MATHEMATICS · GRADES 10-12

The discriminant

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you tell before solving whether a quadratic equation has two answers, one answer, or none, like checking how many times a thrown ball crosses a certain height, so you do not waste work solving the wrong way. One number, worked out from the equation, tells you the whole story before you start solving. If it says there are two answers, you know to look for both, and if it says none, you know not to go hunting for one. That quick check saves time and stops you from chasing an answer that is not there.



Rule

The discriminant: for a quadratic $ax^2 + bx + c$, the discriminant is $b^2 - 4ac$.

If it is positive there are two real roots, if it is zero there is one real root, and if it is negative there are no real roots.

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Worked examples

EXAMPLE 1

Q Find the discriminant of $x^2 + 5x + 6$

SOLUTION

Identify $a = 1$, $b = 5$, $c = 6$.

Compute $b^2 - 4ac$:

$b^2 - 4ac = 5^2 - 4 \times 1 \times 6$

$= 25 - 24 = 1$

The discriminant is 1, which is positive, so there are two distinct real roots.

EXAMPLE 2

Q Find the discriminant of $x^2 + x + 1$

SOLUTION

Identify $a = 1$, $b = 1$, $c = 1$.

Compute $b^2 - 4ac$:

$b^2 - 4ac = 1^2 - 4 \times 1 \times 1$

$= 1 - 4 = -3$

The discriminant is -3, which is negative, so there are no real roots.

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Practice questions

1 $x^2 + 4x + 3$. Find the discriminant.

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2 The discriminant of a quadratic is 9. How many real roots does it have?

A. Two

B. One

C. None

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3

Which quadratic has two real roots?

A $x^2 + 3x + 5$

B $x^2 + 2x + 5$

C $x^2 + 4x + 3$

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4

A parabola crosses the x-axis twice. What can you say about its discriminant?

A It is positive

B It is zero

C It is negative

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5 Find the value of k so that $x^2 + 4x + k$ has discriminant 0.

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6 A quadratic has discriminant 0. What does its graph look like?

A. It crosses the x-axis twice

B. It touches the x-axis once

C. It never touches the x-axis

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7 **Which value of the discriminant means the quadratic has exactly one real root?**

- **A** −3
- **B** 0
- **C** 5

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8 **What are a, b, and c in $2x^2 - 8x + 6 = 0$?**

- **A** a = 2, b = −8, c = 6
- **B** a = 2, b = 8, c = 6
- **C** a = 2, b = −8, c = −6

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9 Which one has discriminant 0?

A $x^2 + 6x + 9$

B $x^2 + 6x + 8$

C $x^2 + 6x + 10$

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10 Which of these quadratics has discriminant 1?

A $x^2 + 3x + 2$

B $x^2 + 2x + 1$

C $x^2 + x + 1$

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ANSWER KEY

1. 4

2. Two

3. $x^2 + 4x + 3$

4. It is positive

5. 4

6. It touches the x-axis once

7. 0

8. $a = 2, b = -8, c = 6$

9. $x^2 + 6x + 9$

10. $x^2 + 3x + 2$

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