MATHEMATICS · GRADES 10-12

Rational equations with extraneous solutions

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you double-check a solution to make sure it actually fits the real situation, like a work schedule that would need a negative number of hours. A calculation can give you an answer that looks right on paper but makes no sense in real life, like a negative time or a speed that cannot exist. A builder who gets a negative length knows right away the answer cannot be used, even if the algebra produced it. Checking an answer against reality is what separates a correct solution from a number that only looks correct.



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Rule

A value that makes a denominator zero is excluded and can never be a solution.

If solving gives you an excluded value, that solution is extraneous, and the equation may have no solution at all.

Worked examples

EXAMPLE 1

Q Solve $\frac{(x - 1)}{(x - 2)} = \frac{1}{(x - 2)}$

SOLUTION

Note the excluded value: x is not 2.

Multiply both sides by (x - 2): x - 1 = 1, so x = 2.

But x = 2 is excluded, so it is extraneous and there is no solution.

EXAMPLE 2

Q Solve $\frac{(x + 1)}{(x - 3)} = \frac{4}{(x - 3)}$

SOLUTION

Note the excluded value: x is not 3.

Multiply both sides by (x - 3): x + 1 = 4, so x = 3.

But x = 3 is excluded, so it is extraneous and there is no solution.

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Practice questions

1 $\frac{(x - 2)}{(x - 5)} = \frac{3}{(x - 5)}$. Solve it. Does it have a solution?

- **A** x = 5
- **B** no solution
- **C** x = 2
- **D** x = 3

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2 Solve $\frac{(x - 1)}{(x - 2)} = \frac{2}{(x - 2)}$. What is x?

- **A** x = 3
- **B** no solution
- **C** x = 2
- **D** x = 1

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3 In $\frac{1}{(x-3)} + \frac{2}{(x+1)} = 5$, which values of x are excluded?

A 3

B –1

C 3 and –1

D 5

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4 In $\frac{(x-2)}{(x-5)} = \frac{3}{(x-5)}$, which value of x is excluded?

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5 Leo solves $\frac{(x - 3)}{(x - 5)} = \frac{2}{(x - 5)}$ and claims $x = 5$. He checks by substituting $x = 5$. What does he find?

- **A** $x = 5$ makes a denominator zero, so it is extraneous
- **B** $x = 5$ works
- **C** $x = 5$ makes both sides equal 2
- **D** There is no excluded value

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6 Solve $\frac{1}{(x - 2)} = \frac{3}{(x - 2)}$. Does it have a solution?

- **A** $x = 2$
- **B** no solution
- **C** $x = 1$
- **D** $x = 3$

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7 Solve $\frac{(2x + 1)}{(x - 5)} = \frac{7}{(x - 5)}$. What is x?

- **A** x = 3
- **B** x = 5
- **C** no solution
- **D** x = 7

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8 $\frac{2}{(x - 1)} = \frac{4}{(x - 1)}$ gives x = 1. Is x = 1 a solution?

- **A** Yes, x = 1 is a solution
- **B** No, x = 1 is extraneous
- **C** Yes, x = 1 is extraneous
- **D** No, x = 1 is the only solution

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9 **Which of these equations has an extraneous solution?**

- **A** $(x - 1)/(x - 2) = 3/(x - 2)$
- **B** $(x - 2)/(x - 5) = 4/(x - 5)$
- **C** $(x + 1)/(x - 3) = 5/(x - 3)$
- **D** $(x - 3)/(x - 6) = 3/(x - 6)$

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10 **Solve $\frac{5}{(x - 9)} = \frac{5}{(x - 9)}$, with x not 9. State the solution set.**

- **A** $x = 9$
- **B** all real numbers except 9
- **C** no solution
- **D** all real numbers

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ANSWER KEY

1. no solution

2. x = 3

3. 3 and –1

4. 5

5. x = 5 makes a denominator zero, so it is extraneous

6. no solution

7. x = 3

8. No, x = 1 is extraneous

9. (x – 3)/(x – 6) = 3/(x – 6)

10. all real numbers except 9

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