Sequences and Factorial Notation

Precalculus Worksheet · Grade 10–12

Name: _____ Date: _____

Learning Objectives

- Evaluate sequences by substituting values of n to find specific terms
- Understand and apply factorial notation including the property that 0! = 1
- Simplify expressions involving factorials by expanding and canceling common factors

Problems

1. Write the first four terms of the sequence defined by the formula below.

$$a_n = 2n + 1$$

2. Evaluate the factorial expression below.

$$4!$$

3. Write the first four terms of the sequence defined by the formula below.

$$a_n = n^2 - 1$$

4. Evaluate the factorial expression below.

$$\frac{6!}{4!}$$

5. Write the first four terms of the sequence defined by the formula below.

$$a_n = 5 + (-1)^n$$

6. Find the 8th term of the sequence defined by the formula below.

$$a_n = 4n - 3$$

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7. Simplify the factorial expression below completely.

$$\frac{8!}{2! \cdot 6!}$$

8. Write the first four terms of the sequence defined by the formula below.

$$a_n = \frac{(-1)^{n+1}}{n}$$

9. Simplify the factorial expression below completely.

$$\frac{2! \cdot 6!}{3! \cdot 5!}$$

10. Write the first four terms of the sequence defined by the formula below, then find the sum of all four terms.

$$a_n = \frac{n!}{(n+1)!}$$

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Sequences and Factorial Notation — Answer Key

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Answer Key

1. Answer: 3, 5, 7, 9

- Substitute n = 1: 2(1) + 1 = 3
- Substitute n = 2: 2(2) + 1 = 5
- Substitute n = 3: 2(3) + 1 = 7
- Substitute n = 4: 2(4) + 1 = 9
- First four terms: 3, 5, 7, 9

2. Answer: 24

- Expand: 4! = 1 × 2 × 3 × 4
- Multiply step by step: 1 × 2 = 2, 2 × 3 = 6, 6 × 4 = 24
- 4! = 24

3. Answer: 0, 3, 8, 15

- Substitute n = 1: 1^2 - 1 = 0
- Substitute n = 2: 2^2 - 1 = 3
- Substitute n = 3: 3^2 - 1 = 8
- Substitute n = 4: 4^2 - 1 = 15
- First four terms: 0, 3, 8, 15

4. Answer: 30

- Expand 6! = 6 × 5 × 4 × 3 × 2 × 1 and 4! = 4 × 3 × 2 × 1
- Cancel the common 4! terms: \frac{6 × 5 × 4!}{4!}
- Left with 6 × 5 = 30

5. Answer: 4, 6, 4, 6

- Substitute n = 1: 5 + (-1)^1 = 5 - 1 = 4
- Substitute n = 2: 5 + (-1)^2 = 5 + 1 = 6
- Substitute n = 3: 5 + (-1)^3 = 5 - 1 = 4
- Substitute n = 4: 5 + (-1)^4 = 5 + 1 = 6
- First four terms: 4, 6, 4, 6

6. Answer: 29

- Substitute n = 8 into the formula
- a_8 = 4(8) - 3 = 32 - 3 = 29

7. Answer: 28

- Expand 8! = 8 × 7 × 6!, 2! = 2 × 1, and cancel 6!
- Expression becomes \frac{8 × 7 × 6!}{2! × 6!}
- After canceling 6!: \frac{8 × 7}{2 × 1} = \frac{56}{2} = 28

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8. Answer: 1, -1/2, 1/3, -1/4

- Substitute n = 1: (-1)^2 / 1 = 1
- Substitute n = 2: (-1)^3 / 2 = -1/2
- Substitute n = 3: (-1)^4 / 3 = 1/3
- Substitute n = 4: (-1)^5 / 4 = -1/4
- First four terms: 1, -1/2, 1/3, -1/4

9. Answer: 2/3

- Expand: 2! = 2, 6! = 6 × 5!, 3! = 6, and 5! cancels
- Expression becomes \frac{2 × 6 × 5!}{6 × 5!}
- After canceling 5! and 6: \frac{2 × 6}{6 × 3} = \frac{12}{18} = \frac{2}{3}

10. Answer: Terms: 1/2, 1/3, 1/4, 1/5 — Sum: 77/60

- Note that (n+1)! = (n+1) × n!, so \frac{n!}{(n+1)!} = \frac{1}{n+1}
- n = 1: 1/2
- n = 2: 1/3
- n = 3: 1/4
- n = 4: 1/5
- Sum = 1/2 + 1/3 + 1/4 + 1/5 = 30/60 + 20/60 + 15/60 + 12/60 = 77/60

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