

## Mathematical Dominoes Rules

### *Rules*

Math Dominoes is a team (or individual) contest in problem-solving. The game is played by several teams of 2 players each. Each team work on problems at its own pace, selecting problem one-by-one from the pool of available problems.

Math Dominoes problems are written on back sides of two-sided cards. The front side of each problem card looks like a domino tile: it has a pair of numbers (domino value) on it. At the start of a game, the circle leader arranges all the cards with problems on the judge's table. The cards are placed dominoes-side up; therefore, the actual problems are hidden from students. Teams start working on the problems at their own pace, selecting problem one-by-one from the pool of available problems. The numbers on the dominoes side of a problem card serve as a predictor of the difficulty level of the problem on this card.

A team earns (or loses) points depending on whether it was able to solve the selected problem. The scoring system works as follows:

- If a team presents the correct solution on the first try, this team is awarded a full score for the problem. The full score is equal to the sum of the two numbers on the domino side of the problem card. For example, if the card shows [5:3] then the team gets  $5+3=8$  points for the successful first try.
- If a team solves the problem on the second try, this team is awarded a partial score, which is equal to the larger of the two numbers on the domino side of the problem card. For example, if the card shows [5:3] then the team gets 5 points for the problem solved on the second try.
- If the answer presented on the second try was incorrect, the team loses points. The penalty is equal to the smaller of the two numbers on the domino side of the card. For example, a team loses 3 points if it failed to solve a [5:3] problem.

- A [0:0] card is special. A team can present the problem on this card just once. The correct solution brings in 10 points, an incorrect answer is not penalized.

After the team is finished with a problem (either by solving it or by failing to solve it on the second try), it returns the problem card to the pool, and chooses a new problem to work on.

### *Strategizing*

One of the most important factors is the presence of an unknown element and, at the same time, of the ability to plan the strategy. How does it work? The problems and their domino values are matched in such a way that the domino side of a card carries a lot of information about expected difficulty of a problem.

Let us compare, for example, the cards with [2:1] and [6:4] domino values. While the maximum reward for the problem on the first card is 3 points, for the second card it is equal to 10 points. Therefore, the problem on the first card should be much easier than on the second card. This example illustrates that the sum of two domino values serves as a good predictor of the difficulty level of a problem.

What about two cards with the same total? Should the difficulty level be the same? Let us look at the [7:1] and [4:4] cards. Each of these problems, if solved on the first try, would bring 8 points. However, if solved on the second try, the first problem is worth 7 points, and the second one – just 4. Moreover, the penalty is much higher for the second card -- 4 points versus 1 point. If the maximum profit is the same, and the punishment is much higher, what would be the motivation to select the second card? The reason is that the [7:1] problem should be more difficult and risky than [4:4] problem. This example shows how the balance of the two domino values on a card can be used for guessing risk and difficulty level of a problem.

Therefore, it is possible for a team to choose its strategy according to the team's standing and the level of players. There are a lot of ways to accumulate points: it is possible to concentrate on difficult high-risk problems, or to bet on solving a lot of easy ones.