1. From the book do problems:

(a) 5.4: 4, 5
(b) 6.1: 5, 10, 12
(c) 6.2: 1, 3, 6

2. Let \( R_n \) be the set of ways to place \( n \) non-attacking rooks on an \( n \times n \) chess-board.

(a) Let \( f : R_n \to \mathbb{Z} \) be given by

\[
f(r) = \text{number of rooks on the diagonal squares of } r, \quad \text{for } r \in R_n.
\]

For example, if \( n = 4 \),

\[
\begin{bmatrix}
\text{II} & \text{II} \\
* & \text{II} \\
\text{II} & *
\end{bmatrix}
= 2,
\]

where \( \begin{bmatrix} \text{II} & \text{II} \\ \text{II} & \text{II} \end{bmatrix} \in R_4 \),

and I've marked the diagonal squares with \( * \).

i. What is \( f(R_n) \)?
ii. Is \( f \) injective?
iii. Is \( f \) surjective?
iv. Find \( |f^{-1}(k)| \) for all \( k \in f(R_4) \).

(b) Find an injective function \( g : R_n \to \mathbb{Z} \) (without changing the sets \( R_n \) and \( \mathbb{Z} \)).