I. Factorial Function

Algorithm F(n)

if n = 0

return 1

else

return F(n-1) * n

$5! = 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 = 120$

$20 \nearrow^{60} \nearrow^{120} \nearrow^{120}$

$5! = 5 \cdot 4!$

$4! = 4 \cdot 3!$

$3! = 3 \cdot 2!$

$2! = 2$

$n! = n \cdot (n-1)!$
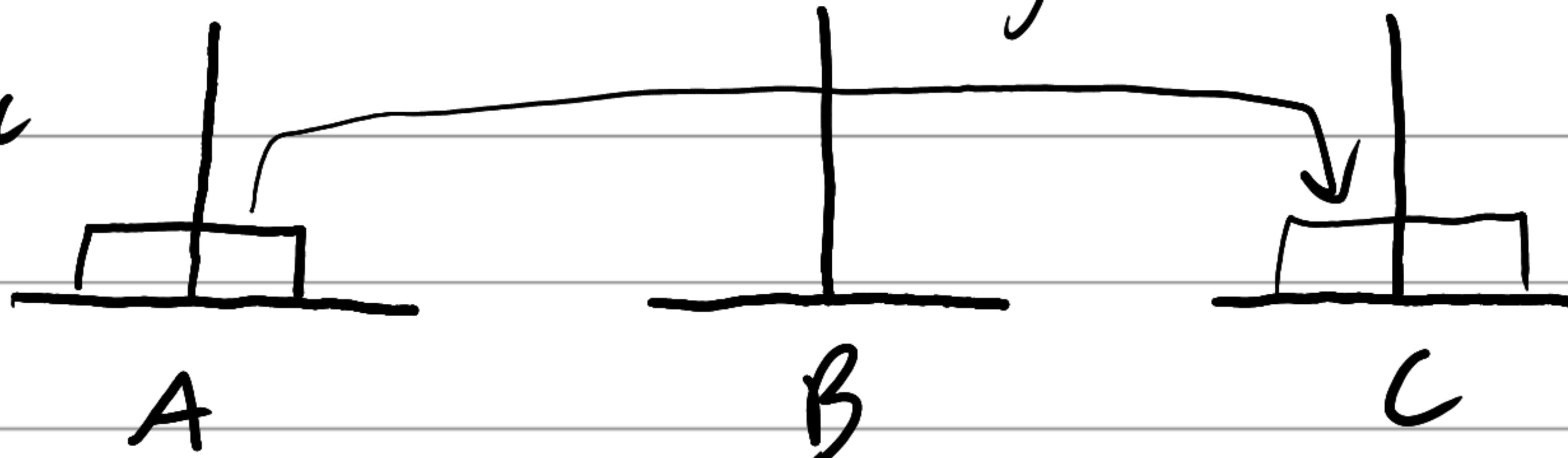
$0! = 1$
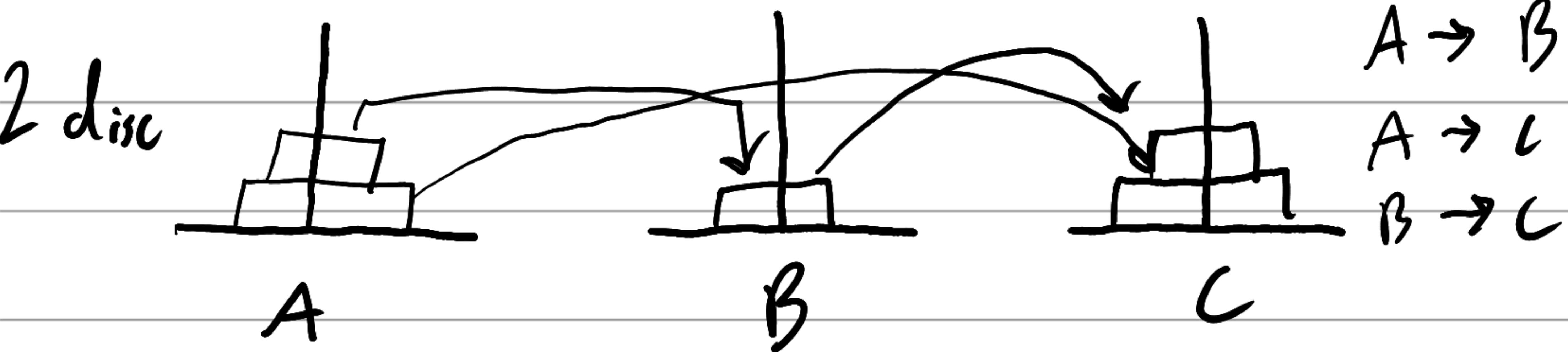
II. Tower of Hanoi   A to C

- One disc at a time, big cannot stack on small

1 disc

A   B   C

$A \to C$

2 disc

A   B   C

$A \to B$

$A \to C$

$B \to C$

3 discs

2 disc $\begin{cases} A \to C \\ A \to B \\ C \to B \end{cases}$
steps

$\underline{A \to C}$

2 disc $\begin{cases} B \to A \\ B \to C \\ A \to C \end{cases}$
steps

A   B   C

A   B   C

A   B   C

A   B   C
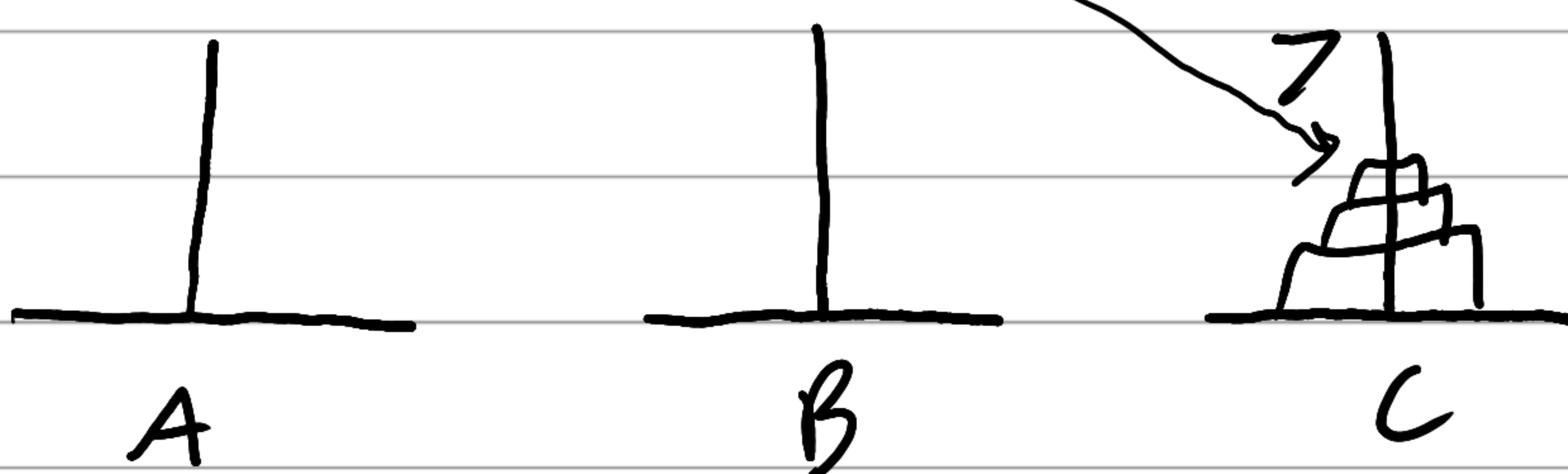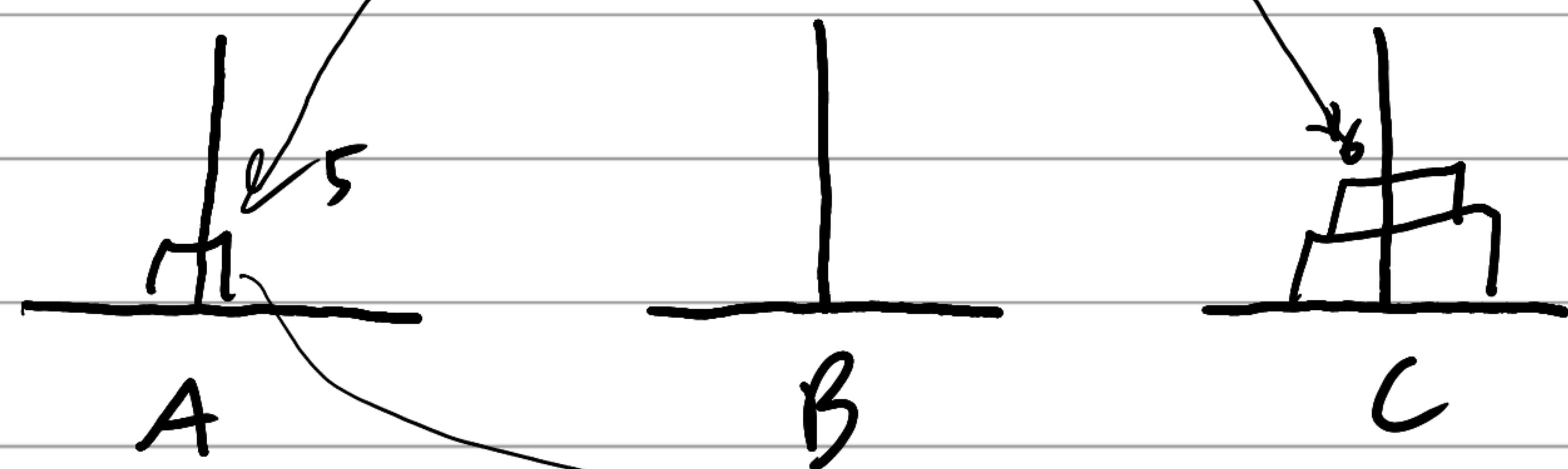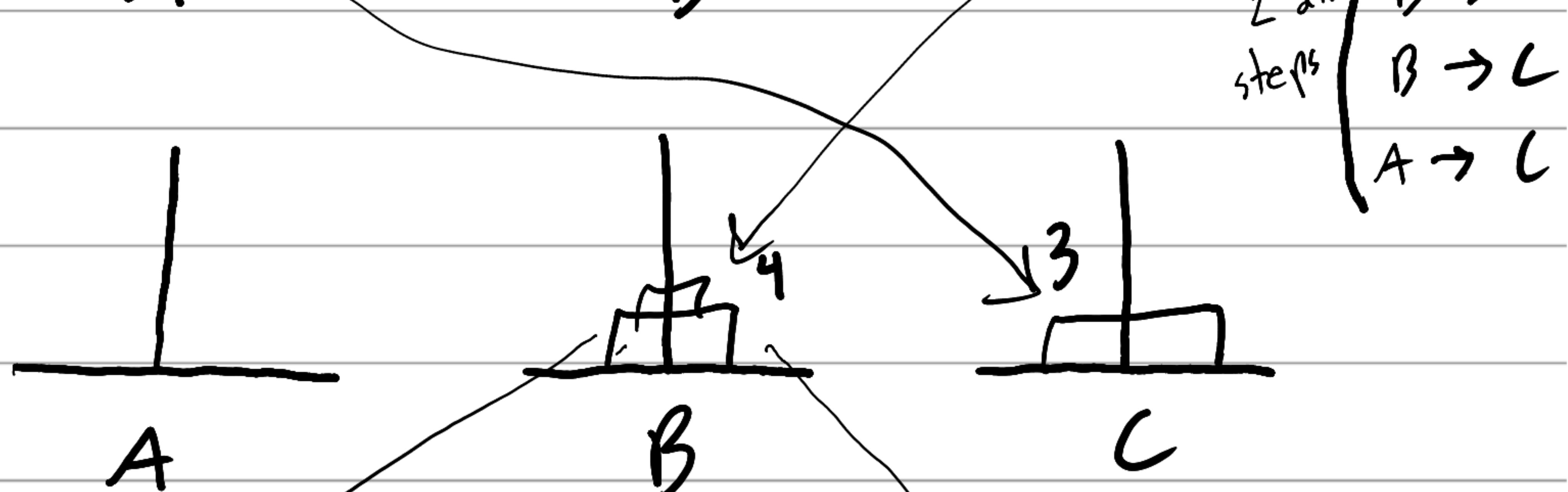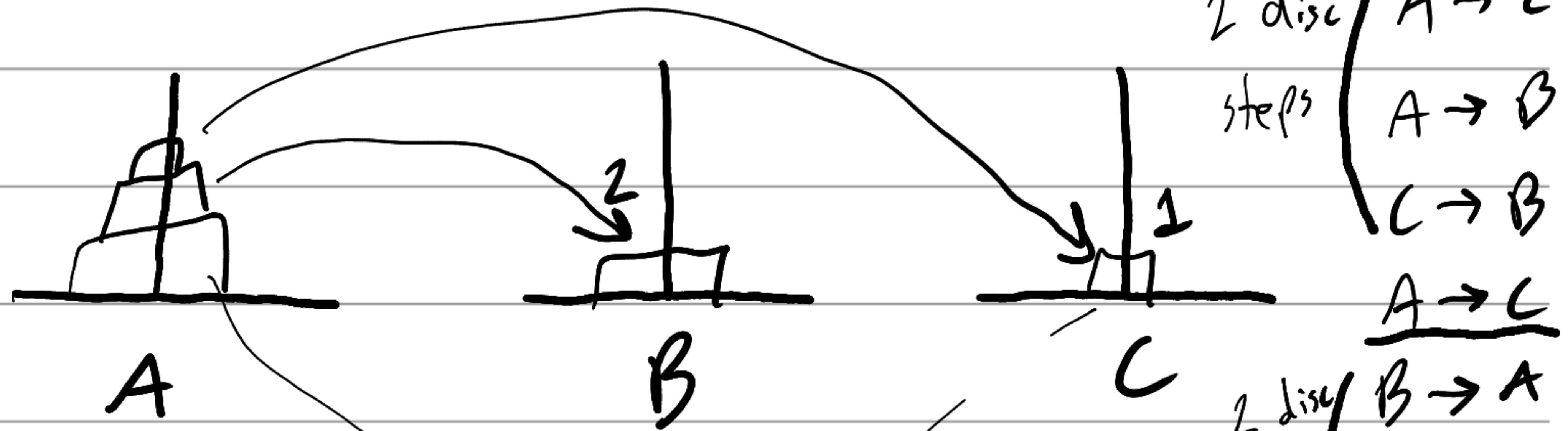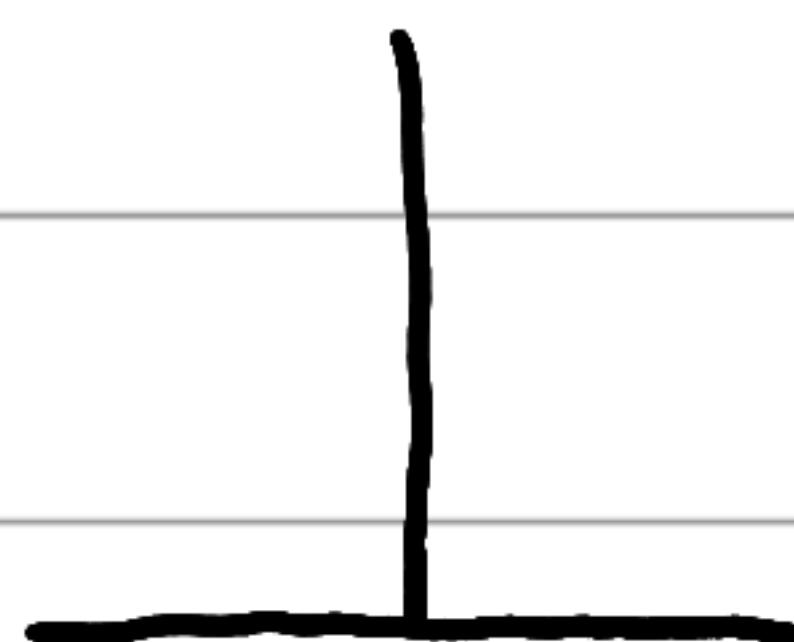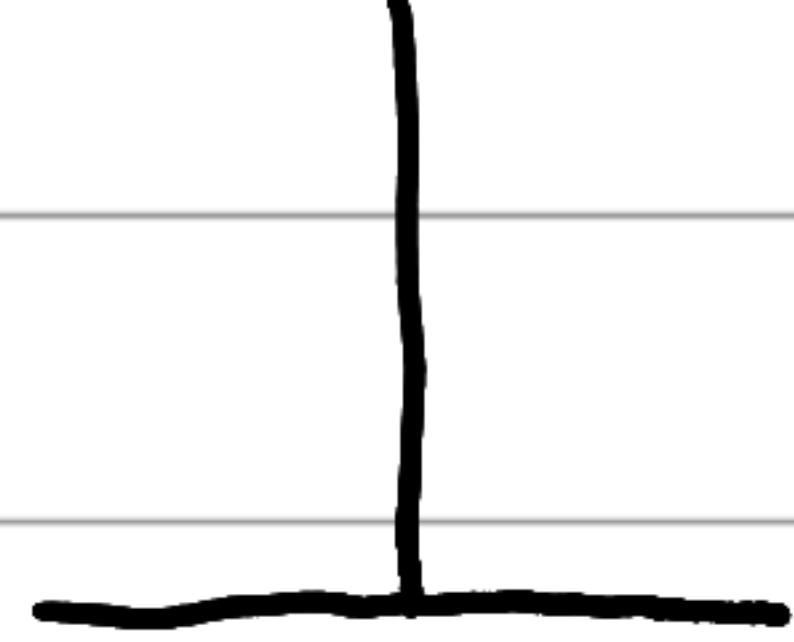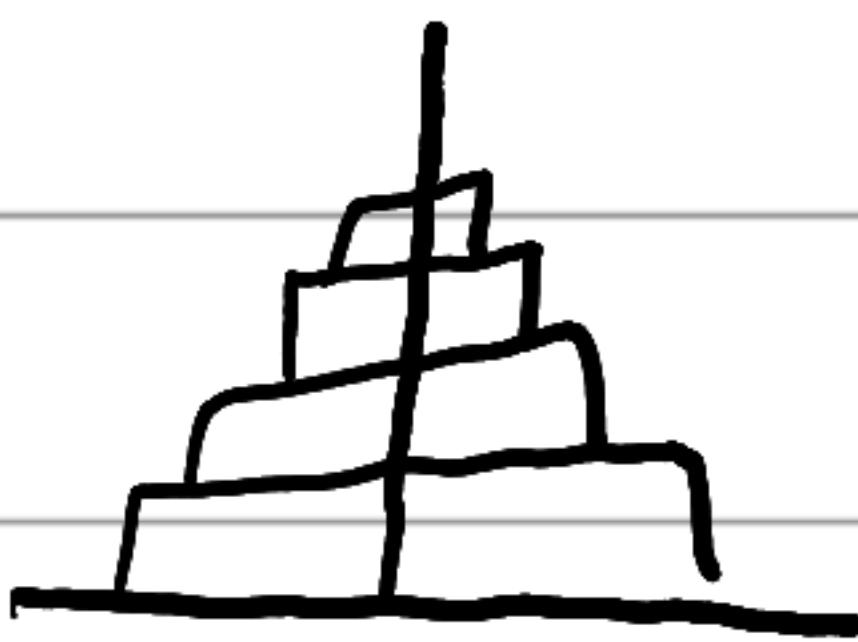
- As discs increase, previous disc amount solution become steps towards solution

$$(2^n - 1) \text{ steps}$$

A   B   C
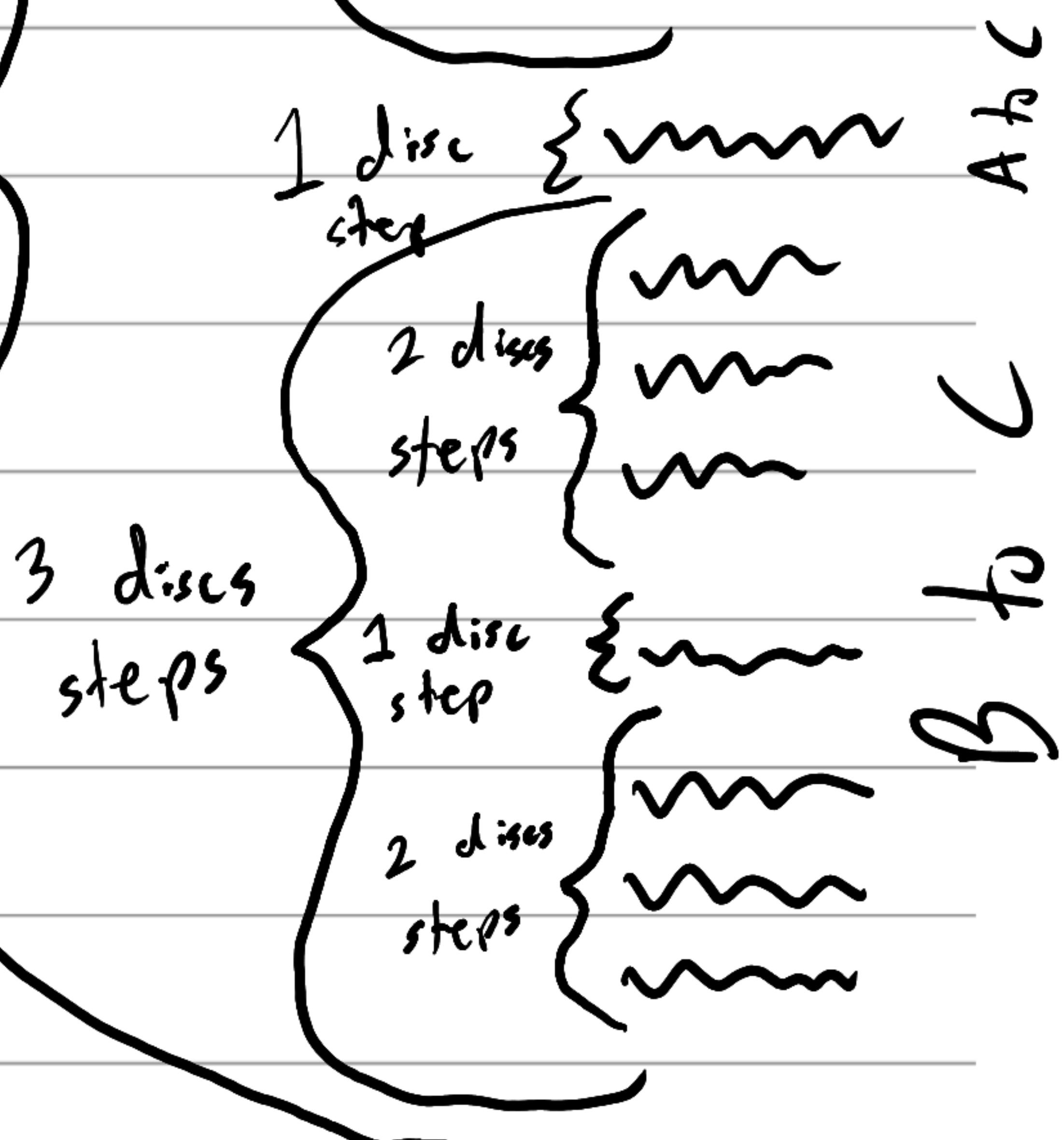
For n discs:
- Move (n-1) discs from A to B recursively using C as temp tower
- Move bottom disc from A to C
- Move n-1 discs from B to C recursively using A as temp tower

4 discs steps

3 discs steps

2 discs steps

1 disc step

2 discs steps

A to B

A to C

1 disc step

3 discs steps

1 disc step

2 discs steps

1 disc step

2 discs steps

B to C

III. Permutations of a String

Ex: "ABC"

- ABC
- ACB
- BAC
- BCA
- CBA
- CAB

Number of permutations = (n)!

n = # of characters

$$A \underset{swap}{\overline{B}} C$$

$$B \underset{swap}{A} C$$

$$C A B$$

$$A \begin{cases} BC \\ CB \end{cases}$$

$$B \begin{cases} AC \\ CA \end{cases}$$

$$C \begin{cases} BA \\ AB \end{cases}$$