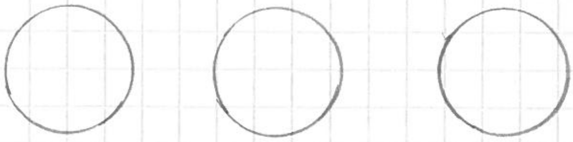
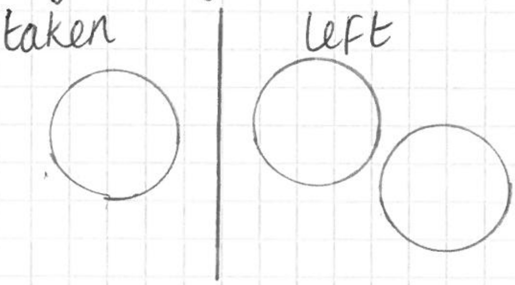
c/w | The Game of NIM | Date

Importance of leaving 3 counters.

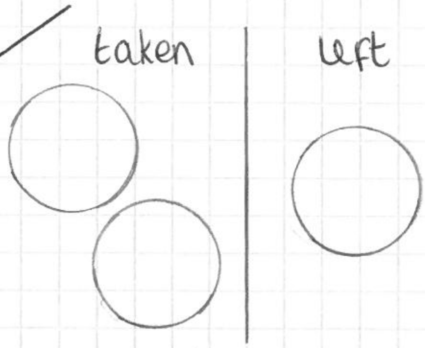


If I get to 3 counters, and it is your go, I can win because



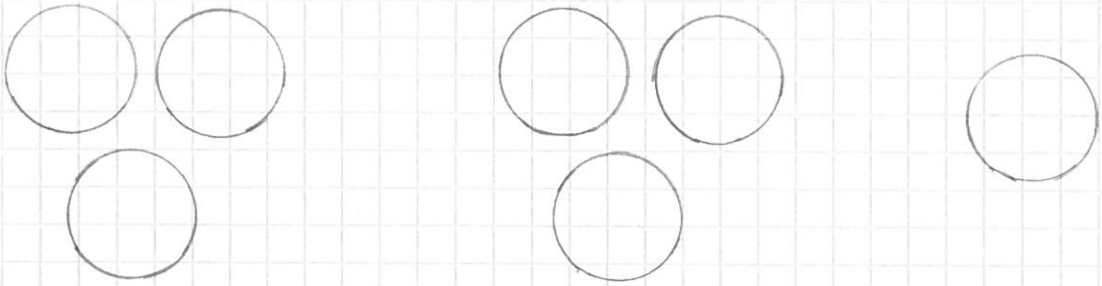
If the other player takes 1, I can take the 2 left and win.

OR



If the other player takes 2, I can take the 1 left and WIN.

Describe how to get a guaranteed win with 7 counters



If I go first.....

I would take one counter, which would leave 2 groups of 3, and I would follow the above strategy to win each group of 3.

If I go second.....

I need to hope the other player makes a mistake to enable me to win a group of 3.

Explaining the strategy.

Forcing my opponent to be left with either 3 or 6 counters, allows me to use the initial strategy to win the game.

Investigate - Change the number of counters

I have investigated different numbers of counters, and I have found

1) Number of counters that are not a multiple of 3, e.g. 10 or 11, then the strategy is the same, go first and continue to follow above strategies, forcing my opponent to be left with multiples of 3. (expect a diagram)
2) Number of counters that are a multiple of 3, e.g. 6 or 9, then you are better going 2nd and follow the above strategy.

Investigate - Taking 1, 2 or 3 counters.

I found that this was the same strategy as only taking 1 or 2, but the key number is a multiple of 4 this time, instead of 3.
(expect a diagram.)

Investigate - Changing the rules.

I changed the rules, so the person who takes the last counter loses.
Whereas before the key numbers were 6 and 3, now they are 7 and 4.
If you leave the other person with 7, no matter

what they do, you can leave them with 4 and then leave them with the last counter.

(expect a diagram)

If the number of counters changes, the key number you need to leave your opponent with, is a number of counters that belongs in the $3n+1$ sequence.

<u>3, 4, 5 NIM strategy</u>

The key to this is to 'pair up' powers of 2.

At the start, the rows can be written as:

$$\left.\begin{array}{ll} 1 & 2 \\ 4 & \\ 1 & 4 \end{array}\right\}$$ always written as the biggest power of 2.

Whatever move your opponent makes, you must respond by 'balancing' the board by ensuring you always have pairs of powers of 2.

Optimal first move is to take 2 counters from the first row.

<u>Extension</u>. (doesn't have to be this specific one.)

Explanation of the change you've made.

Analysis of this (like exemplar)

Summary of possible strategy

Explanation of why strategy works.