# Math Problems

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# Chapter 1

# Partial Sums

## 1.1 Partial Sum Order 0

Find a closed-form expression in $n$ such that

$$f(n) = 1 + 1 + 1 + \cdots + 1 \tag{1.1.1}$$

Note: in the above equation, there are $n$ 1's.

## 1.2 Partial Sum Order 1

Find a closed-form expression in $n$ such that

$$f(n) = 1 + 2 + 3 + \cdots + n \tag{1.2.1}$$

## 1.3 Partial Sum Order 2

Find a closed-form expression in $n$ such that

$$f(n) = 1^2 + 2^2 + 3^2 + \cdots + n^2 \tag{1.3.1}$$

## 1.4 Partial Sum Order $n$

Find a closed-form expression in $n$ such that

$$f(n) = 1^n + 2^n + 3^n + \cdots + n^n \tag{1.4.1}$$

## 1.5 Partial Sum of $n^n$

Find a closed-form expression in $n$ such that

$$f(n) = 1^1 + 2^2 + 3^3 + \cdots + n^n \tag{1.5.1}$$

# Chapter 2

# Gary Larson's Recommended Problems

## 2.1 Hypatia's Problem

Given two integers $a$ and $b$, find integer values for $x$ and $y$ such that

$$(x - y) = a \tag{2.1.1}$$

$$x^2 - y^2 = (x - y) + b \tag{2.1.2}$$

## 2.2 Ramp

Describe a ramp such that a ball will reach the bottom in the same amount of time no matter where its starting position is.

## 2.3 Factor a 15th Order Polynomial

Factor the polynomial

$$x^{15} + 1 \tag{2.3.1}$$

into two polynomials of order 6 and order 9, like so:

$$(a_6x^6 + a_5x^5 + \cdots + a_0)(b_9x^9 + b_8x^8 + \cdots + b_0) \tag{2.3.2}$$