

# Counting Principles

Name: \_\_\_\_\_

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## Q Quick Review

The **Fundamental Counting Principle** says to multiply the number of choices at each stage. If you have 3 shirts and 4 pants, there are  $3 \cdot 4 = 12$  outfits. Use permutations when order matters, combinations when order does not matter. A good habit is to ask: Am I arranging items, or am I simply choosing a group?

## PRACTICE

Count the number of outcomes in each real situation.

- A school store sells spirit shirts in 3 colors and 4 sizes. How many shirt options are available? \_\_\_\_\_
- A cafeteria lunch combo includes 1 drink, 1 meal, and 1 dessert. There are 2 drinks, 5 meals, and 3 desserts. How many combos are possible? \_\_\_\_\_
- A license plate uses 2 letters followed by 3 digits, and repeats are allowed. How many plates can be made? \_\_\_\_\_
- A school tablet code has 4 digits, and digits may repeat. How many different codes are possible? \_\_\_\_\_
- A locker PIN has 4 digits and no digit may repeat. How many PINs are possible? \_\_\_\_\_
- A librarian arranges 5 different display books in a row. How many orders are possible? \_\_\_\_\_
- A student council chooses a president and a vice president from 8 students. How many leadership pairs are possible? \_\_\_\_\_
- A teacher chooses 2 students from 8 to help collect papers. The jobs are the same. How many groups are possible? \_\_\_\_\_
- An art show has 7 posters, but only 3 ordered wall spaces. How many displays are possible? \_\_\_\_\_
- A teacher chooses 3 of 7 posters for a bulletin board, and order does not matter. How many sets are possible? \_\_\_\_\_
- A pizza shop offers 6 toppings. A customer chooses 2 toppings, and order does not matter. How many topping pairs are possible? \_\_\_\_\_
- A smoothie shop lists a first add-in and a second add-in from 6 choices with no repeats. How many ordered pairs are possible? \_\_\_\_\_
- A true/false quiz has 8 questions. How many answer patterns are possible? \_\_\_\_\_
- A multiple-choice quiz has 5 questions with 4 answer choices each. How many answer patterns are possible? \_\_\_\_\_
- A game turn asks a player to roll a die and flip a coin. How many combined outcomes are possible? \_\_\_\_\_
- A classroom prize code uses one letter from A–D and one number from 1–9. How many codes are possible? \_\_\_\_\_
- A club arranges the letters A, B, C, and D on a banner. How many different arrangements are possible? \_\_\_\_\_
- A coach chooses 4 players from a roster of 10 for a skills contest. Order does not matter. How many teams are possible? \_\_\_\_\_
- A teacher assigns two different classroom jobs to students. There are 9 choices for the first job and then 8 choices for the second. How many assignments are possible? \_\_\_\_\_
- A club chooses 2 representatives from 9 members, and both representatives have the same role. How many pairs are possible? \_\_\_\_\_



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**◆ Word Problems**

21. A sandwich shop lets each customer choose one bread, one filling, and one sauce. The menu has 4 breads, 5 fillings, and 3 sauces. How many different sandwiches are possible?

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22. A soccer coach needs to choose a captain and a co-captain from 12 players. Since the two roles are different, how many leadership pairs are possible?

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23. A club chooses 3 students from 12 to attend a meeting. The students will all have the same role at the meeting. How many groups are possible?

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24. A locker code uses three different digits. The first digit cannot be 0, but the second and third digits can be any unused digit. How many codes are possible?

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## Answer Keys

- |                      |          |
|----------------------|----------|
| 1. 12                | 13. 256  |
| 2. 30                | 14. 1024 |
| 3. $26^2 \cdot 10^3$ | 15. 12   |
| 4. 10,000            | 16. 36   |
| 5. 5040              | 17. 24   |
| 6. 120               | 18. 210  |
| 7. 56                | 19. 72   |
| 8. 28                | 20. 36   |
| 9. 210               | 21. 60   |
| 10. 35               | 22. 132  |
| 11. 15               | 23. 220  |
| 12. 30               | 24. 648  |

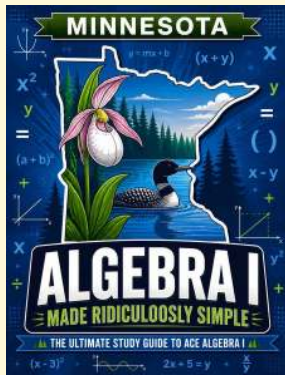
### Step-by-Step Tutor Notes

1. Move carefully through the arithmetic; one clean operation usually unlocks the next one. There are 3 color choices and 4 size choices, so multiply:  $3 \cdot 4 = 12$  options. After simplifying, the answer is 12.
2. Start with the definition the problem is testing, then apply it directly. Choose one item from each category. The total is  $2 \cdot 5 \cdot 3 = 30$  lunch combos. So the answer is 30.
3. Each letter spot has 26 choices and each digit spot has 10 choices, so the count is  $26^2 \cdot 10^3$ .
4. Take it one clear step at a time and keep the original question in mind. Each of the 4 positions has 10 choices, so  $10^4 = 10,000$  codes. So the answer is 10,000.
5. Focus on the main idea of the problem, then simplify carefully. The choices shrink as digits are used:  $10 \cdot 9 \cdot 8 \cdot 7 = 5040$ . So the answer is 5040.
6. Focus on the main idea of the problem, then simplify carefully. All 5 books are being arranged, so use  $5! = 120$ . So the answer is 120.
7. The roles are different, so order matters: 8 choices for president and 7 left for vice president.
8. Start with the definition the problem is testing, then apply it directly. Order does not matter for a group, so use  $\binom{8}{2} = 28$ . So the answer is 28.
9. Focus on the main idea of the problem, then simplify carefully. Order matters because the wall spaces are different:  $7P3 = 7 \cdot 6 \cdot 5 = 210$ . So the answer is 210.
10. Start with the definition the problem is testing, then apply it directly. This is a combination, so  $\binom{7}{3} = 35$ . So the answer is 35.
11. Focus on the main idea of the problem, then simplify carefully. Choosing a pair is a combination:  $\binom{6}{2} = 15$ . So the answer is 15.
12. Move carefully through the arithmetic; one clean operation usually unlocks the next one. Because first and second are different positions, multiply  $6 \cdot 5 = 30$ . After simplifying, the answer is 30.
13. Take it one clear step at a time and keep the original question in mind. Each question has 2 choices, so  $2^8 = 256$  answer patterns. So the answer is 256.
14. Start with the definition the problem is testing, then apply it directly. Each question has 4 choices, so  $4^5 = 1024$ . So the answer is 1024.
15. This is a good place to slow down, check the notation, and simplify cleanly. The die has 6 outcomes and the coin has 2, so  $6 \cdot 2 = 12$ . So the answer is 12.
16. Take it one clear step at a time and keep the original question in mind. There are 4 letter choices and 9 number choices, so  $4 \cdot 9 = 36$ . So the answer is 36.
17. Start with the definition the problem is testing, then apply it directly. All 4 letters are arranged, so  $4! = 24$ . So the answer is 24.
18. Take it one clear step at a time and keep the original question in mind. This is a combination:  $\binom{10}{4} = 210$ . So the answer is 210.
19. Work one inverse operation at a time and keep both sides balanced. The jobs are different, so order matters. Multiply the staged choices:  $9 \cdot 8 = 72$ . After simplifying, the answer is 72.
20. Focus on the main idea of the problem, then simplify carefully. Order does not matter, so use  $\binom{9}{2} = 36$ . So the answer is 36.
21. This is a straight counting-principle situation: one choice from each category. Multiply  $4 \cdot 5 \cdot 3 = 60$  different sandwiches.
22. Order matters because captain and co-captain are not the same role. There are 12 choices for captain and 11 left for co-captain, so  $12 \cdot 11 = 132$ .
23. Because this is just a group, order does not matter. Use a combination:  $\binom{12}{3} = 220$  groups.
24. The first digit has 9 choices (1 through 9). After that, 9 digits remain for the second spot and 8 for the third, giving  $9 \cdot 9 \cdot 8 = 648$  codes.



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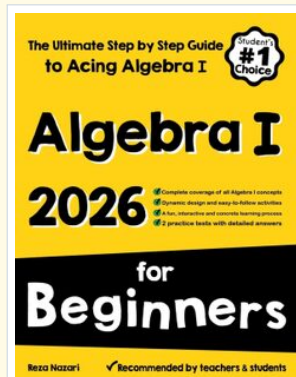
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