean and standard deviation of a concave up survival function  
 Solution: A consequence of convexity 34.3(2003)243
730.  
 Proposer: Jerome Minkus 33.3(2002)241  
 Topic: Properties relating to a triangle with a trisected angle  
 Solution: Similarity invariants for an angle trisection 34.3(2003)244
731.  
 Proposer: Michael Scott McClendon 33.4(2002)325  
 Topic: Find the volume of airspace for a plane attached to a spherical planet  
 Solution: The airspace of a tethered airplane 34.4(2003)328
732.  
 Proposer: Ron Rietz 33.4(2002)325  
 Topic: Inequalities for a logarithmic function and summing the digits in a decimal  
 Solution: Not quite an integer 34.4(2003)329
733.  
 Proposer: William Seaman 33.4(2002)325  
 Topic: Existence of a 1-1 function defined on certain subsets of  $n$  elements  
 Solution: A marriage of sets 34.4(2003)330
734.  
 Proposer: Michael Bataille 33.4(2002)326  
 Topic: Find the gcd's of consecutive terms in recursive sequences  
 Solution: Greatest common divisors in linear recurrence 34.4(2003)331



735.  
 Proposer: Norman Bolton 33.4(2002)326  
 Topic: Probability that  $n$  persons with assigned seats sit in the correct one  
 Solution: Finding the right seat 34.4(2003)332
736.  
 Proposer: Samuel A. Truitt, Jr. 33.5(2002)410  
 Topic: Describe sets of values that satisfy a sine and those that satisfy a cosine equation  
 Solution: Special cases of angle sum formulas 34.5(2003)406
737.  
 Proposer: Thomas J. Pfaff 33.5(2002)410  
 Topic: Can a complete graph be partitioned into edge disjoint paths?  
 Solution: Yet another proof that  $1 + 2 + \dots + (n - 1) = C(n,2)$  34.5(2003)408
738.  
 Proposer: Nora Thornber 33.5(2002)411  
 Topic: Initial value problem for an  $n$ -dimensional vector function  
 Solution: An initial value problem 34.5(2003)408
739.  
 Proposer: Arthur L. Holshouser 33.5(2002)411  
 Topic: Winning strategies for a counter removing game  
 Solution: Strategies in a two-person game 34.5(2003)409
740.  
 Proposer: Richard F. McCoart, Jr. 33.5(2002)411  
 Topic: Perturbing the birth dates of Niels Bohr and Werner Heisenberg  
 Solution: Not just another Bohring question 34.5(2003)410
741.  
 Proposer: Karl Havlak & Charles Diminnie 34.1(2003)68  
 Topic: Limits of 2 sequences of ratios of positive numbers  
 Solution: A pair of similar limits 35.1(2004)56
742.  
 Proposer: Harris Kwong 34.1(2003)68  
 Topic: Inequality involving polynomial sequences  
 Solution: A polynomial inequality 35.1(2004)57
743.  
 Proposer: Najib N. Yazbak 34.1(2003)68  
 Topic: System of 2 equations in 3 variables  
 Solution: Exponential Diophantine equations 35.1(2004)58
744.  
 Proposer: Vassilios C. Hombas 34.1(2003)69  
 Topic: Evaluating a function with  $2^{\text{nd}}$  derivatives appearing in a converging sum at 1  
 Solution: A functional equation 35.1(2004)59

745.  
 Proposer: Rex H. Wu 34.1(2003)69  
 Topic: Divisibility and cardinality of a function yielding prime values  
 Solution: Dividing  $m!$  But not  $(m - 1)!$  Revisited 35.1(2004)56
746.  
 Proposer: Emily Just & Erwin Just 34.2(2003)153  
 Topic: Existence of an integer from sums of integers assigned to  $n$ -gon mid and end points  
 Solution: There are no magic  $(2n + 1)$ -gons 35.2(2004)137
747.  
 Proposer: Josè Luis Díaz-Barrero 34.2(2003)153  
 Topic: Fibonacci number summation inequality  
 Solution: An inequality with Fibonacci numbers 35.2(2004)138
748.  
 Proposer: Kent Holing 34.2(2003)154  
 Topic: Areas of shaded regions in a given configuration  
 Solution: Shades of Pythagoras 35.2(2004)139
749.  
 Proposer: Michael W. Ecker 34.2(2003)154  
 Topic: Existence of fully diversified sequences  
 Solution: To fully diversified and beyond 35.2(2004)140
750.  
 Proposer: Angelo S. DiDomenico 34.2(2003)154  
 Topic: Integer Solutions of an equation in 3 variables  
 Solution: A non-identity with many Solutions 35.2(2004)141
751.  
 Proposer: Seth Zimmerman 34.3(2003)239  
 Topic: Evaluation of sums involving the cardinality and products of integers in a set  
 Solution: A productive sum and its alternating counterpart 35.3(2004)228
752.  
 Proposer: Juan-Bosco Romero Márquez 34.3(2003)239  
 Topic: Exponential Diophantine equation in 2 variables  
 Solution: An asymmetric Diophantine equation 35.3(2004)229
753.  
 Proposer: Youngge Tian 34.3(2003)239  
 Topic: Identity involving the ranks of 2 idempotent matrices  
 Solution: A rank identity 35.3(2004)230
754.  
 Proposer: Andrew Cusumano 34.3(2003)240  
 Topic: Proving the existence of a positive sequence and finding its recurrence relation  
 Solution: A Stirling argument 35.3(2004)230

755.  
 Proposer: Dean Hoffman & Peter Johnson 34.3(2003)240  
 Topic: Strategy needed to maximize the expected value in a gambling game  
 Solution: Strategy is unnecessary 35.3(2004)232
756.  
 Proposer: Michael Bataille 34.4(2003)327  
 Topic: Identity for the 6-term sum of ratios of sines  
 Solution: A trigonometric identity 35.4(2004)312
757.  
 Proposer: W. V. Grounds 34.4(2003)327  
 Topic: Finding primes obtained from 2 different 4<sup>th</sup> degree polynomials in 2 variables  
 Solution: Two polynomials that rarely yield primes 35.4(2004)313
758.  
 Proposer: Gregory Dresden 34.4(2003)327  
 Topic: Differentiability and extreme values of a polar function  
 Solution: A critical parameter for a family of polar curves 35.4(2004)314
759.  
 Proposer: Götz Trenkler 34.4(2003)328  
 Topic: Necessary & sufficient condition that a matrix equation has a Solution  
 Solution: A matrix operation 35.4(2004)316
760.  
 Proposer: Arthur L. Holshouser 34.4(2003)328  
 Topic: Divisibility of and an inequality for a smallest value function  
 Solution: An inequality for an abstract function 35.4(2004)316
761.  
 Proposer: Charles L. Cooper & Michael Scott McClendon 34.5(2003)405  
 Topic: Circles and disks within disks  
 Solution: Disks in unions of discs 35.5(2004)403
762.  
 Proposer: Srinivasan Balaji & Hosam Mahmoud 34.5(2003)405  
 Topic: Characterizing a game matrix involving a tenable Pólya urn containing colored balls  
 Solution: Tenable Pólya urns 35.5(2004)404
763.  
 Proposer: Thomas J. Pfaff 34.5(2003)406  
 Topic: Find a function related to covering a circular cookie at depths in a vat of chocolate  
 Solution: Cookie rolling 35.5(2004)405
764.  
 Proposer: Kedar Hardikar 34.5(2003)406  
 Topic: Finding matrices of coordinates in n-dimensional vector spaces having determinant 0  
 Solution: Vandermonde variations 35.5(2004)406

765.  
 Proposer: Angelo S. DiDomenico 34.5(2003)406  
 Topic: Find primitive quadruples of 4 positive integers satisfying a given condition  
 Solution: Radii in disguise 35.5(2004)407
766.  
 Proposer: Josè Luis Díaz-Barrero 35.1(2004)55  
 Topic: Inequality for coefficients of a polynomial with nonnegative roots  
 Solution: Roots and coefficients 36.1(2005)74
767.  
 Proposer: Ovidiu Furdui 35.1(2004)55  
 Topic: Series sum of  $e^x$ - its Taylor partial sum  
 Solution: Remainder in Taylor's formula 36.1(2005)75
768.  
 Proposer: Michel Bataille 35.1(2004)55  
 Topic: Hyperbolic identity depending on an exponential identity  
 Solution: Hyperbolic and exponential functions 36.1(2005)76
769.  
 Proposer: Wenchang Chu & Leontina Veliana Di Claudio 35.1(2004)56  
 Topic: Binomial product identity  
 Solution: An expression for  $2^n$  36.1(2005)77
770.  
 Proposer: Josè Luis Díaz-Barrero 35.1(2004)56  
 Topic: Logarithmic summation inequality  
 Solution: A logarithmic inequality 36.1(2005)78
771.  
 Proposer: Yi-chuan Pan 35.2(2004)136  
 Topic: Infinitely many rational numbers guarantee 2 quadratics are squared rationals  
 Solution: An ancient and curious problem 36.2(2005)161
772.  
 Proposer: Yongge Tian 35.2(2004)136  
 Topic: Inequalities involving the ranks of 2 given idempotent matrices  
 Solution: Rank inequalities for idempotent matrices 36.2(2005)162
773.  
 Proposer: Ovidiu Furdui 35.2(2004)136; Corrected 35.4(2004)310  
 Topic: Properties of cosines that involve lengths of a triangle  
 Solution: Powers of cosines and triangles 36.2(2005)163; Corrected 36.4(2005)332
774.  
 Proposer: Jody M. Lockhart 35.2(2004)136  
 Topic: Necessary & sufficient condition that the y-coordinate of points on a circle is zero  
 Solution: Points generated by geometric constructions 36.2(2005)163

775.

Proposer: John H. Webb 35.2(2004)137

Topic: Inequalities involving a rational function of the sides of a triangle

Solution: An inequality in algebra and geometry 36.2(2005)164

776.

Proposer: Monte J. Zenger 35.3(2004)227

Topic: Find all idempotent pairs of matrices given 2 such matrices with idempotent products

Solution: Two-by-two idempotent pairs 36.3(2005)239

777.

Proposer: Michael Scott McClendon 35.3(2004)227

Topic: Is every interior point of every convex polygon m-trilinearable?

Solution: Non-convex polygons and m-trilinearable points 36.3(2005)240

778.

Proposer: Will Gosnell 35.3(2004)227

Topic: Condition on 2 parameters that guarantee a given triple primitive

Solution: A parametrization of the sides of right triangles 36.3(2005)241

779.

Proposer: Kedar Hardikar 35.3(2004)228

Topic: Evaluate an integral of an exponential vector function

Solution: An integral in linear algebra 36.3(2005)243

780.

Proposer: Josè Luis Díaz-Barrero 35.3(2004)228

Topic: Inequality involving a sum and an exponential function of Fibonacci numbers

Solution: An inequality involving Fibonacci numbers 36.3(2005)244

781.

Proposer: David Callan 35.4(2004)310

Topic: Probability involving wives, their girlfriends and husbands seated at a table

Solution: Sitting arrangements-wives and their girlfriends 36.4(2005)332

782.

Proposer: Talaat M. Abdin & Hosam M. Mahmoud 35.4(2004)310

Topic: Probability of a gambler in a losing position in a betting game

Solution: Losing a betting game 36.4(2005)333

783.

Proposer: Angelo S. DiDomenico 35.4(2004)311

Topic: Triangles with equal area triangles with and a necessary & sufficient condition for equal products of sides

Solution: Constructions and concurrency 36.4(2005)335

784.

Proposer: Kent Holing 35.4(2004)311

Topic: Lengths that cannot be sides of a right triangle and some that cannot form a square

Solution: Pythagorean triples, Pythagorean triangles, and squares 36.4(2005)337

785.  
 Proposer: Josè Luis Díaz-Barrero 35.4(2004)311  
 Topic: Inequality involving sides, cosines and the inradius of a triangle  
 Solution: A trigonometric inequality involving in-radius 36.4(2005)338
786.  
 Proposer: Michael Golomb 35.5(2004)402  
 Topic: Find conjugate diameters of an ellipse intersecting an arc of maximum length  
 Solution: Conjugate diameters of an ellipse 36.5(2005)414
787.  
 Proposer: Michel Bataille 35.5(2004)402; Corrected 36.1(2005)73  
 Topic: Find the roots of a recursively defined polynomial equation  
 Solution: Roots of recursively defined polynomials 36.5(2005)415
788.  
 Proposer: Elias Lampakis 35.5(2004)402  
 Topic: Find bounds for the probability that a hyperbola has no integer points  
 Solution: The odds of having integer points on a hyperbola 36.5(2005)415
789.  
 Proposer: Zengxiang Tong & Zhen Huang 35.5(2004)403  
 Topic: Show convergence and find limits of 2 sequences related to nested roots of 2  
 Solution: Sequences converging to  $\pi$  36.5(2005)416
790.  
 Proposer: Elliott Cohen 35.5(2004)403  
 Topic: Properties of the rank of a family of determinants of columns of a complex matrix  
 Solution: Ranks: matrices and linear forms 36.5(2005)418
791.  
 Proposer: Gregory Fredricks & Roger Nelson 36.1(2005)73  
 Topic Row and column sums of a (must be) square matrix 36.1(2005)73  
 Solution: Sufficient conditions for square matrices 37.1(2006)62
792.  
 Proposer: Josè Luis Díaz-Barrero 36.1(2005)73  
 Topic: Sum-Product inequality of a positive sequence 36.1(2005)73  
 Solution: A particular case of an inequality 37.1(2006)63
793.  
 Proposer: William P. Wardlaw 36.1(2005)74  
 Topic: Symmetric groups and inner automorphisms 36.1(2005)74  
 Solution: The making of an inner automorphism for  $A_n$  37.1(2006)64
794.  
 Proposer: W. C. Gosnell 36.1(2005)74  
 Topic: Circle with an angle subtended by an arc of a certain length 36.1(2005)74  
 Solution: Existence of some special central angles 37.1(2006)65

795.  
 Proposer: Göt Trenkler 36.1(2005)74  
 Topic: Trace identities of a complex matrix 36.1(2005)73  
 Solution: Necessary & sufficient condition for  $A^2 = -A$  37.1(2006)67
796.  
 Proposer: Andrew Cusumano 36.2(2005)160; Corrected: 36.4(2005)330; 37.2(2006)144  
 Topic: Convergence of 2 series of reciprocals of products of Fibonacci numbers  
 Solution: Infinite sums defined by the Fibonacci sequence 37.4(2006)309
797.  
 Proposer: Josè Luis Díaz-Barrero 36.2(2005)161  
 Topic: Inequalities involving finite sums of squares of secant functions  
 Solution: Endpoint-approximation of a definite integral 37.2(2006)145
798.  
 Proposer: Willaim P. Wardlaw 36.2(2005)161  
 Topic: What characteristic polynomials completely determine the rank of a matrix?  
 Solution: Rank of A and  $\det(xI - A)$  37.2(2006)146
799.  
 Proposer: Mohammad K. Azarian 36.2(2005)161  
 Topic: Limit of a series involving terms of a 2<sup>nd</sup> order recurrence relation  
 Solution: A limit expression of  $1/(e - 1)$  37.2(2006)147
800.  
 Proposer: Hojoo Lee 36.2(2005)161  
 Topic: Show a cubic polynomial satisfying given inequalities is positive for positive values  
 Solution: Conditions for non-negative cubic polynomials 37.2(2006)148
801.  
 Proposer: Nora Thornber 36.3(2005)238  
 Topic: First order matrix differential equation  
 Solution: Generalization of an old CMJ problem 37.3(2006)230
802.  
 Proposer: Willaim P. Wardlaw 36.3(2005)239  
 Topic: Probability that the product of 2 randomly chosen matrices is the identity matrix  
 Solution: The probability that  $AB = I$  37.3(2006)232
803.  
 Proposer: Yongge Tian 36.3(2005)239  
 Topic: Show a matrix of given matrices is an orthogonal projector and construct another  
 Solution: An orthogonal projector consisting of non-negative matrices 37.3(2006)233
804.  
 Proposer: Mohammad Riazi-Kermani & Hongbiao Zeng 36.3(2005)239  
 Topic: Find a sufficient condition that an nth degree polynomial has a complex root  
 Solution: Polynomials: A sufficient condition for a non-real zero 37.3(2006)234

805.  
 Proposer: Josè Luis Díaz-Barrero 36.3(2005)239  
 Topic: Inequality involving Fibonacci numbers  
 Solution: An inequality involving the fourth power of Fibonacci numbers 37.3(2006)235
806.  
 Proposer: Kenneth Fogarty 36.4(2005)331  
 Topic: Lengths of sequences of derived triangles from a given triangle  
 Solution: A sequence of triangles 37.4(2006)311
807.  
 Proposer: Angelo S. DiDomenico 36.4(2005)331  
 Topic: Necessary & sufficient condition on 4 integers generating all Pythagorean triples  
 Solution: Conditions for primitive Pythagorean triples 37.4(2006)312
808.  
 Proposer: Yongge Tian 36.4(2005)331  
 Topic: Equality of ranks of matrices related to a given positive definite matrix  
 Solution: An equality for ranks of symmetric positive definite matrices 37.4(2006)313
809.  
 Proposer: Ovidui Furdui 36.4(2005)331  
 Topic: Limit of a sum involving roots of integers  
 Solution: A limit expression of  $(\ln 2)^2$  37.4(2006)314
810.  
 Proposer: Josè Luis Díaz-Barrero 36.4(2005)331  
 Topic: Limit of a sum of square roots of a ratio of polynomials in 2 variables  
 Solution: A limit computed by integration 37.4(2006)316
811.  
 Proposer: Willaim Wardlaw 36.5(2005)413  
 Topic: Find the characteristic polynomial of the adjoint of a matrix with a 5<sup>th</sup> degree one  
 Solution: Characteristic polynomial of the adjoint of a matrix 37.5(2006)393
812.  
 Proposer: Ovidui Furdui 36.5(2005)413; Corrected: 37.2(2006)143  
 Topic: Find the limit of the difference of exponential functions of sums of sines  
 Solution: A limit related to Euler's constant 38.2(2007)150
813.  
 Proposer: Mohammad K. Azarian 36.5(2005)413  
 Topic: Establishing the sum of perpendicular lengths formed in 45 nested triangles  
 Solution: Forty-five nested equilateral triangles and  $\csc 1^\circ$  37.5(2006)394
814.  
 Proposer: Josè Luis Díaz-Barrero 36.5(2005)414  
 Topic: Find the minimum value of a sum of ratios of 3 positive numbers  
 Solution: Minimizing a constrained symmetric expression 37.5(2006)396



815.  
 Proposer: Youngge Tian 36.5(2005)414  
 Topic: Necessary & sufficient condition for the ranges of Kronecker products of matrices  
 Solution: Comparing ranges of Kronecker products of matrices 37.5(2006)397
816.  
 Proposer: Ovidui Furdui 37.1(2006)59  
 Topic: Find the minimum number that allows 3 given sine terms to be the sides of a triangle  
 Solution: Building triangles for a triangle 38.1(2007)61
817.  
 Proposer: Mohammad K. Azarian 37.1(2006)59  
 Topic: Find values allowing a given slope to the graph of a function with given derivative  
 Solution: Slopes of tangents 38.1(2007)63
818.  
 Proposer: Angelo S. DiDomenico 37.1(2006)60  
 Topic: Identity for 5 consecutive elements in a recurrence relation  
 Solution: A Fibonacci-like sequence 38.1(2007)64
819.  
 Proposer: Michael Andreoli 37.1(2006)60  
 Topic: Evaluate the sum of reciprocals of products of consecutive integers  
 Solution: An interesting and well known series 38.1(2007)65
820.  
 Proposer: Greg Oman 37.1(2006)60  
 Topic: Necessary condition that a commutative ring with identity has non associates  
 Solution: Non-associates 38.1(2007)66
821.  
 Proposer: Andrew Cusumano 37.2(2006)143  
 Topic: Limit of the difference of ratios of sums of powers of integers  
 Solution: An expression of  $e$  38.2(2007)150
822.  
 Proposer: Götz Trenkler 37.2(2006)143  
 Topic: Show that a given matrix and its conjugate transpose have the same column space  
 Solution: Column space of a square matrix and its conjugate transpose 38.2(2007)152
823.  
 Proposer: Michel Bataille 37.2(2006)144  
 Topic: Inequality for the product of powers of tangents and sines  
 Solution: A trigonometric inequality 38.2(2007)153
824.  
 Proposer: Jeremy Leach 37.2(2006)144  
 Topic: Evaluate a double sum involving binomial coefficients and factorials  
 Solution: Always 2 38.2(2007)154

825.  
 Proposer: Juan-Bosco Romero Márquez 37.2(2006)144  
 Topic: Find the limit of the ratio of 2 improper integrals  
 Solution: Two improper integrals and L'Hospital's rule 38.2(2007)155
826.  
 Proposer: Parviz Khalili 37.3(2006)229  
 Topic: Evaluate an improper integral of a reciprocal of sums of 4<sup>th</sup> powers  
 Solution: Evaluation of an improper integral 38.3(2007)228
827.  
 Proposer: Syrous Marivani 37.3(2006)229  
 Topic: Evaluate sums of Fibonacci numbers and sums of Lucas numbers  
 Solution: Sums related to Fibonacci and Lucas sequences 38.3(2007)230
828.  
 Proposer: Michael McClendon 37.3(2006)230  
 Topic: Find parametric equations of a curve with given intercepts to tangent lines  
 Solution: The cycloid 38.3(2007)231
829.  
 Proposer: Dimitri Thoro & Linda Valdes 37.3(2006)230  
 Topic: Finding distances between 2 parallelepipeds cut by a plane  
 Solution: Cutting a rectangular parallelepiped 38.3(2007)232
830.  
 Proposer: Roger Bilisoly 37.3(2006)230; Corrected: 37.4(2006)308; 37.5(2006)392  
 Topic: Finding the area of an alternating n-gon with sides satisfying given conditions  
 Solution: Area of an alternating 2n-gon 38.5(2007)389
831.  
 Proposer: Stanley Rabinowitz 37.4(2006)308  
 Topic: Identities involving tangents and sines of specific angles  
 Solution: The tangent function and  $\sqrt{11}$  38.4(2007)310
832.  
 Proposer: Ken Holing 37.4(2006)309  
 Topic: Necessary & sufficient condition that the Galois group of a quartic polynomial equation is cyclic  
 Solution: Conditions for a cyclic Galois group of a quadratic equation 38.4(2007)312
833.  
 Proposer: Angelo S. DiDomenico 37.4(2006)309  
 Topic: Finding Heronian triangles with conditions on their sides and perimeter  
 Solution: Generating Heronian triangles 38.4(2007)315
834.  
 Proposer: Josè Luis Díaz-Barrero 37.4(2006)309  
 Topic: Inequality involving cube roots of ratios of Fibonacci numbers  
 Solution: An inequality with Fibonacci numbers and cube roots 38.4(2007)316

835.  
 Proposer: Juan-Bosco Romero Márquez 37.4(2006)309  
 Topic: Inequalities involving cubes of sums of 3 positive numbers  
 Solution: An inequality involving cubes 38.4(2007)317
836.  
 Proposer: Josè Luis Díaz-Barrero 37.5(2006)392  
 Topic: Inequality involving sums and powers of 3 real numbers  
 Solution: An inequality with cyclosymmetric functions 38.5(2007)390
837.  
 Proposer: Juan-Bosco Romero Márquez 37.5(2006)392  
 Topic: Inequalities involving the sides and inradius of a triangle  
 Solution: Inequalities from the inscribed circle of a triangle 38.5(2007)391
838.  
 Proposer: Arkady Alt 37.5(2006)393  
 Topic: Inequality for reciprocals of sums and differences of squared sides of a triangle  
 Solution: An acute triangle inequality 38.5(2007)392
839.  
 Proposer: Andrew Cusumano 37.5(2006)393  
 Topic: Find the general term and limit of a sequence of sums of reciprocals of integers  
 Solution: The general term and limit of a sequence 38.5(2007)393
840.  
 Proposer: Ruthven Murgatroyd 37.5(2006)393  
 Topic: Moving circular segments around a right angled hallway  
 Solution: Area of a circle segment and length of its chord 38.5(2007)395
841.  
 Proposer: Mohammad K. Azarian 38.1(2007)60  
 Topic: Find value of 2 fixed points of a quadratic polynomial  
 Solution: Fixed points of a quadratic polynomial 39.1(2008)66
842.  
 Proposer: Hongbiao Zeng 38.1(2007)60  
 Topic: Show existence of a point on the surface of a cube satisfying a distance condition  
 Solution: An inequality of a k-dimensional unit cube 39.1(2008)67
843.  
 Proposer: P. R. Parthasarathy 38.1(2007)60  
 Topic: Equality of n summations of powers of a number in (0,1) to a given determinant  
 Solution: An expression of a determinant 39.1(2008)68
844.  
 Proposer: Ovidui Furdui 38.1(2007)61  
 Topic: Identity for the sum of a sequence involving Euler's constant  
 Solution: Infinite series and Euler's constant 39.1(2008)71

845.  
 Proposer: Mohsen Soltanifar 38.1(2007)61  
 Topic: Continuity of a given Riemann-integrable function which is an integral's derivative  
 Solution: Derivatives of integrals 39.1(2008)6672
846.  
 Proposer: Josè Luis Díaz-Barrero  
 Topic: Inequality involving sums of reciprocals of powers of binomial coefficients  
 Solution: An inequality with the sum of combinations 39.2(2008)154
847.  
 Proposer: Juan-Bosco Romero Márquez  
 Topic: Inequalities for the inradius, circumradius and semi-perimeter of a triangle  
 Solution: Inequalities with inradius and circumradius 39.2(2008)155
848.  
 Proposer: Angelo S. DiDomenico 38.2(2007)149  
 Topic: Identities for generalized Fibonacci-like sequences  
 Solution: An identity for Fibonacci-like sequences 39.2(2008)157
849.  
 Proposer: Gregory L. Wilson 38.2(2007)149  
 Topic: Probability concerning life spans of contemporaries  
 Solution: Probability for two contemporaries 39.2(2008)158
850.  
 Proposer: Charles Redmond 38.2(2007)149  
 Topic: Properties of eigenvectors for a given matrix  
 Solution: Positive eigenvalues 39.2(2008)159
851.  
 Proposer: Josè Luis Díaz-Barrero 38.3(2007)227  
 Topic: Finding eigenvalues of the sum of 2 projection matrices  
 Solution: A conditional inequality 39.3(2008)241
852.  
 Proposer: Frank Morgan 38.3(2007)227; Clarification: 39.1(2008)65  
 Topic: Finding eigenvalues of two orthogonal projection matrices 38.3(2007)227  
 Solution: Eigenvalues of the sum of two orthogonal projection matrices 40.1(2009)56
853.  
 Proposer: Angelo S. DiDomenico 38.3(2007)227  
 Topic: Padoa's inequality and locating a point on a triangle whose sides satisfy it  
 Solution: A generalization of Padoa's inequality 39.3(2008)242
854.  
 Proposer: Ovidui Furdui 38.3(2007)228  
 Topic: Equality for an infinite sum involving harmonic numbers  
 Solution: An equality related to the harmonic series 39.3(2008)243

855.  
 Proposer: Michel Bataille 38.3(2007)228  
 Topic: Identity involving products of sums of functions of floor function  
 Solution: A floor function equality 39.3(2008)245
856.  
 Proposer: Victor Dontsov, Evgeni Maevski & Zokhrab Mustafaev 38.4(2007)309  
 Topic: Limit of a sum of  $n^{\text{th}}$  roots of consecutive integers  
 Solution: A sequence whose limit is 2007! 39.4(2008)308
857.  
 Proposer: Claud Bégin 38.4(2007)309  
 Topic: Finding points which yield a given number of tangents to the graph of a cubic  
 Solution: The number of tangents to the graph of a cubic function 39.4(2008)309
858.  
 Proposer: Ayoub B. Ayoub 38.4(2007)309  
 Topic: Properties of triangles constructed on the sides of a quadrilateral  
 Solution:  $90^\circ$  rotations of triangles about a point 39.4(2008)311
859.  
 Proposer: Josè Luis Díaz-Barrero 38.4(2007)310  
 Topic: Limit of a sum of integrals involving the logarithmic function  
 Solution: Limit of the sum of some improper integrals 39.4(2008)312
860.  
 Proposer: David Finn & Herb Bailey 38.4(2007)310  
 Topic: Property of a hexagon constructed from extending the sides of a triangle  
 Solution: Conditions for cyclic hexagon 39.4(2008)313
861.  
 Proposer: Angelo S. DiDomenico 38.5(2007)388  
 Topic: Existence of integers,  $a$ ,  $b$ , and  $c$ , whose sum is a perfect number, and such that  
 $(a + b, a + c, b + c)$  is a Pythagorean triple  
 Solution: Even perfect numbers and Pythagorean triples 39.5(2008)403
862.  
 Proposer: Elias Lampakis 38.5(2007)388  
 Topic: Existence of 27 rational coefficients which can generate a sequence from itself  
 Solution: A splitting field over the rationals 39.5(2008)404
863.  
 Proposer: Mohsen Soltanifar 38.5(2007)388  
 Topic: Existence of continuumly many metrics for which a given sequence converges  
 Solution: Continuumly many matrices 39.5(2008)406
864.  
 Proposer: Dennis Walsh 38.5(2007)389  
 Topic: Double sum of a sequence depending on 2 indices  
 Solution: An expression for  $e$  39.5(2008)407

865.  
 Proposer: Spiros P. Andriopoulos 38.5(2007)389  
 Topic: Inequality for a double integral of logarithmic functions over polar region  
 Solution: A lower bound for a double integral 39.5(2008)408
866.  
 Proposer: Edwin F. Sampang 39.1(2008)65  
 Topic: Evaluation of a given fraction from two given fractions  
 Solution: Evaluating a fraction of the form  $z/(y + z)$  40.1(2009)58
867.  
 Proposer: Josè Luis Díaz-Barrero 39.1(2008)66  
 Topic: Inequality involving the arithmetic and geometric mean of 4 numbers  
 Solution: A consequence of the arithmetic-geometric inequality 40.1(2009)59
868.  
 Proposer: A. R. Miller 39.1(2008)66  
 Topic: Evaluation of a sum of the reciprocal product of gamma functions  
 Solution: A double sum with the gamma function 40.1(2009)60
869.  
 Proposer: Vicențiu Rădulescu 39.1(2008)66  
 Topic: Product of a function and its 2<sup>nd</sup> derivative inequality  
 Solution: No such function 40.1(2009)61
870.  
 Proposer: Mohammad K. Azarian 39.1(2008)66  
 Topic Evaluating a sum of definite integrals  
 Solution: An expression for  $\pi$  40.1(2009)62
871.  
 Proposer: Greg Oman 39.2(2008)153  
 Topic: Find positive integers so a given equation in 2 variables has integral Solutions  
 Solution: Pythagorean-triple Solutions 40.2(2009)132
872.  
 Proposer: Josè Luis Díaz-Barrero 39.2(2008)153  
 Topic: Inequality for a finite sum of powers of reciprocals of factorials  
 Solution: A lower bound for  $1/(n!)^2$  40.2(2009)133
873.  
 Proposer: Ovidui Furdui 39.2(2008)154  
 Topic: Evaluate infinite series of logarithm terms  
 Solution: Stieltjes constants 40.2(2009)136
874.  
 Proposer: Michael S. Becker 39.2(2008)154  
 Topic: Show that a sum of even derivatives divided by factorials is 1  
 Solution: An infinite sum with  $f^{(4n)}(1)$  and  $f^{(2n)}(1)$  40.2(2009)137

875.  
 Proposer: Dorin Marghidanu 39.2(2008)154  
 Topic: Inequalities involving square roots of products of 4 positive numbers  
 Solution: Two cycle inequalities 40.2(2009)139
876.  
 Proposer: Jody M. Lockhart & William P. Wardlaw 39.3(2008)240  
 Topic: Mod numbers for which rings of polynomials are groups of units  
 Solution: When does  $Z[x]^* = Z_m^*$ ? 40.3(2009)216
877.  
 Proposer: Ovidui Furdui 39.3(2008)241  
 Topic: Sequence of improper integrals to be evaluated  
 Solution: The answer is  $n! \ln 2$  40.3(2009)217
878.  
 Proposer: Josè Luis Díaz-Barrero 39.3(2008)241  
 Topic: Inequality involving the sides and semi-perimeter of a triangle  
 Solution: A cyclical inequality for a triangle 40.3(2009)218
879.  
 Proposer: Dorin Marghidanu 39.3(2008)241  
 Topic: Inequalities for the coefficients of a 4<sup>th</sup> degree polynomial  
 Solution: Roots and coefficients of a quadratic function 40.3(2009)219
880.  
 Proposer: Bianca-Teodora Iordache 39.3(2008)241  
 Topic: An Inequality for a sum of powers of terms of a sequence and a necessary & sufficient condition that equality holds  
 Solution: An application of some inequalities 40.3(2009)220
881.  
 Proposer: Kim McInturff 39.4(2008)307  
 Topic: Identity for a finite sum of binomial coefficients and a sum of sine terms  
 Solution: Representations of a generating function 40.4(2009)294
882.  
 Proposer: Oskar Maria Baksalary 39.4(2008)307  
 Topic: Inequality involving vectors and matrices  
 Solution: An inequality with positive definite matrices 40.4(2009)296
883.  
 Proposer: Brian Bradie 39.4(2008)308  
 Topic: Evaluate 2 integrals, one involving an arctangent, and the other a logarithm  
 Solution: Two closely related definite integrals 40.4(2009)297
884.  
 Proposer: Josè Luis Díaz-Barrero 39.4(2008)308  
 Topic: Evaluate the limit of a double sum involving products of integers  
 Solution: The limit of a double sum 40.4(2009)299

885.  
 Proposer: Ovidui Furdui 39.4(2008)308  
 Topic: Evaluate an improper double integral involving the square of a logarithm  
 Solution: A double integral and the Dirichlet beta function 40.4(2009)300
886.  
 Proposer: Árpád Bényi 39.5(2008)401  
 Topic: Properties of a “good” function composed with itself 2008 times  
 Solution: A good function 40.5(2009)377
887.  
 Proposer: Josè Luis Díaz-Barrero 39.5(2008)402  
 Topic: Evaluate a finite sum of ratios of roots of unity and their conjugates  
 Solution: A sum involving odd roots of unity 40.5(2009)378
888.  
 Proposer: Brian Bradie 39.5(2008)402  
 Topic: Find the limit of a product of powers of a binomial  
 Solution: The limit of a Riemann sum 40.5(2009)380
889.  
 Proposer: Jody M. Lockhart & William P. Wardlaw 39.5(2008)402  
 Topic: Find how many  $4 \times 4$  matrices have a given determinant  
 Solution: The number of  $4 \times 4$  matrices over  $F_8$  40.5(2009)382
890.  
 Proposer: Russell Hendel 39.5(2008)402  
 Topic: Proving that a given  $n^{\text{th}}$  order recurrence relation may or may not exist  
 Solution: Another family of recursions 40.5(2009)382
891.  
 Proposer: William P. Wardlaw 40.1(2009)55  
 Topic: Determining an ordered basis for a certain vector space  
 Solution: An ordered basis for an  $n$ -dimensional space over a field 41.1(2010)65
892.  
 Proposer: Greg Oman 40.1(2009)55  
 Topic: Finding all rings with certain given properties  
 Solution: A characterization of a finite field 41.1(2010)66
893.  
 Proposer: Ovidui Furdui 40.1(2009)56  
 Topic: Summing products of  $x^n$  and the difference of a function and its Taylor polynomial  
 Solution: An infinite sum of a function with its Taylor polynomial 41.1(2010)67
894.  
 Proposer: Juan-Bosco Romero Márquez 40.1(2009)56  
 Topic: Inequality involving the in- and circum- radii of a triangle  
 Solution: Two triangle inequalities 41.1(2010)69



895.  
 Proposer: Ovidui Furdui 40.1(2009)56  
 Topic: Evaluation of a product of powers of a ratio of integers  
 Solution: The limit of an infinite product 41.1(2010)70
896.  
 Proposer: Darij Grinberg 40.2(2009)131  
 Topic: Algebraic inequality in 3 variables  
 Solution: A constrained homogeneous inequality 41.2(2010)161
897.  
 Proposer: R. S. Tiberio 40.2(2009)131  
 Topic: Perpendicular segments from a triangle's circumcenter to its centroid and to its Nagel point  
 Solution: Nagel point, Euler line, and Fuhrmann circle 41.2(2010)161
898.  
 Proposer: Mihály Bencze 40.2(2009)131  
 Topic: Inequality for definite integrals of a function with nonnegative 2<sup>nd</sup> derivative  
 Solution: An inequality with definite integrals of a convex function 41.2(2010)166
899.  
 Proposer: Ovidui Furdui 40.2(2009)132  
 Topic: Limit of a definite integral of a ratio of polynomials  
 Solution: A definite integral involving a geometric series 41.2(2010)167
900.  
 Proposer: Michel Bataille 40.2(2009)132  
 Topic: Summation equality involving the finite harmonic series and its square  
 Solution: An identity with the harmonic series 41.2(2010)169
901.  
 Proposer: Cezar Lupu 40.3(2009)215  
 Topic: Square root inequality in 3 positive numbers  
 Solution: A cyclic inequality 41.3(2010)243
902.  
 Proposer: Mohsen Soltanifar 40.3(2009)215; Clarified: 41.3(2010)242  
 Topic: Convergence of a sum of ratios of powers of a sequence  
 Solution: Conditions of convergence of a series 42.3(2011)233
903.  
 Proposer: José Luis Díaz-Barrero and José Gibergans-Báguena 40.3(2009)216  
 Topic: Inequality involving squares of sums of ratios of square roots  
 Solution: An inequality with telescoping summation 41.3(2010)244
904.  
 Proposer: Ovidiu Furdui 40.3(2009)216  
 Topic: Double integral of the log of the gamma function of 2 variables  
 Solution: A double integral with the Gamma function 41.3(2010)245

905.  
 Proposer: Ovidiu Furdui 40.3(2009)216  
 Topic: Integral involving the fractional part of a number  
 Solution: The Euler-Mascheroni constant in the form of an integral 41.3(2010)246
906.  
 Proposer: Ovidiu Furdui 40.4(2009)293  
 Topic: Infinite product of a product of fractions  
 Solution: The Gamma function and an infinite product 41.4(2010)330
907.  
 Proposer: Brian Bradie 40.4(2009)293  
 Topic: Sum involving Pell-Lucas numbers  
 Solution: An infinite sum with the Pell-Lucas numbers 41.4(2010)332
908.  
 Proposer: Scott Duke 40.4(2009)294  
 Topic: Sequence whose convergence depends on the Riemann zeta function  
 Solution: Limit of a recursive sequence 41.4(2010)333
909.  
 Proposer: Francisco Javier Garcia 40.4(2009)294  
 Topic: Show that a quadrilateral constructed from the incenter of a triangle is cyclic  
 Solution: Reflection and cyclic quadrilateral 41.4(2010)333
910.  
 Proposer: Michael Goldenberg & Mark Kaplan 40.4(2009)294  
 Topic: Show that a ratio of determinants of Tribonacci numbers is a perfect square  
 Solution: determinants based on a tribonacci sequence 41.4(2010)335
911.  
 Proposer: Michael Scott McClendon 40.5(2009)376  
 Topic: Determining if a 7-gon is externally trilinearable  
 Solution: An externally trilinearable 7-gon 41.5(2010)410
912.  
 Proposer: Kenneth W. Fogarty 40.5(2009)376  
 Topic: Evaluating a product of quadratics defined on a given sequence  
 Solution: Product of function images and recursion 41.5(2010)411
913.  
 Proposer: Mihály Bencze 40.5(2009)376  
 Topic: Inequality involving sums and products of a given sequence  
 Solution: An inequality with a finite sum of products 41.5(2010)412
914.  
 Proposer: Y. N. Aliyev 40.5(2009)377  
 Topic: Finding numbers in square roots whose fractional parts satisfy a given condition  
 Solution: The fractional part of a real number 41.5(2010)413

915.  
 Proposer: Will Gosnell & Herb Bailey 40.5(2009)377  
 Topic: Expressing the hypotenuse of a certain right triangle in terms of the gold ratio  
 Solution: A right triangle and the golden ratio 41.5(2010)414
916.  
 Proposer: Kim McInturff 41.1(2010)64  
 Topic: An integral involving the gamma function  
 Solution: A definite integral and the Glaisher-Kinkelin constant 42.1(2011)63
917.  
 Proposer: José Luis Díaz-Barrero 41.1(2010)64  
 Topic: Inequalities involving the sides, inradius and the circumradius of a triangle  
 Solution: An inequality of a triangle with its circumradius and inradius 42.1(2011)66
918.  
 Proposer: Cezar Lupu 41.1(2010)64  
 Topic: When is an expression involving three integers a perfect cube?  
 Solution: Conditions for a perfect cube 42.1(2011)67
919.  
 Proposer: Michel Bataille 41.1(2010)65  
 Topic: Identities involving the sides, inradius and the radii of the excircles of a triangle  
 Solution: Two triangle identities 42.1(2011)68
920.  
 Proposer: Ovidiu Furdui 41.1(2010)65  
 Topic: Absolute convergence of a series involving products of cosines  
 Solution: An infinite sum with the power of a product of cosines 42.1(2011)69
921.  
 Proposer: Ovidiu Furdui 41.2(2010)160  
 Topic: Inequalities involving sequences of towers  
 Solution: Bounes for two subsequences of  $\{1/k$  [towered by  $1/k$ ,  $k$  times] $\}$  42.2(2011)152
922.  
 Proposer: Sadi Abu-Saymeh & Mowaffag Hajja 41.2(2010)161  
 Topic: Equality of distances arising from angle bisectors of angles of a triangle  
 Solution: An isosceles triangle problem again 42.2(2011)155
923.  
 Proposer: Eugen J. Ionascu 41.2(2010)161  
 Topic: Construct a sequence of numbers and determine the limit of the mean of their sums  
 Solution: Constructing a sequence satisfying certain properties 42.2(2011)156
924.  
 Proposer: Joe Howard 41.2(2010)161  
 Topic: Inequality involving a finite sequence whose terms have a product equal to unity  
 Solution: A result from the AM-GM inequality 42.2(2011)157

925.  
 Proposer: Cezar Lupu & Tudorel Lupu 41.2(2010)161  
 Topic: Existence of a vanishing point of the 2<sup>nd</sup> derivative of a function satisfying integrals  
 Solution: Conditions for  $f^{(c)} = 0$  with  $c \in (0,1)$  42.2(2011)158
926.  
 Proposer: Mowaffaq Hajja 41.3(2010)242  
 Topic: Constructing cevians which make equal angles with the base of a triangle  
 Solution: Equal cevian intercepts 42.3(2011)235
927.  
 Proposer: Cezar Lupu & Tudorel Lupu 41.3(2010)242  
 Topic: Inequality involving the difference of two integrals of a differentiable function  
 Solution: An inequality of a function with continuous first derivative 42.3(2011)236
928.  
 Proposer: Michel Bataille 41.3(2010)243  
 Topic: Necessary and sufficient conditions that the rank of two special matrices are equal  
 Solution: Conditions for  $\text{Rank}(A) = \text{Rank}(B)$  42.3(2011)237
929.  
 Proposer: Cezar Lupu & Vlad Matei 41.3(2010)243  
 Topic: Inequality involving the sum of the cubes of three real numbers  
 Solution: A constrained inequality 42.3(2011)238
930.  
 Proposer: Ovidui Furdui 41.3(2010)243  
 Topic: Evaluating the integral of a function with a given finite limit as  $x$  approaches infinity  
 Solution: An application of the Weierstrass Approximation Theorem 42.3(2011)239
931.  
 Proposer: Sam Vandervelde 41.4(2010)329  
 Topic: Equality involving two polynomials and the form of the remainder of their ratio  
 Solution: Composition and product of polynomials 42.4(2011)330
932.  
 Proposer: Cezar Lupu & Tudorel Lupu 41.4(2010)329  
 Topic: Integral inequality involving the 4<sup>th</sup> power of a continuous function on  $[0,1]$   
 Solution: A simple inequality for a definite integral 42.4(2011)332
933.  
 Proposer: Cosmin Pohoată 41.4(2010)329  
 Topic: Inequality involving the inradii of triangles formed from the orthocenter of a triangle  
 Solution: An inequality with inradii 42.4(2011)332
934.  
 Proposer: José Luis Díaz-Barrero 41.4(2010)330  
 Topic: Summation inequality involving the sides and semi-perimeter of an  $n$ -gon  
 Solution: An inequality of  $n$ -gons 42.4(2011)334

935.  
 Proposer: Tom Beatty 41.4(2010)330  
 Topic: Two person game where players alternately select irrational numbers and integers  
 Solution: Winning strategy 42.4(2011)335
936.  
 Proposer: Cezar Lupu & Tudorel Lupu 41.5(2010)409  
 Topic: Inequality involving 3 positive real numbers  
 Solution: A symmetric inequality in three variables 42.5(2011)408
937.  
 Proposer: Panagiote Ligouras 41.5(2010)409  
 Topic: Inequality involving medians, angle bisectors and the circumradius of a triangle  
 Solution: Inequality from a triangle 42.5(2011)409
938.  
 Proposer: Ovidiu Furdui 41.5(2010)409  
 Topic: Integral limit of involving integers  $n$  and polynomials times an integrable function  
 Solution: The limit related to a definite integral 42.5(2011)410
939.  
 Proposer: Cezar Lupu 41.5(2010)410  
 Topic: Necessary and sufficient conditions that the trace of the adjugate of a matrix is zero  
 Solution: An adjugate problem 42.5(2011)411
940.  
 Proposer: Greg Oman 41.5(2010)410  
 Topic: Find rings that require the product of members of a sequence be in the sequence  
 Solution: Identification of some nonzero rings 42.5(2011)412
941.  
 Proposer: Ovidiu Furdui 42.1(2011)62  
 Topic: Evaluating the limit of an integral of a product of two functions  
 Solution: Evaluating and integral limit 43.1(2012)96
942.  
 Proposer: Geoffrey Kandall 42.1(2011)62  
 Topic: Sum of ratios involving angle bisectors intersecting at the incenter of a triangle  
 Solution: An equation in geometry 43.1(2012)98
943.  
 Proposer: Juan-Bosco Romero Márquez & Francisco Javier García Capitán 42.1(2011)62  
 Topic: Locating points on an internal bisector in a triangle which satisfy a given cross ratio  
 Solution: A cross ratio problem 43.1(2012)99
944.  
 Proposer: Duong Viet Thong 42.1(2011)63  
 Topic: Inequalities involving the integral of a continuously differentiable function  
 Solution: The bounds of a definite integral 43.1(2012)100

945.  
 Proposer: Erwin Just 42.1(2011)63  
 Topic: Existence of an integer in a ring which satisfies a given equation and 3 conditions  
 Solution: Properties of some rings 43.1(2012)103
946.  
 Proposer: Greg Oman 42.2(2011)151  
 Topic: For a function,  $f$ , defined on a countable set find a sequence satisfying  $f(x_n) x_{n+1}$   
 Solution: Ordering a countably infinite set with a function 43.2(2012)175
947.  
 Proposer: Ovidiu Furdui 42.2(2011)151  
 Topic: Finding all polynomials,  $P$  and  $Q$  such that for  $i = 1, \dots, n$ ,  $\prod P(i) = Q(\prod i)$   
 Solution: Identifying some polynomials 43.2(2012)176
948.  
 Proposer: Duong Viet Thong 42.2(2011)151  
 Topic: Inequality involving the integral of a continuously differentiable function  
 Solution: An integral inequality 43.2(2012)177
949.  
 Proposer: Cezar Lupu 42.2(2011)152  
 Topic: Identities involving integrals of continuously differentiable functions  
 Solution: Forming integral equations 43.2(2012)178
950.  
 Proposer: José Luis Díaz-Barrero 42.2(2011)152  
 Topic: Inequality involving ratios three numbers summed over all their cyclic permutations  
 Solution: A constrained inequality 43.2(2012)179
951.  
 Proposer: Duong Viet Thong 42.3(2011)232  
 Topic: Existence of a number relating to the derivative of a function satisfying 3 integrals  
 Solution: Mean value theorem for integral 43.3(2012)258
952.  
 Proposer: Michel Bataille 42.3(2011)232  
 Topic: Summing a product of binomial coefficients and powers of two  
 Solution: A binomial coefficient identity 43.3(2012)260
953.  
 Proposer: Tom Beatty 42.3(2011)232  
 Topic: Summing a sequence of numbers satisfying a given non-linear recurrence  
 Solution: A recursively defined series 43.3(2012)261
954.  
 Proposer: Edwin Just 42.3(2011)233  
 Topic: Determining two counterfeit coins in a set of twelve  
 Solution: Detecting two fake coins 43.3(2012)262

955.  
 Proposer: José Luis Díaz-Barrero 42.3(2011)233  
 Topic: Inequality involving ratios three numbers summed over all their cyclic permutations  
 Solution: Another constrained inequality 43.3(2012)263
956.  
 Proposer: Duong Viet Thong 42.4(2011)329  
 Topic: Existence of 3 numbers related to a function whose definite integral is 1  
 Solution: Guaranteeing three function values whose products is 1 43.4(2012)338
957.  
 Proposer: Michel Bataille 42.4(2011)329  
 Topic: Divisibility and a summation involving Fibonacci numbers  
 Solution: Properties of Fibonacci numbers 43.4(2012)339
958.  
 Proposer: Mohammad Azarian 42.4(2011)330  
 Topic: Summation involving a sequence defined by a 2<sup>nd</sup> order nonlinear recurrence relation  
 Solution: Sylvester's sequence and the infinite Egyptian fraction decomposition of 1  
 43.4(2012)340
959.  
 Proposer: Michael Goldberg & Mark Kaplan 42.4(2011)330  
 Topic: Identity involving a sequence defined by a 3<sup>rd</sup> order recurrence relation  
 Solution: An identity for a Fibonacci-like sequence 43.4(2012)342
960.  
 Proposer: Peter Ash 42.4(2011)330  
 Topic: Identity of products of square roots involving three positive numbers  
 Solution: de Gua's theorem 43.4(2012)343
961.  
 Proposer: Andrew Simoson 42.5(2011)407  
 Topic: Proving the difference of two inverse sine functions is a constant  
 Solution: A constant function with arcsin 43.5(2012)411
962.  
 Proposer: Juan-Bosco Romero Márquez 42.5(2011)407  
 Topic: Inequalities involving the inradius and circumradius of a triangle  
 Solution: Inequalities of a non-acute angle 43.5(2012)413
963.  
 Proposer: Duong Viet Thong 42.5(2011)407  
 Topic: Inequality involving definite integrals  
 Solution: An integral inequality 43.5(2012)414
964.  
 Proposer: Jerry Minkus 42.5(2011)408  
 Topic: Identities involving the angles and internal points of a triangle  
 Solution: Equalities with incenter, circumcenter, and orthocenter 43.5(2012)416

965.

Proposer: James Duemmel 42.5(2011)408

Topic: Properties of a sequence formed from a well-known inequality

Solution: Properties of a sequence 43.5(2012)417

966

Proposer: Tahani Fraiwan & Mowaffaq Hajja 43.1(2012)95

Topic: Necessary and sufficient conditions relating to the cevians of a triangle

Solution: Cevians, midpoint and equal areas 44.1(2013)66

967

Proposer: Elias Lampakis 43.1(2012)95

Topic: Prove the tangent lines to a parabola and a polynomial intersect in irrational points

Solution: Irrational intersecting points 44.1(2013)67

968

Proposer: Greg Oman 43.1(2012)95

Topic: Prove or disprove that all members of a ring of monotone functions are constant

Solution: Rings of monotonic functions 44.1(2013)68

969

Proposer: Panagiote Ligouras 43.1(2012)96

Topic: Inequality relating to the sides of a given hexagon

Solution: Hexagon inequality 44.1(2013)69

970

Proposer: Xiang-Qian Chang 43.1(2012)96

Topic: Inequality relating to the traces of a symmetric matrix

Solution: Matrix inequalities 44.1(2013)70

971

Proposer: George Apostolopoulos 43.2(2012)174

Topic: Summation inequality involving 3 variables and their permutations

Solution: An application of the AM-GM inequality 44.2(2013)143

972

Proposer: Elias Lampakis 43.2(2012)174

Topic: Summation inequality involving a finite cyclic sequence

Solution: A lower bound on a sum 44.2(2013)144

973

Proposer: Ion Pătraşcu & Florentine Smarandache 43.2(2012)174

Topic: Identity for the sides of a triangle which is inscribed & circumscribed to circles

Solution: A condition for being a harmonic mean 44.2(2013)144

974

Proposer: Michael Woltermann 43.2(2012)175

Topic: Trigonometric identity involving cosines and inverse cosines

Solution: An expression for  $\cos(2\pi/7)$  44.2(2013)146



975

Proposer: Cezar Lupu 43.2(2012)175

Topic: Common point involving the orthocenters and centroids of triangles inside a hexagon

Solution: Cyclic hexagons, orthocenters and centroids 44.2(2013)147

976

Proposer: D. M. Băţinetu-Giurgiu & Neculai Stanicu 43.3(2012)257

Topic: Inequality involving the semiperimeter, inradius and circumradius of a triangle

Solution: An inequality with a triangle 44.3(2013)234

977

Proposer: Greg Oman 43.3(2012)257

Topic: Proving a property involving subsets which are closed under a given function

Solution: Functions and Countable Sets 44.3(2013)235

978

Proposer: Michel Bataille 43.3(2012)257

Topic: Limits involving the  $n^{\text{th}}$  harmonic number

Solution: A limit with harmonic numbers 44.3(2013)235

979

Proposer: Steven Finch 43.3(2012)258

Topic: Chordal triangle formed from points on a sphere and the probability that it is acute

Solution: The probability of an acute chordal triangle 44.3(2013)237

980

Proposer: George Apostolopoulos 43.3(2012)258

Topic: Finding the angles of a triangle formed from points on a square

Solution: Minimum area of a triangle and its angles 44.3(2013)238

981

Proposer: Michael Bataille 43.4(2012)337

Topic: Inequality involving the inradius and the smallest and largest sides of a triangle

Solution: Largest constant for an inequality of a triangle 44.4(2013)326

982

Proposer: Elias Lampakis 43.4(2012)337

Topic: Inequality involving the orthocenter, the circumradius and altitudes of a triangle

Solution: an inequality in a triangle 44.4(2013)327

983

Proposer: George Apostolopoulos 43.4(2012)337

Topic: Finding triangles of equal area constructed inside a given triangle

Solution: A condition for triangles to have equal area 44.4(2013)327

984

Proposer: D. M. Băţinetu-Giurgiu & Neculai Stanicu 43.4(2012)338

Topic: Inequality involving sums of logarithms

Solution: a logarithmic function inequality 44.4(2013)330

985

Proposer: Greg Oman 43.4(2012)338

Topic: Proving that a certain infinite commutative ring is a principal ideal domain

Solution: Conditions for a principal ideal domain 44.4(2013)331

986

Proposer: D. M. Băţinetu-Giurgiu & Neculai Stanicu 43.5(2012)410

Topic: Inequalities involving sines and cosines of the angles of an acute triangle

Solution: Inequalities with the sine and cosine functions 44.5(2013)438

987

Proposer: Ovidia Furdui 43.5(2012)410

Topic: Limit of the  $n$ th root of an integral involving logarithmic and exponential functions

Solution: A limit converging to  $1/e$  44.5(2013)440

988

Proposer: José Luis Díaz-Barrero 43.5(2012)410

Topic: Inequality involving a set of nonzero real numbers

Solution: Applications of Radon and Bergstrom inequalities 44.5(2013)441

989

Proposer: Yagub N. Aliyev 43.5(2012)411

Topic: Inequalities involving distances from vertices to points on the sides of a triangle

Solution: Inequality for areas of triangles 44.5(2013)442

990

Proposer: Ion Cucurezeanu & Cezar Lupu 43.5(2012)411

Topic: Limit involving the integral of a continuous real valued function on  $[-1,1]$

Solution: A limit with the number of perfect squares 44.5(2013)444

991

Proposer: Ovidu Furdui 44.1(2013)65

Topic: Limits relating to a given sequence

Solution: The limits of two sequences 45.1(2014)58

992

Proposer: D. M. Băţinetu-Giurgiu & Neculai Stanciu 44.1(2013)65

Topic: Sums relating to the inscribed and circumscribed circles of a polygon

Solution: An inequality for a regular polygon 45.1(2014)60

993

Proposer: Michael Woltermann 44.1(2013)66

Topic: Establishing an inequality for the integral of a continuous function

Solution: A concave function inequality 45.1(2014)61

994

Proposer: Elias Lampakis 44.1(2013)66

Topic: Establish an inequality involving the cosines of three angles

Solution: An inequality with cosines 45.1(2014)62

995

Proposer: George Apostolopoulos 44.1(2013)66

Topic: Inequality involving the square root of a sum of products of three fractions

Solution: A constrained inequality 45.1(2014)63

996

Proposer: Perfetti Paolo 44.2(2013)142

Topic: Evaluating a trigonometric integral

Solution: evaluation of an improper integral 45.2(2014)146

997

Proposer: Ovidiu Furdui 44.2(2013)142

Topic: An infinite sum of squares of alternating harmonic series

Solution: An expression of  $\ln 2$  45.2(2014)147

998

Proposer: Elias Lampakis 44.2(2013)142

Topic: Establishing a trigonometric inequality

Solution: An inequality with even powers of sine and cosine 45.2(2014)148

999

Proposer: Cezar Lupu & Ștefan Spătaru 44.2(2013)143

Topic: Inequality involving powers, roots products and sums of two finite sequences

Solution: An application of Poppvocou's theorem 45.2(2014)149

1000

Proposer: Michel Bataille 44.2(2013)143

Topic: Prove that certain set with an associative binary operation is a group

Solution: A sufficient condition for a group 45.2(2014)150

1001

Proposer: Michel Bataille 44.3(2013)233

Topic: Limit of integrals involving a function of sines and cosines

Solution: The limit of the sum of two integrals 45.3(2014)223

1002

Proposer: Mowaffaq Hajja 44.3(2013)233; Corrected 44.5(2013)437; 45.3(2014)224

Topic: Proving the equality of areas of triangles inside a convex quadrilateral

Solution: Area and diagonal bisector of a convex quadrilateral 45.5(2014)394

1003

Proposer: D. M. Băținetu-Giurgiu and Neculai Stanciu 44.3(2013)233

Topic: Inequality involving the lengths of angle bisectors and semiperimeter of a triangle

Solution: An inequality with the angle bisectors of a triangle 45.3(2014)225

1004

Proposer: Ángel Plaza and Sergio Falcón 44.3(2013)234

Topic: Sums of binomial coefficients multiplied by  $(-1)^n$  to a triangular number power

Solution: A combinatorial sum 45.3(2014)227

1005

Proposer: Elias Lampakis 44.3(2013)234

Topic: Summation inequality involving a triangle's inradius, circumradius and excircle radius

Solution: An inequality with the radii of the excircles 45.3(2014)228

1006

Proposer: Greg Oman 44.4(2013)325

Topic: Finding finite commutative rings with only trivial units

Solution: Identifying some finite commutative rings with identity 45.4(2014)319

1007

Proposer: George Apostolopoulos 44.4(2013)325

Topic: Inequality involving three variables and three constants whose product is one

Solution: An inequality with two constraints 45.4(2014)319

1008

Proposer: Cezar Lupo 44.4(2013)325

Topic: Integral inequality involving a differentiable function with a continuous derivative

Solution: An application of Cauchy-Schwarz inequality 45.4(2014)320

1009

Proposer: Valery Karachik 44.4(2013)326

Topic: Finding the limit of a sum of ratios involving a sequence with a known limit

Solution: Evaluating the limit of a sum 45.4(2014)321

1010

Proposer: George Apostolopoulos 44.4(2013)326

Topic: Inequality involving  $n$ th power of a function of three positive numbers

Solution: A collaboration of various inequalities 45.4(2014)322

1011

Proposer: Greg Oman 44.5(2013)437

Topic: Determine if an injective mapping on a group is a homomorphism

Solution: Injective maps and group homomorphisms 45.5(2014)395

1012

Proposer: George Apostolopoulos 44.5(2013)437

Topic: Inequalities involving circumradii and incenters of three triangles

Solution: Inequalities related to circumradius and incenter 45.5(2014)396

1013

Proposer: D. M. Băţinetu-Giurgiu 44.5(2013)437

Topic: Inequalities involving tangents and the inradius and circumradius of a triangle

Solution: Triangle inequalities and the tangent function 45.5(2014)397

1014

Proposer: Luz M. DeAlba 44.5(2013)438

Topic: The inverse points of two circles are not the limit points of their coaxial family

Solution: Coaxial family determined by two circles 45.5(2014)398

1015

Proposer: Michael Goldberg & Mark Kaplan 44.5(2013)438

Topic: Symmetry of median extensions of a triangle with respect to an angle bisector

Solution: Bilateral symmetry 45.5(2014)399

1016

Proposer: Wei-Kai Lai 45.1(2014)57

Topic: Finding the limit of a sum of inner products of vectors in a triangle

Solution: A limit built on a triangle 46.1(2015)62

1017

Proposer: Götz Trenkler & Dietrich Trenkler 45.1(2014)57

Topic: Finding an algebraic expression for a sum of skew symmetric matrices

Solution: Simplifying a matrix expression 46.1(2015)63

1018

Proposer: D. M. Băţinetu-Giurgiu & Neculai Stanicu 45.1(2014)58;  
corrected 45.3(2014)222, 46.1(2015)64

Topic: Inequality involving the inradius of a triangle and one involving the inradius of the sphere of a tetrahedron

Solution: Heights in a triangle 46.3(2015)226

1019

Proposer: George Apostolopoulos 45.1(2014)58

Topic: Proving the orthogonality of circles relating to the diagonals of a parallelogram

Solution: Conditions for orthogonal circles in a parallelogram 46.1(2015)64

1020

Proposer: Elias Lampakis 45.1(2014)58

Topic: Inequality involving the circumradius and inradius of a triangle

Solution: An inequality with semiperimeter, inradius, and circumradius 46.1(2015)65

1021

Proposer: George Apostolopoulos 45.2(2014)145

Topic: Inequality involving the cosines of angles in an acute triangle

Solution: An inequality with cosines on an acute angle 46.2(2015)143

1022

Proposer: Elias Lampakis 45.2(2014)145

Topic: Inequality involving sides and the cosines of angles in an acute triangle

Solution: Another inequality with cosines on an acute triangle 46.2(2015)144

1023

Proposer: George Apostolopoulos 45.2(2014)145

Topic: Identity involving the sides and tangent of one of the angles in a specific triangle

Solution: An identity on a 45-60-75 triangle 46.2(2015)145

1024

Proposer: Ovidiu Furdui 45.2(2014)146

Topic: Powers of integrals equaling integrals of powers of a continuous function

Solution: Conditions for a constant function 46.2(2015)146

1025

Proposer: Yanus Tunçbilek 45.2(2014)146

Topic: Inequality involving positive numbers and their logarithms

Solution: A straight-forward inequality 46.2(2015)146

1026

Proposer: Elias Lampakis 45.3(2014)222

Topic: Inequality involving three positive real numbers

Solution: Another algebraic inequality 46.3(2015)221

1027

Proposer: George Apostolopoulos 45.3(2014)223

Topic: Inequality involving three non-zero real numbers

Solution: Another constrained inequality 46.3(2015)222

1028

Proposer: George Apostolopoulos 45.3(2014)223

Topic: Find the ratio of areas inside a convex quadrilateral

Solution: Areas in a convex quadrilateral 46.3(2015)223

1029

Proposer: José Luis Díaz-Barrero & Ángel Plaza 45.3(2014)223

Topic: Inequality involving Fibonacci and Lucas numbers

Solution: Connecting three sequences 46.3(2015)224

1030

Proposer: Elias Lampakis 45.3(2014)223

Topic: Solving six equations in six non-zero variables

Solution: An interesting system of equations 46.3(2015)225

1031

Proposer: George Apostolopoulos 45.4(2014)318

Topic: Inequality for areas of internal triangle in a triangle and a sum of squares of sides

Solution: An inequality for areas 46.4(2015)301

1032

Proposer: George Apostolopoulos 45.4(2014)318

Topic: Inequality involving sines and cosines of angles in an acute triangle

Solution: A trigonometric inequality 46.4(2015)303

1033

Proposer: Michel Bataille 45.4(2014)318

Topic: Sum of reciprocals of a product of sines of non-multiples of  $\pi$

Solution: A finite trigonometric sum 46.4(2015)304

1034

Proposer: Don Redmond 45.4(2014)319

Topic: Evaluating an integral of even powers of a differentiable function

Solution: Integral of an involution 46.4(2015)305

1035

Proposer: Michel Bataille 45.4(2014)319

Topic: Inequality involving the sides, incenter and an interior point of a triangle

Solution: An inequality for triangles 46.4(2015)306

1036

Proposer: George Apostolopoulos 45.5(2014)393

Topic: Inequality involving three positive real numbers whose product is 1

Solution: An algebraic inequality 46.5(2015)370

1037

Proposer: George Apostolopoulos 45.5(2014)393

Topic: Inequality involving a point inside a triangle and its projections to the sides

Solution: A trigonometric inequality 46.5(2015)371

1038

Proposer: D. M. Băţinetu-Giurgiu & Neculai Stanicu 45.5(2014)393

Topic: Inequality for the area and sides of a triangle and three non-negative real numbers

Solution: An inequality for triangles 46.5(2015)372

1039

Proposer: José Luis Díaz-Barrero 45.5(2014)394

Topic: Inequality involving a finite sequence of positive real numbers whose product is 1

Solution: An inequality in  $n$  variables 46.5(2015)373

1040

Proposer: Michael Goldenberg & Mark Kaplan 45.5(2014)394

Topic: Brocard points and intersections of lines and the circumcircle of a triangle

Solution: Brocard points 46.5(2015)374

1041

Proposer: George Apostolopoulos 46.1(2015)61

Topic: Inequality involving three variables and fifth powers

Solution: An algebraic inequality 47.1(2016)62

1042

Proposer: Ovidiu Furdui 46.1(2015)61

Topic: limit of the  $n$ th root of an integral

Solution: The limit of an integral 47.1(2016)63

1043

Proposer: Peter Nüesch 46.1(2015)61

Topic: Inequality involving the sides, semiperimeter and circumradius of a triangle

Solution: An inequality for triangles 47.1(2016)64

1044

Proposer: Spiros P. Andriopoulos 46.1(2015)62

Topic: Inequality involving the angles (in radians) and sines of the angles of a triangle

Solution: An inequality for the angles of a triangle 47.1(2016)65

1045

Proposer: George Apostolopoulos 46.1(2015)62  
Topic: Inequality involving the medians and inradius of a triangle  
Solution: An inequality for the medians of a triangle 47.1(2016)65

1046

Proposer: Spiros P. Andriopoulos 46.2(2015)142  
Topic: Inequalities involving sines and exponentials  
Solution: Sines and exponentials 47.2(2016)139

1047

Proposer: Spiros P. Andriopoulos 46.2(2015)142  
Topic: Inequality involving products of ratios of sines  
Solution: An  $n$ -fold product of quotients of sines 47.2(2016)141

1048

Proposer: Michel Bataille 46.2(2015)143  
Topic: Find the minimal value of the difference between the sum and product of a sequence of real numbers  
Solution: A sum minus a product 47.2(2016)141

1049

Proposer: Michel Bataille 46.2(2015)143  
Topic: Equivalence of two equations for an orthogonal and a skew symmetric matrix  
Solution: Commuting matrices 47.2(2016)142

1050

Proposer: D. M. Bătinetu-Giurgiu & Neculai Stanicu 46.2(2015)143  
Topic: Inequality of a product of sums involving the sides of a convex  $n$ -gon  
Solution: Convex  $n$ -gons 47.2(2016)143

1051

Proposer: Michel Bataille 46.3(2015)220  
Topic: Finding bounds for a ratio involving reciprocals of a sequence of positive numbers  
Solution: GLB and LUB 47.3(2016)222

1052

Proposer: Michel Bataille 46.3(2015)220  
Topic: Proving a relationship involving a point on a perpendicular bisector in a triangle  
Solution: Projections of the symmetric in a scalene triangle 47.3(2016)223

1053

Proposer: Ovidiu Furdui 46.3(2015)220  
Topic: Proving a property involving a matrix and its transpose  
Solution: A determinant 47.3(2016)224

1054

Proposer: Greg Oman 46.3(2015)221  
Topic: Determining if two rings of sequences are isomorphic  
Solution: Sequences which are ultimately constant 47.3(2016)225



1055

Proposer: D. M. Băţinetu-Giurgiu & Neculai Stanicu 46.3(2015)221

Topic: Relationships of the radii of three inscribed circles of three triangles in a triangle

Solution: Radii of inscribed circles 47.3(2016)226

1056

Proposer: Stan Byrd & Roger Nichols 46.4(2015)300

Topic: Find the coefficients which minimize a definite integral of a cubic polynomial

Solution: Optimizing a cubic polynomial and its integral 47.4(2016)301

1057

Proposer: Spiro P. Andriopoulos 46.4(2015)300

Topic: Inequality involving sums of two converging sequences of integers and their limits

Solution: Estimating an infinite sum 47.4(2016)302

1058

Proposer: George Apostolopoulos 46.4(2015)300

Topic: A string of inequalities involving the cosines and sine of the angles of triangle

Solution: A product of sums of sines and cosines 47.4(2016)303

1059

Proposer: Minh Can 46.4(2015)301

Topic: Inequality involving the sines of the angles of a triangle

Solution: An inequality involving sines 47.4(2016)304

1060

Proposer: George Apostolopoulos 46.4(2015)301

Topic: Inequality involving cosines, circumradius, inradius and semiperimeter of a triangle

Solution: A sum with cotangents 47.4(2016)305

1061

Proposer: Arkady Alt 46.5(2015)369

Topic: Inequality involving two positive real numbers

Solution: An inequality between Hölder and Lehner means 47.5(2016)370

1062

Proposer: D. M. Băţinetu-Giurgiu & Neculai Stanicu 46.5(2015)369; 47.2(2016)138

Topic: Inequalities involving the sides and semiperimeter of a nonisosceles triangle  
Corrected 47.5(2016)372

Solution: More triangle inequalities 48.2(2017)139

1063

Proposer: D. M. Băţinetu-Giurgiu & Neculai Stanicu 46.5(2015)369

Topic: Inequality involving the sides and inradius of a nonisosceles triangle

Solution: An inequality for nonisosceles triangles 47.5(2016)372

1064

Proposer: Mircea Merca 46.5(2015)370; 47.2(2016)138

Topic: Inequality for a sum of cosines of a rational expression involving positive integers  
Corrected 47.5(2016)373

Solution: A sum of cosine powers 48.2(2017)140

1065

Proposer: José Luis Díaz-Barrero José Luis Díaz-Barrero 46.5(2015)370

Topic: Inequalities involving the real parts of sums of sets of complex numbers

Solution: Two inequalities for complex numbers

Corrected 47.5(2016)373

1066

Proposer: George Apostolopoulos 47.1(2016)61

Topic: Identity involving tangents of angles, and the in-and-circum radii of a triangle

Solution: A half-angle identity for triangles 48.1(2017)59

1067

Proposer: Greg Oman 47.1(2016)61

Topic: find all commutative Artinian rings with the only units 1 and  $-1$

Solution: Artinian rings 48.1(2017)60

1068

Proposer: Spiros P.Andriopoulos 47.1(2016)61

Topic: Inequality involving a product of integrals of ratios of continuous positive functions

Solution: A lower bound for a product of integrals 48.1(2017)60

1069

Proposer: Ángel Plaza 47.1(2016)61

Topic: Finding the limit of a recursive sequence in terms of its initial conditions

Solution: A nonlinear recursion 48.1(2017)61

1070

Proposer: Stephen Kaczowski 47.1(2016)62

Topic: Find a closed form of the limit of a sequence involving the sum of powers of a ratio

Solution: A sum with an exponential limit 48.1(2017)62

1071

Proposer: Xiang Qian Chang 47.2(2016)138

Topic: Inequality involving a determinant and its trace

Solution: Trace and determinant 48.2(2017)141

1072

Proposer: Spiros P.Andriopoulos 47.2(2016)139

Topic: Inequality for the sum of a ratio involving powers of three positive numbers

Solution: An inequality with an infinite sum 48.2(2017)142

1073

Proposer: George Apostolopoulos 47.2(2016)139

Topic: Formula for the tangent of the acute angle of the diagonals of a quadrilateral

Solution: Convex quadrilaterals 48.2(2017)142

1074

Proposer: Panagiotis Ligouras 47.2(2016)139

Topic: Two inequalities for expression involving six positive real numbers

Solution: An inequality in six unknowns 48.2(2017)144

1075

Proposer: Elias Lampakis 47.2(2016)139

Topic: Inequality for sums of expressions involving the sides of a triangle

Solution: An inequality for the sides of a triangle 48.2(2017)145

1076

Proposer: D. M. Băţinetu-Giurgiu & Neculai Stanicu 47.3(2016)221

Topic: Inequality involving the sides and circumradius of a triangle

Solution: An inequality for the sides and circumradius of a triangle 48.3(2017)220

1077

Proposer: Spiros P.Andriopoulos 47.3(2016)221

Topic: Inequality for the sum of sequence of a ratio of logarithms

Solution: A sum of logarithms 48.3(2017)221

1078

Proposer: Greg Oman 47.3(2016)221

Topic: Does there exist a well ordered uncountable set a function satisfying an inequality?

Solution: Well-ordered sets 48.3(2017)222

1079

Proposer: Valeriy Karachic & Leonid Menikhes 47.3(2016)222

Topic: Find and prove the limit for the fractional part of a sum of square roots

Solution: The limit of a sum 48.3(2017)223; Correction 49.2(2018)146

1080

Proposer: George Apostolopoulos 47.3(2016)222

Topic: Five inequalities of expressions involving three positive numbers whose sum is three

Solution: A chain of inequalities 48.3(2017)223

1081

Proposer: Michel Bataille 47.4(2016)300

Topic: Finding three numbers that relate to the definite integral of a ratio of polynomials

Solution: A limit of an integral 48.4(2017)293

1082

Proposer: Michael Goldenberg & Mark Kaplan 47.4(2016)300

Topic: Three conjectures involving a hyperbola related to a certain triangle

Solution: A hyperbola tangent to a triangle 48.4(2017)295

1083

Proposer: Alina Sîntămărian 47.4(2016)301

Topic: Find the sum of a ratio of polynomials of integers

Solution: A difference of familiar sums 48.4(2017)296

1084

Proposer: George Apostolopoulos 47.4(2016)301

Topic: Finding the maximum area of a certain triangle

Solution: Maximizing the area of a triangle 48.4(2017)297

1085

Proposer: Eugen J. Ionascu 47.4(2016)301

Topic: Two conjectures involving quadruples of numbers relating to area in a quadrilateral

Solution: A chain of inequalities 48.4(2017)298

1086

Proposer: Michel Bataille 47.5(2016)369

Topic: Constructing a triangle with conditions on its legs with a set square

Solution: A triangle construction 48.5(2017)371

1087

Proposer: Ian Cavey 47.5(2016)369

Topic: Two properties concerning the Center( $n$ ) in a regular  $n$ -gon

Solution: The area of the “center” of a regular polygon 48.5(2017)372

1088

Proposer: Eugen J. Ionascu 47.5(2016)369

Topic: Inequality for the absolute value of the integral of a differentiable function

Solution: Estimating an integral 48.5(2017)373

1089

Proposer: Ángel Plaza 47.5(2016)370

Topic: Proving a string of inequalities in three variables

Solution: A compound Inequality 48.5(2017)375

1090

Proposer: Ovidiu Furdui 47.5(2016)370

Topic: Solving a functional equation in two variables

Solution: A functional equation 48.5(2017)376

1091

Proposer: Ovidiu Furdui 48.1(2017)58

Topic: Condition needed to prove that the sine of a  $2 \times 2$  integral matrix is an integral matrix

Solution: Two-by-two integer matrices 49.1(2018)61

1092

Proposer: Mehtaab Sawhney 48.1(2017)58

Topic: Inequality involving sums of logarithmic terms

Solution: Sums of some logarithms 49.1(2018)62

1093

Proposer: Greg Oman 48.1(2017)58

Topic: Proving the existence of a certain linearly independent subset in a vector space

Solution: Really many conditionally convergent series 49.1(2018)63

1094

Proposer: Mehtaab Sawhney 48.1(2017)59

Topic: Finding quadratic polynomials in powers of a  $2 \times 2$  matrix of quadratic polynomials

Solution: Matrices and quadratic polynomials 49.1(2018)64

1095

Proposer: Keith Kearnes & Greg Oman 48.1(2017)59

Topic: Proving or disproving a statement about countable subsets closed under a function

Solution: Countable closed-under- $f$  subsets implies countable 49.1(2018)66

1096

Proposer: Keith Kearnes & Greg Oman 48.2(2017)138

Topic: Finding commutative rings with identity relating to a set of units in a given ring

Solution: Units of a commutative ring with identity 49.2(2018)141

1097

Proposer: Ovidiu Furdui & Alina Sîntămărian 48.2(2017)138

Topic: Calculating the limit of an integral involving the cosine function

Solution: The limit of an integral 49.2(2018)142

1098

Proposer: Michel Bataille 48.2(2017)138

Topic: Inequality involving sums of hyperbolic functions

Solution: A hyperbolic function inequality 49.2(2018)144

1099

Proposer: Kimberly D. Apple & Eugen J. Ionascu 48.2(2017)139

Topic: Find the maximum number of faces of one color on a two color icosahedron

Solution: Colorings of an icosahedron 49.2(2018)145

1100

Proposer: Mehtaab Sawhney 48.2(2017)139

Topic: Inequality involving three non negative real numbers

Solution: A three-variable inequality 49.2(2018)145

1101

Proposer: Mehtaab Sawhney 48.3(2017)219

Topic: Inequality involving double sums of sequences of real numbers

Solution: An inequality involving sums 49.3(2018)223

1102

Proposer: Mehtaab Sawhney 48.3(2017)219

Topic: Identity involving sums of combinatorial numbers

Solution: A binomial Identity 49.3(2018)225

1103

Proposer: Greg Oman 48.3(2017)220

Topic: Consider the existence of a countable collection of ideals in a polynomial ring

Solution: Ideals of a polynomial ring 49.3(2018)226

1104

Proposer: Greg Oman 48.3(2017)220

Topic: Proving the existence of a pseud-order on a finite field lacking transitivity

Solution: An ordered field minus transitivity 49.3(2018)227

1105

Proposer: Ángel Plaza 48.3(2017)220

Topic: Inequality involving sums of powers of three positive real numbers

Solution: A three-variable inequality 49.3(2018)228

1106

Proposer: Greg Oman 48.4(2017)292

Topic: Finding groups with two generating sets with nonempty intersection

Solution: Groups with intersecting generating sets 49.4(2018)296

1107

Proposer: Mehtaab Sawhney 48.4(2017)292

Topic: Inequality involving a finite polynomial sum with combinatoric coefficients

Solution: A factorial inequality 49.4(2018)297

1108

Proposer: Francisco Javier Garcia Capitán 48.4(2017)292

Topic: Geometry problem involving a triangle and its circle of Apollonius

Solution: Circles of Apollonius 49.4(2018)297

1109

Proposer: Yongge Tian 48.4(2017)293

Topic: Max-min problems involving square matrices

Solution: Bounds on the rank of a sum of matrices 49.4(2018)298

1110

Proposer: Spiros P.Andriopoulos 48.4(2017)293

Topic: Inequality involving a sequence whose limit is given

Solution: A bound of the sum of the terms of a sequence 49.4(2018)300

1111

Proposer: Greg Oman 48.5(2017)370

Topic: Finding a subsequence with an irrational sum from a given convergent sequence

Solution: A subsequence with irrational sum 49.5(2018)372

1112

Proposer: Ovidiu Furdui 48.5(2017)370

Topic: Proving properties of a two by two matrix and the cosh of it

Solution: The hyperbolic cosine of a matrix 49.5(2018)373

1113

Proposer: Ovidiu Furdui 48.5(2017)371

Topic: Finding the limit of the  $n^{\text{th}}$  power of a two by two matrix

Solution: Limit of powers of a matrix 49.5(2018)374

1114

Proposer: Ovidiu Furdui & Alina Sîntămărian 48.5(2017)371

Topic: Finding differentiable functions satisfying a functional equation

Solution: A functional equation solvable as a differential equation 49.5(2018)375

1115

Proposer: Mehtaab Sawhney 48.5(2017)371

Topic: Inequalities involving integrals of exponential functions

Solution: A pair of integral inequalities 49.5(2018)375

1116

Proposer: Mehtaab Sawhney 49.1(2018)60

Topic: Algebraic inequality

Solution: An asymmetric inequality in three variables 50.1(2019)62

1117

Proposer: Ovidiu Furdui 49.1(2018)60; Correction 49.2(2018)140

Topic: Logarithm integral, the Riemann zeta function and Stirling numbers of the first kind

Solution: An inequality in terms of Stirling numbers and the Riemann zeta function 50.1(2019)63

1118

Proposer: Greg Oman 49.1(2018)61

Topic: Finding semigroups without a constant function in a set of differentiable functions

Solution: The set of differentiable functions as a semigroup 50.1(2019)64

1119

Proposer: Spiros Andriopoulos 49.1(2018)61

Topic: Inequality involving an algebraic sum and a logarithmic function

Solution: Estimating an infinite series with a logarithm 50.1(2019)65

1120

Proposer: Johannas Winterink 49.1(2018)61

Topic: Finding the line containing inner and outer centers of Soddy circles

Solution: Soddy circles 50.1(2019)66

1121

Proposer: George Stoica 49.2(2018)140

Topic: Finite sum of even powers of a cosine function

Solution: A trigonometric sum 50.2(2019)144

1122

Proposer: D. M. Băţinetu-Giurgiu & Neculai Stanicu 49.2(2018)141

Topic: Show that the limit of a sum of reciprocals of square roots of integers is the  
Ioachimescu constant 49.2(2018)141

Solution: A limit involving the Ioachimescu constant 50.2(2019)145

1123

Proposer: Michel Bataille 49.2(2018)141

Topic: Finding all functions satisfying a two variable functional equation 49.2(2018)141

Solution: A functional equation 50.2(2019)147

1124

Proposer: Josua Hernández 49.2(2018)141

Topic: Find a closed form for a sum involving combinatorics and reciprocals of integers  
49.2(2018)141

Solution: A sum of two binomial coefficients 50.2(2019)148

1125

Proposer: Greg Oman 49.2(2018)141

Topic: Prove the existence a chain of ideals in a non Noetherian integral domain 49.2(2018)141

Solution: Non-Noetherian commutative integral domains 50.2(2019)149

1126

Proposer: George Stoica 49.3(2018)222

Topic: Verifying that the limit of an infinite product is one

Solution: The limit of an infinite product 50.3(2019)225

1127

Proposer: D. M. Băţinetu-Giurgiu & Neculai Stanicu 49.3(2018)222

Topic: Finding the limit of a sequence involving the Euler and the Ioachimescu constants

Solution: A limit involving the Ioachimescu constant 50.3(2019)226

1128

Proposer: Arthur L. Holshouser & Benjamin G. Klein 49.3(2018)222

Topic: Verifying that two linear expressions involving six variables are relatively prime

Solution: Fractions 50.3(2019)227

1129

Proposer: David M. Bradley 49.3(2018)223

Topic: Show that two given properties characterize the natural logarithm

Solution: A characterization of the natural logarithm 50.3(2019)228

1130

Proposer: Michael Goldberg & Mark Kaplan 49.3(2018)223

Topic: Constructing a sequence of triangles that converge to an equilateral triangle

Solution: A sequence of triangles 50.3(2019)229

1131

Proposer: Yagub Alijev 49.4(2018)295

Topic: Inequality involving a pair of positive integers

Solution: A self-improving approximation to an irrational 50.4(2019)302

1132

Proposer: Paul Bracken 49.4(2018)295

Topic: Finding the closed form of a doubly infinite series

Solution: A double sum 50.4(2019)303

1133

Proposer: Lirk Madsen 49.4(2018)295

Topic: Proving or finding counter example of four claims about a certain metric space

Solution: A metric property between completeness and compactness 50.4(2019)304

1134

Proposer: Greg Oman 49.4(2018)296

Topic: Does an uncountable set and a function satisfying certain conditions exist?

Solution: There is no order preserving function on an uncountable well-ordered set 50.4(2019)305



1135

Proposer: Alan Loper 49.4(2018)296

Topic: Prove or disprove the existence of a certain noncommutative ring

Solution: An infinite noncommutative ring all of whose proper unital subrings are commutative  
50.4(2019)305

1136

Proposer: George Stoica 49.5(2018)371

Topic: Prove that a multiplicative group with commutator and conditions is abelian

Solution: A condition on comutators that implies a group is abelian 50.5(2019)380

1137

Proposer: D. M. Băținetu-Giurgiu & Neculai Stanicu 49.5(2018)371

Topic: Find the limit of an expression involving a sine, an arc sine and roots of factorials

Solution: The limit of a sequence involving sines 50.5(2019)381

1138

Proposer: Souvik Dey 49.5(2018)371

Topic: Prove that a finite commutative ring with condition is a principal ideal ring

Solution: A condition for a ring to be a principal ideal ring 50.5(2019)381

1139

Proposer: Paul Bracken 49.5(2018)371

Topic: Prove that an integral involving powers of a logarithm yields the Riemann zeta function and find the sum of a series involving Stirling numbers of the first kind

Solution: A sum involving Stirling numbers 50.5(2019)382

1140

Proposer: Greg Oman 49.5(2018)372

Topic: Prove that an element from a sequence related to the first uncountable ordinal has both left and right neighbors

Solution: Uncountable ordinals 50.5(2019)384

1141

Proposer: George Stoica 50.1(2019)61

Topic: Finding the number of roots of a certain polynomial

Solution: Real roots of a polynomial 51.1(2020)67

1142

Proposer: Ovidu Furdui & Alina Sîntămărian 50.1(2019)61

Topic: Evaluate the limit of an integral involving powers of sines and cosines

Solution: Wallis integrals and the squeeze theorem to calculate the limit of an integral  
51.1(2020)68

1143

Proposer: George Stoica 50.1(2019)61

Topic: Prove that the lim sup of a ratio of logarithms is one

Solution: A partial harmonic sum 51.1(2020)69

- 1144  
 Proposer: Andrew Wu 50.1(2019)61  
 Topic: Necessary and sufficient conditions concerning parallel lines in a scalene triangle  
 Solution: Co-linear points and parallel lines 51.1(2020)70
- 1145  
 Proposer: Greg Oman 50.1(2019)61  
 Topic: Investigating some properties of a direct product of groups  
 Solution: When does an isomorphic product of groups imply isomorphic groups 51.1(2020)72
- 1146  
 Proposer: John Engbers & Adam Hammett George Stoica 50.2(2019)143  
 Topic: Finite summation identity involving Stirling numbers of the second kind  
 Solution: An identity involving Stirling numbers of the second kind 51.2(2020)147
- 1147  
 Proposer: Souvik Dey 50.2(2019)143  
 Topic: Open subsets in a path connected  $T_1$  topological space  
 Solution: Path connected  $T_1$  spaces 51.2(2020)148
- 1148  
 Proposer: Eugen Ioanescu 50.2(2019)143  
 Topic: Finding and proving the number of points inside a tetrahedron  
 Solution: Integer lattice points in and on a tetrahedron 51.2(2020)148
- 1149  
 Proposer: George Stoica 50.2(2019)144  
 Topic: Equation involving sums containing combinatorial numbers and their reciprocals  
 Solution: A binomial sum identity 51.2(2020)149
- 1150  
 Proposer: Greg Oman 50.2(2019)144  
 Topic: Rings of sequences of real numbers  
 Solution: Non-isomorphic rings of infinite sequences 51.2(2020)151
- 1151  
 Proposer: Gregory Dresden 50.3(2019)224  
 Topic: Finding the highest power of 2 that divides any entry in powers of a 2x2 matrix  
 Solution: Highest power of two dividing an entry of a matrix 51.3(2020)227
- 1152  
 Proposer: Yagoub Aliev 50.3(2019)224  
 Topic: Inequality involving the area and circumradius of a triangle  
 Solution: An inequality for the area of a triangle 51.3(2020)228
- 1153  
 Proposer: Eugen Ionascu 50.3(2019)224  
 Topic: Probability involving equally spaced points on a line segment  
 Solution: Probability of equally spaced points 51.3(2020)229

1154

Proposer: Ovidiu Furdui & Alina Sîntămărian 50.3(2019)224

Topic: Finding the value of derivatives of a product of sine functions for argument zero

Solution: The derivative of a product of sines 51.3(2020)231

1155

Proposer: Greg Oman 50.3(2019)225

Topic: Determining if a field exists satisfying an isomorphism involving a subfield

Solution: There is no field algebraic over the rationals isomorphic to a proper sub field  
51.3(2020)231

1156

Proposer: George Stoica 50.4(2019)301

Topic: Two sums involving a sequence of positive numbers with a ratio of consecutive terms approach a limit of one

Solution: Convergent or divergent? 51.4(2020)307

1157

Proposer: So Mi Lin & Sung Soo Kim 50.4(2019)301

Topic: Convergence comparison test for a sum of terms of a sequence and the sum of a ratio between members of the sequence and its partial sums

Solution: If the sum of terms divided by the partial sums converges, then so does the sum of terms  
51.4(2020)309

1158

Proposer: Digby Smith 50.4(2019)301

Topic: Inequality involving even powers of three positive numbers

Solution: A constrained three-variable inequality 51.4(2020)310

1159

Proposer: Paul Bracken 50.4(2019)302

Topic: An arctangent inequality

Solution: An arctan inequality 51.4(2020)311

1160

Proposer: Ángel Plaza & Pedro Jesús Rodríguez de Rivera 50.4(2019)302

Topic: Finding the limit of a sum of a sum involving combinatorics

Solution: A limit of a double sum of Binomial coefficients 51.4(2020)311

1161

Proposer: Jathan Austin 50.5(2019)379

Topic: Proving vectors of primitive Pythagorean triples are linearly independent

Solution: Primitive Pythagorean triples 51.5(2020)387

1162

Proposer: Dennis S. Bernstein, Adam Bruce & Omran Kouba 50.5(2019)379

Topic: Inequality involving three real numbers between 0 and 1

Solution: One inequality implies another 51.5(2020)388

1163

Proposer: Ovidiu Furdui & Alina Sîntămărian 50.5(2019)379

Topic: Finding continuous functions satisfying an integral equation

Solution: An integral equation 51.5(2020)388

1164

Proposer: George Stoica 50.5(2019)380

Topic: Inequality involving a double integral of a Riemann integrable function

Solution: An integral inequality implies a function is identically zero 51.5(2020)390

1165

Proposer: George Stoica 50.5(2019)380

Topic: Necessary and sufficient conditions for the sum of powers of a given sequence

Solution: When is a sum of powers independent of the power? 51.5(2020)390

1166

Proposer: Greg Oman 51.1(2020)66

Topic: Existence of values in a left-Noetherian ring satisfying an equality

Solution: An equation in a Noetherian ring 52.1(2021)65

1167

Proposer: Paul Bracken 51.1(2020)66

Topic: Proving the give values of three infinite sums are correct

Solution: A family of sums of binomials 52.1(2021)66

1168

Proposer: George Stoica 51.1(2020)66

Topic: Proving an identity in a Hilbert space

Solution: An inequality in a Hilbert space 52.1(2021)68

1169

Proposer: Adam Hammett & Lindsey McCarty 51.1(2020)67

Topic: Finding where any extreme values occur for a bivariate function on a given quarter plane

Solution: Extrema of a function of two variables 52.1(2021)69

1170

Proposer: Rick Mabry 51.1(2020)67

Topic: Show given comparison of two quadrilaterals exist if and only if they are parallelograms

Solution: A quadrilateral in a quadrilateral 52.1(2021)69

1171

Proposer: George Apostplopoulos 51.2(2020)146

Topic: Finding the value of a sum of squares of ratios of the roots of a cubic equation

Solution: Roots of a cubic equation 52.2(2021)144

1172

Proposer: Xiang-Qian Chang 51.2(2020)146

Topic: Verify the behavior of the solution on a non-linear differential equation near infinity

Solution: Asymptotic behavior of the solution of a first-order difference equation 52.2(2021)145

1173

Proposer: Greg Oman 51.2(2020)146

Topic: Investigating the existence of an integral domain integral over a given integral domain

Solution: An infinite integral domain has the same cardinality as the set of units of an integral domain which is integral over it 52.2(2021)146

1174

Proposer: George Stoica 51.2(2020)147

Topic: Proving the convergence of an infinite product and finding its value

Solution: Criterion for convergence of an infinite product 52.2(2021)146

1175

Proposer: George Stoica 51.2(2020)147

Topic: Determine if there is a field isomorphism preserving signs in two sub-fields

Solution: Nonexistence of a sign-preserving field isomorphism between distinct proper subfields of the reals 52.2(2021)148

1176

Proposer: Xiang-Qian Chang 51.3(2020)225

Topic: Inequality involving traces of powers of an Hermitian matrix

Solution: An inequality involving the trace 52.3(2021)229

1177

Proposer: Ovidu Furdui & Alina Sîntămărian 51.3(2020)225

Topic: Finding functions that satisfy an integral equation

Solution: {See Problem 1163} An integral equation 51.5(2020)388; 52.3(2021)230

1178

Proposer: Cezar Lupo 51.3(2020)225

Topic: Inequalities involving the radius of the circumcircle of a triangle

Solution: Circles internally tangent to two sides of a triangle and the circumcircle 52.3(2021)230

1179

Proposer: Greg Oman 51.3(2020)226

Topic: Proving existence and uniqueness of certain ideals in an infinite ring with identity

Solution: Small maximal ideals 52.3(2021)231

1180

Proposer: Luke Harmon 51.3(2020)226

Topic: Proving existence of ideals with certain properties in a commutative ring with identity

Solution: Ideals in ideals 52.3(2021)232

1181

Proposer: Ovidu Furdui & Alina Sîntămărian 51.4(2020)305

Topic: Limit problems for integrals involving  $n$ th roots of  $x$  over the unit interval

Solution: Two limits of integrals 52.4(2021)307

1182

Proposer: Adam Hammett 51.4(2020)305

Topic: Questions of convergence and inequalities of a power series of a given sequence

Solution: The edge of convergence 52.4(2021)310

1183

Proposer: Eugen Ionascu 51.4(2020)306

Topic: Showing the existence of inequalities of sums of odd integers placed around a circle

Solution: Circular sums 52.4(2021)312

1184

Proposer: Seán Stewart 51.4(2020)306

Topic: Double integral involving a product of sine functions

Solution: A double integral of a product 52.4(2021)314

1185

Proposer: Greg Oman 51.4(2020)306

Topic: Determining if a certain special subring exists in a commutative ring with unity

Solution: The non-existence of 'special' rings 52.4(2021)315

1186

Proposer: Gregory Dresden & Zhen Shu Luan 51.5(2020)386

Topic: Finding a closed form expression for a given continued fraction

Solution: A continued fraction given by Fibonacci 52.5(2021)389

1187

Proposer: Reza Farhadian 51.5(2020)386

Topic: Proving the limit of an expression involving  $n$ th roots of a product of maximal functions

Solution: A limit of maxima 52.5(2021)390

1188

Proposer: Ángel Plaza 51.5(2020)386

Topic: Finding the value of a limit involving a definite integral of a sine function with upper entry of the integral a sequence of functions and proving a related logarithmic identity

Solution: A recursively defined sequence of trigonometric functions 52.5(2021)393

1189

Proposer: Seán Stewart 51.5(2020)387

Topic: Evaluating an infinite sum involving harmonic numbers

Solution: A sum of harmonic sums 52.5(2021)394

1190

Proposer: George Stoica 51.5(2020)387

Topic: Finding solutions to a second order non-linear differential equation

Solution: A second-order differential equation 52.5(2021)396

1191

Proposer: Herb Bailey 52.1(2021)64; Correction 52.3(2021)227

Topic: Show a necessary and sufficient condition that the triangle formed by a point on one of the sides of an isosceles triangle, its incenter and circumcenter form an equilateral triangle

Solution: An equilateral triangle in an isosceles triangle 53.1(2022)70

1192

Proposer: Greg Oman 52.1(2021)64

Topic: Proving the existence of a finite commutative ring with zero diisors

Solution: Ubiquitous zero divisors without nontrivial nilpotent elements implies infinite  
53.1(2022)73

1193

Proposer: George Stoica 52.1(2021)64; Correction 52.3(2021)227

Topic: See problem 1188

Solution: A function that is a polynomial over the rationals in each slot separately need not be a  
polynomial over  $\mathbb{Q}^2$  53.1(2022)74

1194

Proposer: Andrew Simoson 52.1(2021)65

Topic: Two inequalities involving two integers

Solution: A two-variable inequality over the integers 53.1(2022)74

1195

Proposer: Marián Štofka 52.1(2021)65

Topic: Infinite sum involving generalized harmonic numbers

Solution: A sum of harmonic sums 53.1(2022)75

1196

Proposer: Ferenc Beleznay & Daniel Hwang 52.2(2021)142

Topic: For an integer  $n$ , does there exist a polynomial whose graph is tangent to some circle at  $n$   
points

Solution: Polynomials of degree  $n$  tangent to a circle at  $n - 1$  points 53.2(2022)154

1197

Proposer: Valery Karachic & Leonid Menikhes 52.2(2021)142

Topic: Problem involving a matrix with a column removed

Solution: Matrices with persistently unequal rows 53.2(2022)156

1198

Proposer: Alan Loper & Greg Oman 52.2(2021)142

Topic: Determining the number of maximal ideals of a ring of polynomials

Solution: The cardinality of a set of maximal ideals 53.2(2022)157

1199

Proposer: Corey Shanbrom 52.2(2021)143 Correction 52,4(2021)324

Topic: Find a smooth oscillating function with periods forming a bi-finite geometric sequence

Solution: An oscillating function with prescribed zeros 53.2(2022)158

1200

Proposer: Russ Gordon & George Stoica 52.2(2021)143

Topic: Show a sequence defined by a generating function satisfies a given difference equation

Solution: A recurrence satisfied by a sequence with a given generating function 53.2(2022)159

1201

Proposer: Eugen Ioanescu 52.3(2021)228

Topic: Expected value related to an ellipse formed by a plane intersecting an ellipsoid

Solution: The intersection of an ellipsoid and a plane 53.3(2022)239

1202

Proposer: Cezar Lupu 52.3(2021)228

Topic: Proving the square of the adjoint of a non-invertible matrix is the zero matrix

Solution: A condition on two square matrices forcing the adjugate of one of them to be zero  
53.3(2022)241

1203

Proposer: Greg Oman 52.3(2021)228

Topic: Two questions concerning a sum free subset of the integers

Solution: Sum-free sets 53.3(2022)242

1204

Proposer: George Stoica 52.3(2021)228

Topic: Showing the integrals of the product of a continuous function with the real and the imaginary parts of a complex polynomial along a smooth curve are zero

Solution: An integral along a curve 53.3(2022)243

1205

Proposer: George Stoica 52.3(2021)228

Topic: Proving a certain associative prime ring is commutative

Solution: A condition causing a prime ring to be commutative 53.3(2022)244

1206

Proposer: Seán M. Stewart 52.4(2021)396

Topic: Summation problem involving the product of triangle, harmonic and Fibonacci numbers

Solution: Harmonic, Fibonacci and triangular numbers 53.4(2022)320

1207

Proposer: Ovidiu Furdui & Alina Sîntămărian 52.4(2021)396

Topic: Proving a triple summation yields two Riemann zeta functions

Solution: A sum of products of sums 53.4(2022)321

1208

Proposer: Marián Štofka 52.4(2021)397

Topic: Proving an integral involving a product of logarithm functions yields a zeta function

Solution: No solution will appear as the problem appeared in the May 2021 issue of the Monthly.

Solution: However: An integral of logarithms 53.4(2022)323

1209

Proposer: George Stoica 52.4(2021)397

Topic: Establishing the rank of all sub matrices of an infinite matrix with given sequence entries

Solution: The rank of a matrix 53.4(2022)324

1210

Proposer: Greg Oman 52.4(2021)397

Topic: Determining the existence of a certain integral domain and a special collection of ideals

Solution: The existence of a countable commutative integral domain with a sum-free collection of ideals 53.4(2022)325



1211

Proposer: Necdet Batir 52.5(2021)388

Topic: Find the limit of a sequence involving harmonic numbers

Solution: The limit of a difference of harmonic sums 53.5(2022)401

1212

Proposer: Paul Bracken 52.5(2021)388

Topic: Prove that the sums given involving trigonometric expressions are correct

Solution: Two trig sum identities 53.5(2022)403

1213

Proposer: Rafael Jakimczuk 52.5(2021)389

Topic: Find the limit of a product of factors involving a given sequence

Solution: The limit of a product of powers of sums 53.5(2022)405

1214

Proposer: Luis Moreno 52.5(2021)389

Topic: Find a closed form expression for the Olmstead sequence

Solution: A closed form expression for a sequence 53.5(2022)405

1215

Proposer: Greg Oman 52.5(2021)389

Topic: Problem involving finding all rings with special subring conditions

Solution: Rings for which no proper subring has an identity 53.5(2022)406

1216

Proposer: Oluwatobi Alabi 53.1(2022)69

Topic: Problem involving tiling a square with rectangles

Solution: Tiling a square with small squares and narrow rectangles 54.2(2023)148

1217

Proposer: Eugen Ionascu 53.1(2022)69

Topic: Prove the existence of a function,  $f(x)$  satisfying an integral equation; and express it in terms of elementary and that  $f^k(0)$  is related to Fibonacci numbers

Solution: Fibonacci numbers from the solution to an integral equation 54.2(2023)150

1218

Proposer: Ángel Plaza 53.1(2022)70

Topic: Expressing polynomials in terms of Pell and Pell-Lucas numbers

Solution: Pell numbers and Pell-Lucas numbers 54.2(2023)152

1219

Proposer: Greg Oman 53.1(2022)70

Topic: Proving necessary and sufficient conditions that a ring with a product of ideals is a field

Solution: A criterion for a commutative ring to be a field 54.2(2023)153

1220

Proposer: Jeff Stuart 53.1(2022)70

Topic: Proving three statements concerning the cofactors of a matrix

Solution: Cofactors of cofactors 54.2(2023)154

1221

Proposer: Gregory Dresden 53.2(2022)152

Topic: Finding areas in polar graphs of various sine functions

Solution: Area of a polar graph 54.2(2023)154

1222

Proposer: Kent Holing 53.2(2022)153

Topic: Showing several properties of a given parabola

Solution: Properties of a general parabola 54.2(2023)156

1223

Proposer: Don Redman 53.2(2022)153

Topic: Prove solutions exist for an equation involving the rectangular of order  $h$  of an integer

Solution: Which rectangular numbers are squares - again? 54.2(2023)158

1224

Proposer: George Stoica 53.2(2022)153

Topic: Proving that a certain finite group is cyclic

Solution: A criterion for a group to be cyclic 54.2(2023)159

1225

Proposer: Greg Oman 53.2(2022)153

Topic: Two problems involving chained rings

Solution: A reduced ring with all subrings chained is a field 54.2(2023)159

1226

Proposer: George Apostolopoulos 53.3(2022)237

Topic: Inequality with three variables involving a logarithm

Solution: An easy logarithmic inequality 54.3(2003)238, 4.4(2023)395

1227

Proposer: Albert Nation 53.3(2022)237

Topic: Determine if two functions exist which satisfy two given conditions involving inequalities

Solution: Nonexistence of a pair of functions with intertwined inequalities 54.3(2003)238, 54.4(2023)396

1228

Proposer: Greg Oman 53.3(2022)237

Topic: Finding commutative rings with a multiplicative function and satisfying two properties

Solution: Rings with few multiplicative maps are rare 54.3(2003)239, 54.4(2023)396

1229

Proposer: George Stoica 53.3(2022)238

Topic: Necessary and sufficient conditions that the spectral radius of a matrix is less than 1.

Solution: A bound on the spectral radius of a matrix 54.3(2003)240, 54.4(2023)397

1230

Proposer: Jason Zimba 53.3(2022)238

Topic: Show an infinite number of Heronian triangles have equivalent rectangles

Solution: Primitive Heronian triangles with equivalent rectangles 54.3(2003)241, 54.4(2023)398

1231

Proposer: George Apostolopoulos 53.4(2022)319

Topic: Inequality for a sum of a product of sine and cosine for an angle in a triangle

Solution: An inequality for the angles of a triangle 54.4(2023)401

1232

Proposer: Jacob Guerra 53.4(2022)319

Topic: Problem involving Catalan numbers and complex polynomials

Solution: The Catalan numbers 54.4(2023)401

1233

Proposer: Albert Nation 53.4(2022)319

Topic: Prove two random variable are uniform over  $[0,1]$

Solution: Uniform random variables 54.4(2023)402

1234

Proposer: Moubinool Omarjee 53.4(2022)320

Topic: Finding the limit of a difference of two sums of inverse powers of integers

Solution: The limit of a quotient of sequences defined by sums 54.4(2023)403

1235

Proposer: Greg Oman 53.4(2022)320

Topic: Finding structures of a Set and a function where the set is not finitely generated

Solution: Non-finitely generated sets whose proper subsets closed under a given function are all finitely generated 54.4(2023)404

1236

Proposer: Tran Quang Hung 53.5(2022)400

Topic: Finding the centroid of special tetrahedron

Solution: The centroid of a tetrahedron 54.5(2023)493

1237

Proposer: Tran Quang Hung 53.5(2022)401

Topic: Summation equality involving  $2n$ -regular polygons

Solution: Two polygons 54.5(2023)495

1238

Proposer: Jacob Siehler 53.5(2022)401

Topic: Finding the average area relating to a square and a copy of itself

Solution: Rotated squares 54.5(2023)496

1239

Proposer: Moubinool Omarjee 53.5(2022)401

Topic: Find a closed form for a non-linear recurrence relation

Solution: An explicit formula for a sequence from a recursion 54.5(2023)497

1240

Proposer: Eden Ketchum & Greg Oman 53.5(2022)401

Topic: Problem involving a field and its multiplicative subgroups

Solution: Fields for which the collection of additive subgroups and the collection of multiplicative subgroups are isomorphic 54.5(2023)498

1241

Proposer: Reza Farhadian 54.1(2023)70

Topic: Inequality involving  $n$ th roots of sums of members of a sequence between 0 and 1

Solution: \*\*\*\*\*

1242

Proposer: Adam Glessner 54.1(2023)70

Topic: Transcendental equation involving the arcsine and exponential functions

Solution: \*\*\*\*\*

1243

Proposer: Cezar Lupu 54.1(2023)70

Topic: Inequality involving the square of an integrable function

Solution: \*\*\*\*\*

1244

Proposer: Albert Natian 54.1(2023)71

Topic: Prove that the fractional part of a random variable is uniformly distributed over  $[0,1]$

Solution: \*\*\*\*\*

1245

Proposer: George stoica 54.1(2023)71

Topic: Proving that a polynomial involving two sequences has real roots

Solution: \*\*\*\*\*

1246

Proposer: Cezar Lupu 54.2(2023)147

Topic: Inequality involving the square of an integrable function

Solution: \*\*\*\*\*

1247

Proposer: Moubinool Omarjee 54.2(2023)147

Topic: Finding the limit of the  $n$ th power of a sequence of sums of reciprocals

Solution: \*\*\*\*\*

1248

Proposer: Greg Oman 54.2(2023)147

Topic: Finding all special rings having at least two distinct proper ideals

Solution: \*\*\*\*\*

1249

Proposer: Dadier Pinchon & George Stoica 54.2(2023)148

Topic: Prove that the sum of products of a given sequence is a binomial number

Solution: \*\*\*\*\*

1250

Proposer: Jeff Stuart 54.2(2023)148

Topic: Showing three properties of the determinant of a matrix with complex entries

Solution: \*\*\*\*\*

1251

Proposer: Cezar Lupu 54.4(2023)394

Topic: Proving a factor of a sum of powers of a matrix

Solution: \*\*\*\*\*

1252

Proposer: Narendra Bhandari 54.4(2023)394

Topic: Showing an infinite sum involving a product of binomial expressions is  $1/\pi$

Solution: \*\*\*\*\*

1253

Proposer: Reza Farhadian 54.4(2023)394

Topic: Find the limit of a product involving a ratio of 2 sums of real number powers of integers

Solution: \*\*\*\*\*

1254

Proposer: Ovidiu Furdui & Alina Sîntămărian 54.4(2023)395

Topic: Finding the limit of an integral of the  $n^{\text{th}}$  power of a binomial expression

Solution: \*\*\*\*\*

1255

Proposer: Albert Natian 54.4(2023)395

Topic: Computing the expected value two minimal expressions

Solution: \*\*\*\*\*

1256

Proposer: Greg Oman 54.4(2023)400

Topic: Finding fields and F-vector spaces with any two bases having non-empty intersections

Solution: \*\*\*\*\*

1257

Proposer: Toyesh Prakash Sharma 54.4(2023)400

Topic: Double integral involving the logarithmic function

Solution: \*\*\*\*\*

1258

Proposer: Alaric Pow Ian-Jun 54.4(2023)400

Topic: Identity involving the ratio of a sum of cosines over a sum of sines

Solution: \*\*\*\*\*

1259

Proposer: Antonio Garcia 54.4(2023)400

Topic: Inequality involving sums of products of roots involving three nonnegative numbers

Solution: \*\*\*\*\*

1260

Proposer: Nick Fiala & Greg Oman 54.4(2023)401

Topic: Proving that in finite negative power division rings with more than 2 elements, all elements have additive inverses

Solution: \*\*\*\*\*

1261

Proposer: Brian Bradie 54.5(2023)492

Topic: Infinite integral involving the arctangent function

Solution: \*\*\*\*\*

1262

Proposer: George Apostolopoulos 54.5(2023)492

Topic: Inequality involving the circumradius and the inradius of a triangle

Solution: \*\*\*\*\*

1263

Proposer: Marius Munteanu 54.5(2023)492

Topic: Find all solutions of a quintic polynomial equation with constant term between 0 and 1

Solution: \*\*\*\*\*

1264

Proposer: Stanescu Florin 54.5(2023)492

Topic: Proving that a certain finite group of order at least 3 is abelian

Solution: \*\*\*\*\*

1265

Proposer: Narendra Bhandari 54.5(2023)493

Topic: Double sum involving the Riemann zeta function

Solution: \*\*\*\*\*

\*\*\*\*\*