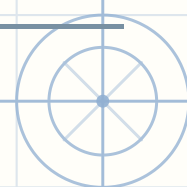


Win or go second — Piles up to 24

Name: _____

Date: _____



Take turns taking counters. Say how to force a win, or that you cannot.

- 1 23 matches lie in a pile on the table. Two players take turns, and on your turn you take between 1 and 3 of them. Whoever takes the very last match wins. You go first.

Can you be sure to win? If so, how many should you take on your first turn? Write SECOND if going first cannot win.

Why The losing pile sizes are the multiples of 4: from one of them, whatever the other player takes — 1 up to 3 — you take the rest of a group of 4, and the pile drops straight to the next multiple. So aim to always hand them a multiple of 4. Here $23 - 3 = 20$, and 20 is a multiple of 4, so take 3 matches first. After that, when they take t you take $4 - t$; every round removes 4 between you, and you take the last.

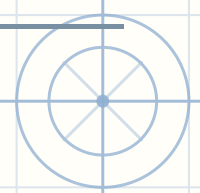
3



Win or go second — Piles up to 24

Name: _____

Date: _____



Take turns taking counters. Say how to force a win, or that you cannot.

- 2 12 pebbles are heaped on the ground. Two players take turns, and on your turn you take between 1 and 3 of them. Whoever takes the very last pebble wins. You go first.

Can you be sure to win? If so, how many should you take on your first turn? Write SECOND if going first cannot win.

Why

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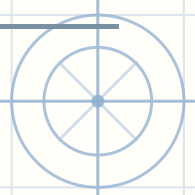
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Win or go second — Piles up to 24

Name: _____

Date: _____



(Take turns taking counters. Say how to force a win, or that you cannot.

- 3 A stack of 21 counters sits between the two players. Two players take turns, and on your turn you take between 1 and 4 of them. Whoever takes the very last counter wins. You go first.

Can you be sure to win? If so, how many should you take on your first turn? Write SECOND if going first cannot win.

Why

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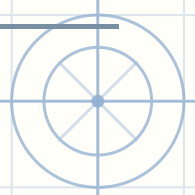
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Win or go second — Piles up to 24

Name: _____

Date: _____



Take turns taking counters. Say how to force a win, or that you cannot.

- 4 8 matches lie in a pile on the table. Two players take turns, and on your turn you take between 1 and 3 of them. Whoever takes the very last match wins. You go first.

Can you be sure to win? If so, how many should you take on your first turn? Write SECOND if going first cannot win.

Why

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Win or go second · Piles up to 24 — Answer key

If they are stuck

- Play the smallest piles by hand. Which sizes lose for the player who must move, and what do they share?



1. The losing pile sizes are the multiples of 4: from one of them, whatever the other player takes — 1 up to 3 — you take the rest of a group of 4, and the pile drops straight to the next multiple. So aim to always hand them a multiple of 4. Here $23 - 3 = 20$, and 20 is a multiple of 4, so take 3 matches first. After that, when they take t you take $4 - t$; every round removes 4 between you, and you take the last.

3. The losing pile sizes are the multiples of 5: from one of them, whatever the other player takes — 1 up to 4 — you take the rest of a group of 5, and the pile drops straight to the next multiple. So aim to always hand them a multiple of 5. Here $21 - 1 = 20$, and 20 is a multiple of 5, so take 1 counter first. After that, when they take t you take $5 - t$; every round removes 5 between you, and you take the last.

2. 12 is already a multiple of 4 — $12 \div 4 = 3$ whole groups of 4. Whatever you take first, from 1 up to 3, the other player takes the rest of that group, bringing the pile back to a multiple of 4. You are always the one facing a multiple, so however you play it is the other player who takes the last. Going first cannot win here: the answer is SECOND.

4. 8 is already a multiple of 4 — $8 \div 4 = 2$ whole groups of 4. Whatever you take first, from 1 up to 3, the other player takes the rest of that group, bringing the pile back to a multiple of 4. You are always the one facing a multiple, so however you play it is the other player who takes the last. Going first cannot win here: the answer is SECOND.