MATHEMATICS · GRADES 10-12

Factored form

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you read off where a curve crosses the ground. A thrown ball leaves your hand at one moment and lands at another, and the factored form shows you both moments at a glance. You do not need to solve anything, the answers are sitting right there in the brackets. It is the fastest way to find the starting and ending points of a flight or a fall.



Rule

Factored form: a quadratic (an expression with an x^2 term) written as $y = a(x - r)(x - s)$, where a is the leading coefficient (the number in front of the brackets), crosses the x-axis at $x = r$ and $x = s$.

Set each bracket to zero to read the roots straight off.

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Worked examples

EXAMPLE 1

Q Find the roots of $y = (x - 2)(x + 4)$

SOLUTION

Factored form is $y = a(x - r)(x - s)$, where r and s are the roots.

Set each bracket to zero: $x - 2 = 0$ or $x + 4 = 0$

From $x - 2 = 0$, $x = 2$. From $x + 4 = 0$, $x = -4$, because 4 must be taken from both sides.

So the roots are $x = 2$ and $x = -4$

EXAMPLE 2

Q Find the roots of $y = 2(x - 1)(x - 3)$

SOLUTION

The leading factor 2 does not change the roots.

Set each bracket to zero: $x - 1 = 0$ or $x - 3 = 0$

So the roots are $x = 1$ and $x = 3$

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Practice questions

1 Find the roots of $y = (x - 5)(x + 2)$.

- **A** $x = 5$ and $x = -2$
- **B** $x = -5$ and $x = 2$
- **C** $x = 5$ and $x = 2$
- **D** $x = -5$ and $x = -2$

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2 Expand $y = (x + 3)(x + 7)$ into standard form.

- **A** $x^2 + 10x + 21$
- **B** $x^2 - 10x + 21$
- **C** $x^2 + 10x - 21$
- **D** $x^2 + 21x + 10$

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3 Find the roots of $y = 3(x - 4)(x + 1)$.

- **A** $x = -4$ and $x = 1$
- **B** $x = 4$ and $x = 1$
- **C** $x = -4$ and $x = -1$
- **D** $x = 4$ and $x = -1$

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4 What is the product of the roots of $y = (x - 6)(x - 2)$?

- **A** 12
- **B** 8
- **C** -12
- **D** 4

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5 What is the sum of the roots of $y = (x + 8)(x - 3)$?

- **A** -5
- **B** 5
- **C** 11
- **D** -11

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6 A parabola crosses the x-axis at 3 and -1. Which factored form is it, with leading coefficient 1?

- **A** $y = (x - 3)(x + 1)$
- **B** $y = (x + 3)(x + 1)$
- **C** $y = (x - 3)(x - 1)$
- **D** $y = (x + 3)(x - 1)$

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7 **A parabola has roots $x = -4$ and $x = 6$ and leading coefficient 2. Which is its factored form?**

- **A** $y = 2(x + 4)(x - 6)$
- **B** $y = (x + 4)(x - 6)$
- **C** $y = 2(x - 4)(x + 6)$
- **D** $y = 2(x + 4)(x + 6)$

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8 **The parabola $y = 2(x + 5)(x + 5)$ has two brackets but only one root. Why?**

- **A** Because the leading factor 2 cancels one of the roots
- **B** Both brackets give $x = -5$, so the root is repeated
- **C** Because $(x + 5)$ is squared, the second bracket does not count
- **D** Because the root $x = -5$ is negative, it only counts once

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9 **How many times does $y = (x - 7)(x + 2)$ cross the x-axis?**

- **A** 0
- **B** 1
- **C** 2
- **D** 3

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10 **Three of these parabolas cross the x-axis once on each side of zero and one does not. Which one is it?**

A $y = (x - 2)(x + 3)$

B $y = (x + 2)(x - 3)$

C $y = (x - 3)(x + 2)$

D $y = (x - 2)(x - 3)$

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ANSWER KEY

1. $x = 5$ and $x = -2$

2. $x^2 + 10x + 21$

3. $x = 4$ and $x = -1$

4. 12

5. -5

6. $y = (x - 3)(x + 1)$

7. $y = 2(x + 4)(x - 6)$

8. Both brackets give $x = -5$, so the root is repeated

9. 2

10. $y = (x - 2)(x - 3)$

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