

Instructions: Homework must be done in teams of three or four. Show ALL work neatly for full credit.

1. Consider a similar game to 21 that we'll call 52. In this game, the players each take turns naming and adding numbers from 1 to 5, where the winner is the player who reaches 52. What's the winning strategy? And for which player? What if we want to reach the number 53? or 54? Does the answer change? Why or why not?

2. These questions all deal with tic-tac-toe (regular or inverse). For the sake of simplicity, we assume X goes first.

(a) In inverse tic-tac-toe, given the position below, what are the best move(s) for player 2 (if any)? Why?

X	○	X

(b) In inverse tic-tac-toe, given the position below, what are the best moves for player 1 (if any)? Why?

X	○	
	X	
		○

(c) Counting for rotational symmetry, how many different configurations are there where player 1 wins regular tic-tac-toe on her third move?

(d) Let's consider a new variation of the game. Gravity tic-tac-toe is a combination of tic-tac-toe and connect-four. Essentially you can only choose which column to place an X or ○, and it sinks to the bottom-most available spot. You still want to get three-in-a-row to win.

Give the best strategies for player 1 and the best strategy for player 2. Justify your answer. The more clear your answer, the better. Points will be taken off for incomplete or confusing explanations.

3. Alice, Bob, Cheryl, Daniel and Elliott need to line up for a photograph. However, Alice and Bob hate each other and refuse to stand next to each other. How many different ways can we arrange the photograph without upsetting Alice and Bob?