NAME _____ DATE _____ PERIOD _____

14-2 Permutations and Combinations

(Pages 760–767)

An arrangement in which order is important is called a **permutation**. Arrangements or listings where the order is not important are called **combinations**. Working with these arrangements, you will use **factorial** notation. The symbol 5!, or 5 factorial, means $5 \cdot 4 \cdot 3 \cdot 2 \cdot 1$. The expression $n!$ means the product of all counting numbers beginning with n and counting backwards to 1. The definition of 0! is 1.

Working with Permutations and Combinations	The symbol ${}_7P_3$ means the number of permutations of 7 things taken 3 at a time. To find ${}_7P_3$ use the formula ${}_nP_r = \frac{n!}{(n-r)!}$, or $\frac{7!}{(7-3)!} \cdot \frac{5040}{24} = 210$. The symbol ${}_7C_3$ means the number of combinations of 7 things taken 3 at a time. To find ${}_7C_3$ use the formula ${}_nC_r = \frac{n!}{(n-r)!r!}$, or $\frac{7!}{(7-3)!3!} \cdot \frac{5040}{144} = 35$.

Examples

a. Find ${}_5P_3$

${}_5P_3 = 5 \cdot 4 \cdot 3$ or 60

${}_5P_3 = \frac{5!}{(5-3)!} = \frac{5 \cdot 4 \cdot 3 \cdot 2 \cdot 1}{2 \cdot 1} = 60$

b. Find ${}_5C_3$

First find the value of ${}_5P_3$ or $\frac{5!}{(5-3)!3!}$.

From Example A, you know that ${}_5P_3$ is 60.

Divide 60 by 3!. This is $\frac{60}{6}$ or 10.

c. Fred plans to buy 4 tropical fish from a tank at a pet shop. Does this situation represent a permutation or a combination? Explain.

This situation represents a combination. The only thing that matters is which fish he selects. The order in which he selects them is irrelevant.

Practice

Tell whether each situation represents a permutation or combination.

1. a stack of 18 tests

2. two flavors of ice cream out of 31 flavors

3. 1st-, 2nd-, and 3rd-place winners

4. 20 students in a single file line

How many ways can the letters of each word be arranged?

5. RANGE

6. QUARTILE

7. MEDIAN

Find each value.

8. ${}_5P_2$

9. ${}_{10}P_3$

10. 7!

11. 9!

12. ${}_7C_2$

13. ${}_{12}C_3$

14. $\frac{5!2!}{3!}$

15. $\frac{8!4!}{7!3!}$

16. **Standardized Test Practice** If there are 40 clarinet players competing for places in the district band, how many ways can the 1st and 2nd chairs be filled?

A 40!

B $40 \cdot 39$

C $\frac{40 \cdot 39}{2!}$

D 2

Answers: **1.** permutation **2.** combination **3.** permutation **4.** permutation **5.** 120 ways **6.** 40,320 ways **7.** 720 ways **8.** 20 **9.** 720 **10.** 5040 **11.** 362,880 **12.** 21 **13.** 220 **14.** 40 **15.** 32 **16.** B