Permutations

Counting & Arrangements Worksheet · Grade 9–12

Name: _____ Date: _____

Learning Objectives

- Apply the permutation formula nPr = n! / (n – r)! to evaluate expressions and solve real-world problems
- Identify the values of n and r in a permutation context and understand that n must be greater than r
- Calculate the number of distinct arrangements of words with repeated letters using the formula n! / (r■! · r■! · …)

Problems

1. Evaluate the permutation expression.

$5P2$

2. Evaluate the permutation expression.

$6P3$

3. Evaluate the permutation expression.

$8P2$

4. A club has 8 members. In how many ways can they choose a President, Vice-President, and Secretary (all different people)?

$8P3$

5. Six runners are in a race. How many different ways can the gold, silver, and bronze medals be awarded?

$6P3$

6. How many 4-letter arrangements can be made from the letters in the word PENCIL (no letter repeated)?

$6P4$

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7. Find the number of distinct arrangements of all the letters in the word LEVEL.

$$\frac{5!}{2! \cdot 2!}$$

8. Find the number of distinct arrangements of all the letters in the word MISSISSIPPI.

$$\frac{11!}{4! \cdot 4! \cdot 2!}$$

9. A photographer must arrange 4 people from a group of 10 in a single row for a photo. How many different arrangements are possible?

$10P4$

10. A security system requires a 3-digit PIN using digits from 1 through 9 with no digit repeated. How many possible PINs are there? Then find how many of these PINs start with the digit 5.

$9P3$

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Permutations — Answer Key

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Answer Key

1. Answer: 20
- Use the formula: nPr = n! / (n – r)!
- 5P2 = 5! / (5 – 2)! = 5! / 3!
- = (5 × 4 × 3!) / 3! = 5 × 4 = 20

2. Answer: 120
- Use the formula: nPr = n! / (n – r)!
- 6P3 = 6! / (6 – 3)! = 6! / 3!
- = 6 × 5 × 4 × 3! / 3! = 6 × 5 × 4 = 120

3. Answer: 56
- Use the formula: nPr = n! / (n – r)!
- 8P2 = 8! / (8 – 2)! = 8! / 6!
- = 8 × 7 × 6! / 6! = 8 × 7 = 56

4. Answer: 336
- Order matters (different titles), so use permutation: n = 8, r = 3
- 8P3 = 8! / (8 – 3)! = 8! / 5!
- = 8 × 7 × 6 × 5! / 5! = 8 × 7 × 6 = 336

5. Answer: 120
- Order matters (1st, 2nd, 3rd places are distinct), so use permutation: n = 6, r = 3
- 6P3 = 6! / (6 – 3)! = 6! / 3!
- = 6 × 5 × 4 × 3! / 3! = 6 × 5 × 4 = 120

6. Answer: 360
- PENCIL has 6 distinct letters, and we arrange 4 at a time: n = 6, r = 4
- 6P4 = 6! / (6 – 4)! = 6! / 2!
- = 6 × 5 × 4 × 3 × 2! / 2! = 6 × 5 × 4 × 3 = 360

7. Answer: 30
- LEVEL has 5 letters: L appears 2 times, E appears 2 times, V appears 1 time
- Use the repeated-letters formula: n! / (r■! · r■! · …)
- = 5! / (2! × 2!) = 120 / (2 × 2) = 120 / 4 = 30

8. Answer: 34,650
- MISSISSIPPI has 11 letters: M=1, I=4, S=4, P=2
- Use the repeated-letters formula: 11! / (1! × 4! × 4! × 2!)
- = 39,916,800 / (1 × 24 × 24 × 2) = 39,916,800 / 1,152 = 34,650

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9. Answer: 5,040

- Order matters (positions in a row are distinct): n = 10, r = 4
- 10P4 = 10! / (10 – 4)! = 10! / 6!
- = 10 × 9 × 8 × 7 × 6! / 6! = 10 × 9 × 8 × 7 = 5,040

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10. Answer: Total PINs: 504; PINs starting with 5: 56

- Part 1 — Total PINs: n = 9, r = 3 → 9P3 = 9! / 6! = 9 × 8 × 7 = 504
- Part 2 — PINs starting with 5: Fix digit 5 in the first position; choose remaining 2 digits from the 8 remaining digits in order
- 8P2 = 8! / 6! = 8 × 7 = 56
- So there are 504 total PINs and 56 that start with the digit 5

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