Recall the falling and rising factorial notation:

\[
\begin{align*}
n_\downarrow &= n(n-1) \cdots (n-(k-1)) = \prod_{i=0}^{k-1} (n-i), \\
n_\uparrow &= n(n+1) \cdots (n+(k-1)) = \prod_{i=0}^{k-1} (n+i).
\end{align*}
\]

1. Consider a bookshelf with \( n \) shelves (\( n \geq 3 \)) and \( k \) non-
identical books. Suppose that any shelf could hold all of the books, and that the order of the books on each shelf matters. How many ways are there to put the books on the shelves if there must be at least three non-empty shelves at the end? You should be able to find an answer without a summation sign.

2. Consider a bookshelf with \( n \) shelves (\( n \geq 3 \)) and \( k \) identical books. Suppose that any shelf could hold all of the books, and that the order of the books on each shelf does not matter. How many ways are there to put the books on the shelves if there must be at least three non-empty shelves at the end? You should be able to find an answer without a summation sign.