MATHEMATICS · GRADES 10-12

Solving rational equations

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you work out a real-life rate problem, like how long two people take to paint a room together or how fast a trip goes with a stop, when the unknown sits underneath a fraction. Rates are fractions by nature, so the time or speed you are looking for often ends up on the bottom of one. Solving means clearing those fractions carefully, so the unknown comes out on top where you can read it. That is how you plan shared work, work out travel times, or split a job between two machines.



Rule

Solving rational equations: multiply both sides by the denominator to clear the fractions, then solve the equation that is left.

Check the answer is not a value that makes a denominator zero.

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Worked examples

EXAMPLE 1

Q Solve $\frac{2}{x} = \frac{1}{2}$

SOLUTION

Cross multiply: the top of each side times the bottom of the other side: $2 \times 2 = x \times 1$.

Simplify each side: $2 \times 2 = 4$ and $x \times 1 = x$, so $4 = x$, and $x = 4$.

Check: x cannot be 0, and 4 is allowed. Put $x = 4$ back in: $\frac{2}{4} = \frac{1}{2}$, so it checks out.

EXAMPLE 2

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

SOLUTION

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

Expand and solve: $1 = 2x - 2$, so $2x = 3$ and $x = \frac{3}{2}$.

Check: $x = \frac{3}{2}$ is not the excluded value 1, so it is valid.

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Practice questions

1 Find x in $\frac{3}{x} = 1$

- **A** x = 1
- **B** x = 2
- **C** x = 3
- **D** x = 4

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2 Find x in $\frac{1}{x} = \frac{1}{4}$

- **A** x = 1
- **B** x = 2
- **C** x = 4
- **D** x = 16

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3 Find x in $\frac{2}{(x - 1)} = 1$

- **A** x = 1
- **B** x = 3
- **C** x = 2
- **D** x = 4

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4 Find x in $\frac{5}{x} = 10$

- **A** $\frac{1}{3}$
- **B** $\frac{1}{2}$
- **C** 2
- **D** $\frac{1}{5}$

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5 Find x in $\frac{1}{(x+2)} = \frac{1}{3}$.

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

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6 Find x in $\frac{1}{x} = \frac{1}{3}$.

- **A** x = 9
- **B** x = 3
- **C** x = 1
- **D** x = 2

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7 An equation has solution $x = 6$. Which one is it?

A $\frac{3}{x} = \frac{1}{3}$

B $\frac{1}{x} = \frac{1}{7}$

C $\frac{2}{x} = \frac{1}{3}$

D $\frac{4}{x} = \frac{1}{3}$

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8 Max solves $\frac{3}{x} = 1$ and writes $x = \frac{1}{3}$. What is Max's mistake?

A. He cross multiplied the wrong way: $x = \frac{1}{3}$ is right.

B. He flipped the fraction over: $\frac{3}{x} = 1$ gives $x = 3$.

C. He should have multiplied both sides by 3 twice.

D. He forgot the minus sign: $x = -3$.

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9 What is the solution of $\frac{4}{x} = 1$?

A. $x = 1$

B. $x = 2$

C. $x = 4$

D. $x = 5$

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10 Four equations are listed. Which one has a different solution?

A $\frac{3}{x} = 1$

B $\frac{1}{x} = \frac{1}{3}$

C $\frac{6}{x} = 2$

D $\frac{2}{x} = 1$

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ANSWER KEY

1. $x = 3$

2. $x = 4$

3. $x = 3$

4. $x = \frac{1}{2}$

5. $x = 1$

6. $x = 3$

7. $\frac{2}{x} = \frac{1}{3}$

8. He flipped the fraction over: $\frac{3}{x} = 1$ gives $x = 3$.

9. $x = 4$

10. $\frac{2}{x} = 1$

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