Combinations

Probability & Counting Worksheet · Grade 9–12

Name: _____ Date: _____

Learning Objectives

- Understand the difference between combinations and permutations, recognizing that order does not matter in combinations
- Apply the combination formula C(n, r) = n! / [(n – r)! · r!] using direct substitution
- Solve real-world word problems involving combinations by identifying n and r correctly

Problems

1. Evaluate the combination of 5 taken 2 at a time.

$C(5, 2)$

2. Evaluate the combination of 6 taken 3 at a time.

$C(6, 3)$

3. Evaluate the combination of 8 taken 5 at a time.

$C(8, 5)$

4. A teacher wants to select 2 students from a class of 7 to represent the school at a science fair. How many possible combinations of students can be chosen?

$C(7, 2)$

5. From a group of 5 volunteers — Gabby, Carly, Ivana, Alfredo, and Angelo — only 3 are chosen to join the Math Olympics. How many possible combinations can be formed?

$C(5, 3)$

6. A pizza shop offers 9 toppings. A customer wants to choose any 4 toppings for their pizza. How many different combinations of toppings are possible?

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$C(9, 4)$

7. A basketball coach needs to choose 5 players from a roster of 12 to start a game. How many different starting lineups are possible?

$C(12, 5)$

8. A committee of 4 people is to be formed from a group of 10 candidates. In how many ways can the committee be selected? Then, determine how many more ways there would be if the committee size were increased to 5 people instead.

$C(10, 4)$ and $C(10, 5)$

9. A deck of 52 cards is used in a card game. A hand of 5 cards is dealt to a player. How many different 5-card hands are possible from a standard 52-card deck?

$C(52, 5)$

10. A school club has 6 boys and 5 girls. A committee of 4 members must be selected such that exactly 2 are boys and exactly 2 are girls. In how many ways can this committee be formed?

$C(6, 2) \times C(5, 2)$

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Combinations — Answer Key

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Answer Key

1. Answer: 10

- Write the formula: C(n, r) = n! / [(n – r)! · r!]
- Substitute n = 5, r = 2: C(5, 2) = 5! / [(5 – 2)! · 2!]
- Simplify: 5! / (3! · 2!) = (5 × 4) / (2 × 1) = 20 / 2 = 10

2. Answer: 20

- Write the formula: C(n, r) = n! / [(n – r)! · r!]
- Substitute n = 6, r = 3: C(6, 3) = 6! / [(6 – 3)! · 3!]
- Simplify: 6! / (3! · 3!) = (6 × 5 × 4) / (3 × 2 × 1) = 120 / 6 = 20

3. Answer: 56

- Write the formula: C(n, r) = n! / [(n – r)! · r!]
- Substitute n = 8, r = 5: C(8, 5) = 8! / [(8 – 5)! · 5!]
- Simplify: 8! / (3! · 5!) = (8 × 7 × 6) / (3 × 2 × 1) = 336 / 6 = 56

4. Answer: 21

- Identify n = 7 (total students) and r = 2 (students to choose)
- Apply the formula: C(7, 2) = 7! / [(7 – 2)! · 2!]
- Simplify: (7 × 6) / (2 × 1) = 42 / 2 = 21 possible combinations

5. Answer: 10

- Identify n = 5 (total volunteers) and r = 3 (students to choose)
- Apply the formula: C(5, 3) = 5! / [(5 – 3)! · 3!]
- Simplify: (5 × 4 × 3) / (3 × 2 × 1) = 60 / 6 = 10 combinations

6. Answer: 126

- Identify n = 9 (total toppings) and r = 4 (toppings chosen)
- Apply the formula: C(9, 4) = 9! / [(9 – 4)! · 4!]
- Expand numerator: 9 × 8 × 7 × 6 = 3024; denominator: 4 × 3 × 2 × 1 = 24
- C(9, 4) = 3024 / 24 = 126 combinations

7. Answer: 792

- Identify n = 12 (total players) and r = 5 (starters needed)
- Apply the formula: C(12, 5) = 12! / [(12 – 5)! · 5!]
- Expand: (12 × 11 × 10 × 9 × 8) / (5 × 4 × 3 × 2 × 1) = 95040 / 120 = 792

8. Answer: C(10,4) = 210; C(10,5) = 252; difference = 42

- Calculate C(10, 4): 10! / (6! · 4!) = (10 × 9 × 8 × 7) / (4 × 3 × 2 × 1) = 5040 / 24 = 210
- Calculate C(10, 5): 10! / (5! · 5!) = (10 × 9 × 8 × 7 × 6) / (5 × 4 × 3 × 2 × 1) = 30240 / 120 = 252

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- Difference: 252 – 210 = 42 more ways with a committee of 5

9. Answer: 2,598,960

- Identify n = 52 and r = 5
- Apply the formula: C(52, 5) = 52! / [(52 – 5)! · 5!]
- Expand numerator: 52 × 51 × 50 × 49 × 48 = 311,875,200
- Denominator: 5! = 120
- C(52, 5) = 311,875,200 / 120 = 2,598,960

10. Answer: 150

- Choose 2 boys from 6: C(6, 2) = 6! / (4! · 2!) = (6 × 5) / (2 × 1) = 15
- Choose 2 girls from 5: C(5, 2) = 5! / (3! · 2!) = (5 × 4) / (2 × 1) = 10
- Multiply the two combinations: 15 × 10 = 150 possible committees

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