Counting Principles

Name: ______________________	Date: ______________	Score: _____ / 24

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.

1. A school store sells spirit shirts in 3 colors and 4 sizes. How many shirt options are available? ________

2. 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? ________

3. A license plate uses 2 letters followed by 3 digits, and repeats are allowed. How many plates can be made? ________

4. A school tablet code has 4 digits, and digits may repeat. How many different codes are possible? ________

5. A locker PIN has 4 digits and no digit may repeat. How many PINs are possible? ________

6. A librarian arranges 5 different display books in a row. How many orders are possible? ________

7. A student council chooses a president and a vice president from 8 students. How many leadership pairs are possible? ________

8. A teacher chooses 2 students from 8 to help collect papers. The jobs are the same. How many groups are possible? ________

9. An art show has 7 posters, but only 3 ordered wall spaces. How many displays are possible? ________

10. A teacher chooses 3 of 7 posters for a bulletin board, and order does not matter. How many sets are possible? ________

11. A pizza shop offers 6 toppings. A customer chooses 2 toppings, and order does not matter. How many topping pairs are possible? ________

12. 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? ________

13. A true/false quiz has 8 questions. How many answer patterns are possible? ________

14. A multiple-choice quiz has 5 questions with 4 answer choices each. How many answer patterns are possible? ________

15. A game turn asks a player to roll a die and flip a coin. How many combined outcomes are possible? ________

16. A classroom prize code uses one letter from A–D and one number from 1–9. How many codes are possible? ________

17. A club arranges the letters A, B, C, and D on a banner. How many different arrangements are possible? ________

18. A coach chooses 4 players from a roster of 10 for a skills contest. Order does not matter. How many teams are possible? ________

19. 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? ________

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