**Vector Tug-of-War**

*Two people compete to get the resultant that matches their starting goal*

Materials: Tug-of-War playsheet, pen/pencil, calculator, Phet graphing software (optional) <https://phet.colorado.edu/en/simulation/legacy/vector-addition>

Setup: The top of the playsheet should be folded behind the page along the horizontal dashed line. The paper should then be folded in half vertically so that the player’s names are on the outside of the folds. Each player should write their name, then secretly write a component form vector goal. The components should be between 0 and 40 if using the Phet software. You must remember your goal! Once both players have written their goal, the sheet should be refolded vertically so that the goals are hidden inside.

Rounds: Players should each write one vector to try to get towards their goal, keeping the vector secret (paper folded) until both players have written one down. The paper is unfolded and the vectors are then added from the origin to get the resultant vector **A**. If the resultant vector is outside of the graphing area, the game is over and neither player wins.

If the resultant exactly matches the goal of a player after a round, that player wins immediately!

After each round, refold the paper vertically and continue with the next using the above steps. Each time, the vectors are added to the resultant from the round before.

After round three, the total resultant C is calculated and the paper should be unfolded so the goals are revealed. Each player should find the difference vector between their goal and the resultant, then find the magnitude of this vector. The player with the smallest magnitude wins!

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