Problem 11

In how many ways can 3 novels, 2 mathematics books, and 1 chemistry book be arranged on a bookshelf if

(a) the books can be arranged in any order?

(b) the mathematics books must be together and the novels must be together?

(c) the novels must be together, but the other books can be arranged in any order?

Solution

Part (a)

Any of the six books can be placed in the first spot. Only five remain for the second spot and so on. By the counting principle, there are

$$6 \times 5 \times 4 \times 3 \times 2 \times 1 = 6! = 720$$

different arrangements.

Part (b)

Treat the two mathematics books as a block and treat the three novels as a block. The number of ways to arrange the chemistry book and these two blocks is $3 \times 2 \times 1$. Multiply this result by the number of ways the mathematics books and novels can be arranged inside their respective blocks to get the final answer.

$$3 \times 2 \times 1 \times (2 \times 1) \times (3 \times 2 \times 1) = 72$$

Part (c)

Treat the three novels as a block. The number of ways to arrange the chemistry book, the two mathematics books, and this block is $4 \times 3 \times 2 \times 1$. Multiply this result by the number of ways the three novels can be arranged inside the block to get the final answer.

$$4 \times 3 \times 2 \times 1 \times (3 \times 2 \times 1) = 144$$