

# 12-7 Permutations and Combinations (Pages 641–645)

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.

<p><b>Working with Permutations and Combinations</b></p>	<ul style="list-style-type: none"> <li>The symbol <math>P(7, 3)</math> means the number of permutations of 7 things taken 3 at a time. To find <math>P(7, 3)</math>, multiply the number of choices for the 1st, 2nd, and 3rd positions. <math>P(7, 3) = 7 \cdot 6 \cdot 5</math> or 210</li> <li>The symbol <math>C(7, 3)</math> means the number of combinations of 7 things taken 3 at a time. To find <math>C(7, 3)</math>, divide <math>P(7, 3)</math> by <math>3!</math>, which is the number of ways of arranging 3 things in different orders. <math>C(7, 3) = \frac{P(7, 3)}{3!} = \frac{7 \cdot 6 \cdot 5}{3 \cdot 2 \cdot 1}</math> or 35</li> </ul>
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### Examples

**a. Find  $P(5, 3)$ .**

$P(5, 3) = 5 \cdot 4 \cdot 3$  or 60

**b. Find  $C(5, 3)$ .**

First find the value of  $P(5, 3)$ . From Example A, you know that  $P(5, 3)$  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. $P(5, 2)$  | 9. $P(10, 3)$  | 10. $7!$              | 11. $9!$                |
| 12. $C(7, 2)$ | 13. $C(12, 3)$ | 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?

- |              |                        |                                   |            |
|--------------|------------------------|-----------------------------------|------------|
| <b>A</b> 40! | <b>B</b> $40 \cdot 39$ | <b>C</b> $\frac{40 \cdot 39}{2!}$ | <b>D</b> 2 |
|--------------|------------------------|-----------------------------------|------------|

<p><b>Answers:</b> 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</p>
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