



# 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  $\theta$ ,  $x$  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

## The ProbLemma's Channel Season 3 Index

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| S3M3           | <a href="#">Season 3 Episode 2</a>  | <a href="#">Season 3 Episode 4</a> |
| S3M4           | <a href="#">Season 3 Episode 2</a>  | Season 3 Episode 5                 |
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| S3CS1          | Season 3 Episode 6                  | Season 3 Episode 7                 |
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| S3CS3          | Season 3 Episode 10                 | Season 3 Episode 11                |
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| S3M10          | Season 3 Episode 12                 | Season 3 Episode 13                |
| S3P4           | Season 3 Episode 13                 | Season 3 Episode 14                |
| S3CS4          | Season 3 Episode 14                 | Season 3 Episode 15                |
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