Counting Principle and Permutations

Spot mistakes, reason, and work backward

Name _____ **Date** _____ **Score** _____ / 10

QUICK REVIEW

Order and replacement are separate decisions. A three-digit code with repetition from five symbols has $5^3 = 125$ outcomes; without repetition it has $5 \cdot 4 \cdot 3 = 60$. An unordered three-person group divides ordered selections by $3! = 6$. For a number, a leading zero is usually forbidden; for a code it may be allowed if the problem says so.

Worked example

Example for form 2: assign two distinct roles to different people from a group of 6.

1. The positions are distinct, so order matters. Without reuse, the choice counts are $6, 5$ for the successive positions.

2. Multiply: $6 \cdot 5 = 30$. Swapping two selected people or objects changes their positions, so do not divide by the number of reorderings.

Answer: 30 arrangements.

Practice Problems

Show your thinking.

1. A learner adds 4 jacket choices and 3 scarf choices to count outfits. Correct the count.

2. A learner uses 6 times 6 for president and secretary from 6 people, with no one holding both roles. Correct it.

3. A learner counts 20 two-person groups from 5 people by ordering the names. Correct the unranked count.

4. A learner divides by 6 for a gold-silver-bronze podium from 5 entrants. Count the actual ranked outcomes.

5. A learner uses decreasing choices for a 2-letter code from 5 letters even though repetition is allowed. Correct it.

6. A meal has one soup and one drink. There are 3 soups and 18 possible meals. How many drink choices are there?

7. Count three-digit numbers from 0, 1, 2, 3 with no repeated digit; a leading zero is forbidden.

8. Why do 3-person unranked committees from 6 people total 20, not 120? Verify numerically.

9. A learner says a repeated letter is allowed when arranging 3 of 4 distinct cards without replacement. Count legal arrangements.

10. Four people form a two-person team. If each team then chooses a captain from its members, how many team-with-captain outcomes result?

Answer Key

1. 12 outcomes.
2. 30 arrangements.
3. 10 selections.
4. 60 arrangements.
5. 25 outcomes.
6. 6 drinks.
7. 18 outcomes.
8. $120/6 = 20$
9. 24 arrangements.
10. 12 outcomes.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. There are 4 jacket choices, and each can be paired with all 3 scarves. The sum $4 + 3 = 7$ does not count jacket-scarf pairs.

2. Multiply the number of choices at the successive stages: $4 \cdot 3 = 12$. Each complete outcome uses one choice at every stage, so addition would count only separate choices, not completed outcomes.

Problem 2

1. The positions are distinct, so order matters. Without reuse, the choice counts are $6, 5$ for the successive positions.

2. Multiply: $6 \cdot 5 = 30$. Swapping two selected people or objects changes their positions, so do not divide by the number of reorderings.

Problem 3

1. Counting ordered choices first gives $5 \cdot 4 = 20$. But each selected group appears in $2! = 2$ different orders.

2. Order is irrelevant here, so divide out those repeats: $20/2 = 10$. This is a combination, not an assignment to distinct positions.

Problem 4

1. The positions are distinct, so order matters. Without reuse, the choice counts are $5, 4, 3$ for the successive positions.

2. Multiply: $5 \cdot 4 \cdot 3 = 60$. Swapping two selected people or objects changes their positions, so do not divide by the number of reorderings.

Problem 5

1. The first position has 5 choices. Because repetition is allowed, the second position still has all 5 choices, including the first letter again.

2. Multiply the number of choices at the successive stages: $5 \cdot 5 = 25$. Each complete outcome uses one choice at every stage, so addition would count only separate choices, not completed outcomes.

Problem 6

1. Let d be the drink count. Each of 3 soups pairs with each drink, so the counting principle gives $3d = 18$.

2. Divide by 3: $d = 18/3 = 6$. Check $3(6) = 18$ complete soup-drink pairs, matching the required total.

Problem 7

1. The first digit has 3 nonzero choices. Then 3 unused digits remain, including zero; after the second choice, 2 digits remain.

2. Multiply the number of choices at the successive stages: $3 \cdot 3 \cdot 2 = 18$. Each complete outcome uses one choice at every stage, so addition would count only separate choices, not completed outcomes.

Problem 8

1. The ordered count is $6(5)(4) = 120$. Any one three-person committee appears in $3(2)(1) = 6$ orders.

2. Divide the ordered count by these duplicate orders: $120/6 = 20$. A committee has no first, second, or third position, so those six orders are the same group.

Problem 9

1. The positions are distinct, so order matters. Without reuse, the choice counts are $4, 3, 2$ for the successive positions.

2. Multiply: $4 \cdot 3 \cdot 2 = 24$. Swapping two selected people or objects changes their positions, so do not divide by the number of reorderings.

Problem 10

1. The unordered team count is $4(3)/2 = 6$. Every selected pair has exactly 2 possible captains.

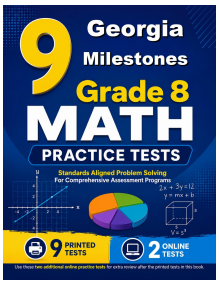
2. Multiply $6(2) = 12$. This matches choosing the captain first in 4 ways and the other team member in 3 ways, giving $4(3) = 12$.

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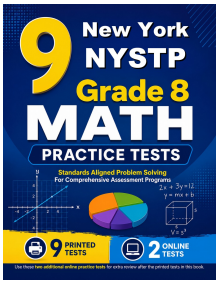
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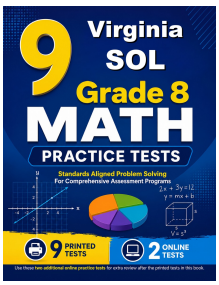
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