Permutations and the Fundamental Counting Principle

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Name: ______________________ Date: ______________ Score: / 10

Learning Objectives

- Evaluate permutation notation nPr using factorials
- Apply the Fundamental Counting Principle to multi-stage selections
- Compute permutations of objects with repeated (identical) items
- Solve word problems involving arrangements where order matters

Solve each problem, showing all factorial setups and final whole-number answers.

1. Evaluate the permutation.

$_{7}P_{3}$

Answer: ______________________

2. Evaluate the permutation.

$_{8}P_{4}$

Answer: ______________________

3. Evaluate the permutation.

$_{10}P_{2}$

Answer: ______________________

4. In how many ways can a president, vice-president, and secretary be chosen from a club of 12 members?

$_{12}P_{3}$

Answer: ______________________

5. How many different 4-letter arrangements can be formed from the letters of the word MATH if no letter is repeated?

$_{4}P_{4}$

Answer: ______________________

6. Find the number of distinguishable arrangements of the letters of the word BANANA.

$$\frac{6!}{3! \cdot 2!}$$

Answer: ______________________

7. Find the number of distinguishable arrangements of the letters of the word BARSTOW.

$7!$

Answer: ________________________________

8. Find the number of distinguishable arrangements of the letters of the word MISSISSIPPI.

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

Answer: ________________________________

9. Using the Fundamental Counting Principle, how many different outfits can be made from 5 shirts, 4 pairs of pants, and 3 pairs of shoes?

$5 \cdot 4 \cdot 3$

Answer: ________________________________

10. How many 3-digit numbers can be formed from the digits 1, 2, 3, 4, 5, 6, 7 with no digit repeated?

${}_{7}P_{3}$

Answer: ________________________________

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ANSWER KEY & SOLUTIONS

This worksheet covers the topics presented in the video: evaluating 7P3 using the permutation formula, solving a word problem with permutations, finding the number of distinguishable arrangements of the letters of BANANA (permutations with repetition), and finding the number of arrangements of the letters of BARSTOW (permutations of distinct letters). The Fundamental Counting Principle is reinforced throughout.

Solutions

1. Evaluate the permutation.

$_{7}P_{3}$

→ *Use the permutation formula nPr equals n factorial divided by the quantity n minus r factorial.*
→ *Substitute n equals 7 and r equals 3 to get 7 factorial divided by 4 factorial.*
→ *Expand to 7 times 6 times 5.*
→ *Multiply to obtain 210.*

Answer: 210

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2. Evaluate the permutation.

$_{8}P_{4}$

→ *Apply the permutation formula with n equals 8 and r equals 4.*
→ *Write 8 factorial divided by 4 factorial, which simplifies to 8 times 7 times 6 times 5.*
→ *Multiply 8 times 7 to get 56.*
→ *Multiply 56 times 6 to get 336, then 336 times 5 to get 1680.*

Answer: 1680

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3. Evaluate the permutation.

$_{10}P_{2}$

→ *Use the permutation formula with n equals 10 and r equals 2.*
→ *This simplifies to 10 times 9.*
→ *Multiply to obtain 90.*

Answer: 90

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4. In how many ways can a president, vice-president, and secretary be chosen from a club of 12 members?

$_{12}P_{3}$

→ *Because the three positions are distinct, order matters, so use permutations.*
→ *Compute 12P3 as 12 times 11 times 10.*
→ *Multiply 12 times 11 to get 132.*
→ *Multiply 132 times 10 to obtain 1320.*

Answer: 1320

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5. How many different 4-letter arrangements can be formed from the letters of the word MATH if no letter is repeated?

$_4P_4$

→ *All 4 distinct letters are arranged, so compute 4 factorial.*
→ *Expand 4 factorial as 4 times 3 times 2 times 1.*
→ *Multiply step by step to obtain 24.*

Answer: 24

6. Find the number of distinguishable arrangements of the letters of the word BANANA.

$\frac{6!}{3! \cdot 2!}$

→ *The word BANANA has 6 letters with the letter A repeated 3 times and the letter N repeated 2 times.*
→ *Use the formula n factorial divided by the product of the factorials of each repeated letter count.*
→ *Set up 6 factorial over 3 factorial times 2 factorial, which is 720 divided by 12.*
→ *Divide to get 60 distinguishable arrangements.*

Answer: 60

7. Find the number of distinguishable arrangements of the letters of the word BARSTOW.

$7!$

→ *BARSTOW has 7 distinct letters with no repetitions.*
→ *Compute 7 factorial as 7 times 6 times 5 times 4 times 3 times 2 times 1.*
→ *Multiply step by step to obtain 5040.*

Answer: 5040

8. Find the number of distinguishable arrangements of the letters of the word MISSISSIPPI.

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

→ *The word has 11 letters with I repeated 4 times, S repeated 4 times, and P repeated 2 times.*
→ *Set up 11 factorial divided by the product of 4 factorial, 4 factorial, and 2 factorial.*
→ *Compute 11 factorial equals 39916800 and the denominator equals 24 times 24 times 2 equals 1152.*
→ *Divide 39916800 by 1152 to obtain 34650.*

Answer: 34650

9. Using the Fundamental Counting Principle, how many different outfits can be made from 5 shirts, 4 pairs of pants, and 3 pairs of shoes?

$5 \cdot 4 \cdot 3$

→ *By the Fundamental Counting Principle, multiply the number of choices at each stage.*
→ *Multiply 5 shirts times 4 pairs of pants to get 20.*
→ *Multiply 20 by 3 pairs of shoes to obtain 60 different outfits.*

Answer: 60

10. How many 3-digit numbers can be formed from the digits 1, 2, 3, 4, 5, 6, 7 with no digit repeated?

$_7P_3$

→ *Order matters since each digit position is distinct, so use the permutation 7P3.*
→ *Expand as 7 times 6 times 5.*
→ *Multiply to obtain 210 different 3-digit numbers.*

Answer: 210