



The ProbLemma's Channel Season 3 Guide

Season 3 Episode 1: The Index Of Tools

- All the problem-solving approaches studied so far, across seasons 1 and 2, are indexed by the episodes in which they were defined and practiced

Season 3 Episode 2: An Integral Transformation

- Problem **S3M1** solved, show that for all θ , x real, with $x > 1$, and $n = 1, 2, 3, 4, 5 \dots$ it is the case that:

$$\int_0^\pi \left(x + \sqrt{x^2 - 1} \cos(\theta) \right)^n d\theta = \int_0^\pi \frac{d\theta}{\left(x - \sqrt{x^2 - 1} \cos(\theta) \right)^{n+1}}$$

- Problems **S3M2/3/4** formulated:
 - Problems **S3M2/3/4**: deduce in at least 3 distinct ways an alternative expression (a product) for the following finite sum:

$$\sum_{k=0}^n \cos(a + k\theta)$$

Season 3 Episode 3: One Telescope, Two Telescopes

- Problem **S3M2** solved

Season 3 Episode 4: A Complex Approach

- Problem **S3M3** solved

Season 3 Episode 5: Euclid Says

- Problems **S3M4** solved
- Problem **S3P1** formulated:
 - **S3P1**: find the period of oscillation of a triangular spring oscillator

Season 3 Episode 6: Triangular Spring Oscillator

- Problem **S3P1** solved
- Problem **S3CS1** formulated:
 - **S3CS1**: sort 3 integers creatively, without the popular containers and/or industrial strength algorithms

Season 3 Episode 7: 3-Integer Sort, A Discovery

- Problem **S3CS1** solved

- Problem **S3M5** formulated:
 - **S3M5**: construct a point, N, inside of a right triangle, ABC, such that the magnitudes of all the angles NAB, NBC and NCA are all equal one another

Season 3 Episode 8: Brocard Points Introduction

- Problem **S3M5** solved
- Problem **S3M6** formulated:
 - **S3M6**: invent a way to evaluate finite sums based on a popular approach that is used in combinatorial analysis to prove binomial identities

Season 3 Episode 9: Summation By Double-Counting

- Problem **S3M6** solved
- Problem **S3P2** formulated:
 - **S3P2**: find the distance covered by a bouncing material point

Season 3 Episode 10: Infinity In Physics

- Problem **S3P2** solved
- Problem **S3CS2** formulated:
 - **S3CS2**: suggest a Turing Machine-friendly algorithm for testing if a given point is located outside or inside of a given triangle

Season 3 Episode 11: A Point-in-triangle Detection Algorithm

- Problem **S3CS2** solved
- Problem **S3M7** formulated:
 - **S3M7**: find a way to integrate a binomial differential $x^m(a + bx^n)^p dx$

Season 3 Episode 12: Integration Of Binomial Differentials

- Problem **S3M7** solved
- Problem **S3M8** formulated:
 - **S3M8**: use the integration of binomial differentials machinery developed in the previous problem in order to evaluate the following infinite sum:

$$\sum_{n=1}^{+\infty} \frac{1}{n(n+1)(n+2)\dots(n+p)}, \quad p \geq 2$$

Season 3 Episode 13: Binomial Differentials Slay Infinite Sums Before Breakfast

- Problem **S3M8** solved
- Problem **S3P3** formulated:
 - **S3P3**: distinguish a sphere from an identical ball of same radius and mass

Season 3 Episode 14: Sisyphus Versus Spherical Chickens Of Uniform Density

- Problem **S3P3** solved
- Problem **S3CS3** formulated:
 - **S3CS3**: construct a single-pass algorithm for sorting **0s** and **1s**

Season 3 Episode 15: Single-pass Janus Sort

- Problem **S3CS3** solved
- Problem **S3M9** formulated:
 - **S3M9**: construct an equilateral triangle on 3 parallel straight lines

Season 3 Episode 16: An Equilateral Triangle On 3 Parallel Straight Lines Construction

- Problem **S3M9** solved
- Problem **S3M10** formulated:
 - **S3M10**: reconstruct a square given 4 points that belong to one side of that square each

Season 3 Episode 17: 4-Point Square Reconstruction

- Problem **S3M10** solved
- Problem **S3P4** formulated:
 - **S3P4**: find the normal and the tangential accelerations as functions of time of a point that moves along a parabola with its acceleration vector staying parallel to the y -axis at all times

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| S3M4 | Season 3 Episode 2 | Season 3 Episode 5 |
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