THE GAME OF NIM

NIM is a game played with piles of stones (or pennies). You will need a partner to play this game. Here are the rules:

(1) On your turn, you can take as many stones you want from one pile.
(2) You must take at least one stone on each turn.
(3) Players alternate taking turns.
(4) The player who takes the last stone from the last pile wins.

From last time while looking at two pile nim games, we discovered there are losing arrangements that if you leave your opponent with one of these arrangements after each turn he will lose (and you will win). We'll call these arrangements *losing positions*.

Question 1: What are the losing positions for two pile nim?

Question 2: On the back of this page there are a bunch of three pile nim arrangements. Are any of them losing positions?

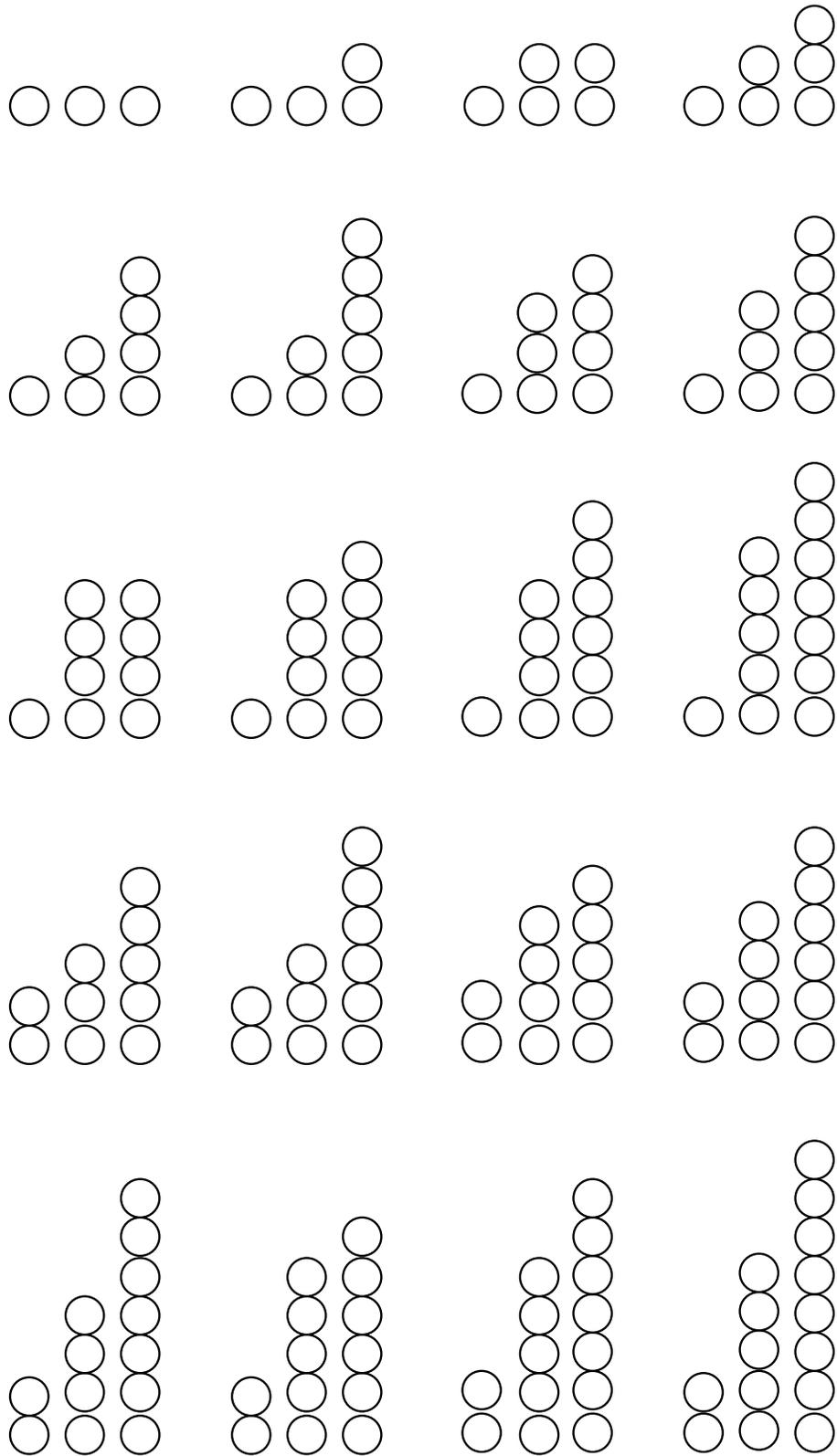*Question 3: Is there any pattern?*

Question 4: Are there any four pile losing positions?

FIGURE 1. Three Pile Nim Arrangements