

Marathon Math Problems - Week 5

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*Nim* is a game played between two players. The game begins with three piles of matches; pile 1 which has 1 marble, pile 2 which has 2 marble, and pile 3 which has 4 marbles. The players take turns removing one or more marbles from a SINGLE pile. The goal of the game is to be the one to remove the last marble.

You should write all answers on a *separate sheet of paper*.

**Problem 1**

Assume there are two piles left, a 1 marble pile and a 3 marble pile. It is your move. What should you do to make sure you win the game? Explain your reasoning. (Test it by playing!)

**Problem 2**

In the full game of Nim, would you rather go first or second? What is your strategy to ensure victory? (Test it by playing!)

**Problem 3**

The letters A, B, and C each represent a *different* digit between 1 and 9. Find the largest possible value of the sum

$$ABC + BAC + CBA.$$

Explain your reasoning.

## Marathon Math Problems - Week 6

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*Min* is based on the game *Nim* that we played last week. The only difference is that in order to win a game of *Min*, you must force your opponent to take the final marble. The game begins with three piles of marbles; pile one which has 1 marbles, pile two which has 2 marble, and pile three which has 4 marbles. The players take turns removing one or more marbles from a SINGLE pile.

You should write all answers on a *separate sheet of paper*.

### **Problem 1**

Assume there are two piles left, a 1 marble pile and a 3 marble pile. It is your move. What should you do to make sure you win the game? Explain your reasoning. (Test it by playing!)

### **Problem 2**

Make a table with all of the possible two-pile arrangements going down one column. In the next column, record what you think the result will be *for the player whose turn it is*, assuming both players play perfectly.

### **Problem 3**

In the full game of *Min*, would you rather go first or second? What is your strategy to ensure victory? (Test it by playing!)

Marathon Math Problems - Week 7

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*Oddly* is a game similar to *Nim* and *Min*. In *Oddly*, the game begins with three piles of marbles—a 1 marble pile, a 3 marble pile, and a 5 marble pile. Players take turns removing any number of marbles from a single pile. *The goal of the game is to be the player who has collected an odd number of marbles at the end of the game.*

You should write all answers on a *separate sheet of paper*.

**Problem 1**

Assume there are two piles left, a 2 marble pile and a 3 marble pile. It is your move. So far you have collected 2 marbles, and your opponent has collected 2. What is your best move? How can you win the game from here?(Test it by playing!)

**Problem 2**

Play at least 5 games of *Oddly* where you make the first move, and at least 5 games where you make the second move. Would you rather go first or second? What is your strategy?

**Problem 3**

Write down the rules to your own *Nim*-like game, and play it at least twice. You could change the number of players, the goal of the game, the number of piles, or anything else you can think of.