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A **permutation** is an arrangement of objects in a specific order. Here are the possible permutations of the letters A, B, and C without repeating any letters.

ABC ACB BAC BCA CAB CBA

Problem 2 Finding Permutations

Got It? A swimming pool has 8 lanes. In how many ways can 8 swimmers be assigned lanes for a race?

11. Working from left to right, write how many choices there are for a swimmer to be assigned to each lane. (*Hint:* When you determine the number of choices for a lane, assume that a swimmer has been chosen for each lane to the left.)

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A shorter way to write the product in Problem 2 is 8!, read "eight factorial." For any positive integer *n*, the expression *n* factorial is written as *n*! and is the product of the integers from *n* down to 1. The value of 0! is defined to be 1.

You can use factorials to write a formula for the number of permutations of *n* objects arranged *r* at a time.

Key Concept Permutation Notation

The expression ${}_{n}P_{r}$ represents the number of permutations of *n* objects arranged *r* at a time.

Example $_{8}P_{2} = \frac{8!}{(8-2)!} = \frac{8!}{6!} = \frac{8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1}{6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1} = 56$

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 $_{n}\mathrm{P}_{r} = \frac{n!}{(n-r)!}$

14. Find the number of permutations of 5 objects arranged 3 at a time.



The expression ${}_{n}C_{r}$ represents the number of combinations of *n* objects chosen *r* at a time.

$${}_{n}\mathbf{C}_{r} = \frac{n!}{r!(n-r)!}$$

Example ${}_{8}C_{2} = \frac{8!}{2!(8-2)!} = \frac{8!}{2!6!} = \frac{8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1}{(2 \cdot 1)(6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1)} = 28$

18. Find the number of combinations of 4 objects chosen 3 at a time.



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