



# Nim With Factors

**Math Concepts:** Division, factors

**Materials:** None

**Players:** 2

**Set up:** A starting number, say 50, is agreed upon by the two players. One of the players is allowed to choose whether to go first or second.

**Play:** On a turn, a player is allowed to subtract from the current number any one of its factors. For example, if the current number is 50, then the player may subtract any one of 1, 2, 5, 10, or 25 to produce the new working number of 49, 48, 45, 40, or 25.

**Goal:** Win by forcing the other player to subtract to 0.

## – DISCUSSION AND TIPS –

Discuss student strategies for this game.

Let your students play for a long time before looking at the best way to play this game. As with other versions of Nim, a lot can be learned by the basic problem solving strategy of learning from smaller examples - which player will win when the starting number is 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10? What is the pattern and why does it happen?

The winning strategy is surprisingly simple: You will win if you have an even number, and lose if you have an odd number. This is because if you have an even number, you can always subtract 1 (or any other odd divisor) to give the other player an odd number. If you have an odd number, it only has odd divisors, so you must subtract an odd number, which will give the other player an even number.