MATHEMATICS · GRADES 10-12

# Factorials

### Difficulty level: Advanced

### Mathematics: Grades 10-12

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## *Overview of the concept*

This is how you count the ways to arrange things in order. The ways to line up players for a team photo, or to deal out cards in a game, both come down to multiplying down from the number of items. A factorial is just that countdown multiplication written short. It is the counting tool behind every question about arrangements and orders.



## *Rule*

**Factorial: n! means multiply n by every whole number below it, down to 1.**

So 4! = 4 × 3 × 2 × 1 = 24. By agreement, 0! = 1.

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## Worked examples

EXAMPLE 1

**Q** Find 4 factorial.

SOLUTION

4! = 4 × 3 × 2 × 1

Multiply step by step: 4 × 3 = 12, 12 × 2 = 24, 24 × 1 = 24

4 factorial = 24

EXAMPLE 2

**Q** Find 5 factorial divided by 3 factorial.

SOLUTION

Write them out: (5 × 4 × 3 × 2 × 1) ÷ (3 × 2 × 1)

Cancel the common part 3 × 2 × 1

You are left with 5 × 4 = 20

## Practice questions

1 A coach lines up 3 players for a team photo. How many orders are possible?

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2 **What is 5 factorial?**

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3 **An empty shelf has 0 books. How many ways can they be ordered?**

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4 **How many ways can 5 runners finish first, second, and third?**

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5 **Two friends swap seats, but Ana must sit on the left. How many orders are possible?**

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6 **What is 3 factorial times 4 factorial?**

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7 **What is 4 factorial divided by 2 factorial?**

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8 One trophy is awarded. How many ways can it be given?

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9 What is 6 factorial minus 4 factorial?

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10 What is 3 factorial plus 4 factorial?

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## ANSWER KEY

**1.** 6

**2.** 120

**3.** 1

**4.** 60

**5.** 1

**6.** 144

**7.** 12

**8.** 1

**9.** 696

**10.** 30

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