Converting Rational Numbers to Decimals

Spot mistakes, reason, and work backward

Name _____ **Date** _____ **Score** _____ / 10

QUICK REVIEW

Divide numerator by denominator. A repeated remainder makes a repeating block; a zero remainder ends the decimal. $1/5 = 0.2$ terminates. $1/9 = 0.\overline{1}$ repeats. A reduced denominator with only factors $2, 5$ terminates. A bar is not a rounding symbol.

Worked example

Convert $9/16$ to an exact decimal.

1. $16(625) = 10000$, so use ten-thousandths.
2. $9(625) = 5625$, so $9/16 = 5625/10000 = 0.5625$.
3. Only factors of 2 occur in $16 = 2^4$, so the decimal terminates.
Answer: 0.5625, terminating.

Practice Problems

Show your thinking.

1. A student rounds $\frac{3}{8}$ to 0.38 and calls that exact. Write the exact decimal and explain whether the rounded value is equal to it. Compare the exact reading with 0.4 and find their exact difference.

2. A student rounds $-\frac{7}{20}$ to -0.35 and calls that exact. Write the exact decimal and explain whether the rounded value is equal to it. Write the original value as a signed percent.

3. A student rounds $\frac{5}{6}$ to 0.83 and calls that exact. Write the exact decimal and explain whether the rounded value is equal to it. Add $1/6$ exactly; explain why using rounded hundredths can lose the exact sum.

4. A student rounds $\frac{2}{11}$ to 0.18 and calls that exact. Write the exact decimal and explain whether the rounded value is equal to it. Use $100d - d$ to verify the repeating decimal as an exact fraction.

5. A student rounds $-\frac{4}{9}$ to -0.44 and calls that exact. Write the exact decimal and explain whether the rounded value is equal to it. Find the positive distance between this value and $-1/2$.

6. A student rounds $\frac{7}{12}$ to 0.58 and calls that exact. Write the exact decimal and explain whether the rounded value is equal to it. Recover the missing fraction x in $x + 5/12 = 1$ and relate it to this reading.

7. Signal record: a display rounds $\frac{7}{16}$ to 0.44. Is the rounded value exact? Find the exact absolute rounding error.

8. Distance marker: convert exact decimal -0.36 to a fraction, showing its place-value or repeating-block calculation.

9. Balance check: a display rounds $\frac{11}{30}$ to 0.37. Is the rounded value exact? Find the exact absolute rounding error.

10. Reference scale: convert $\frac{7}{11}$ to an exact decimal; use a bar only for a repeating block.

Answer Key

1. 0.375; the rounded value is not exact. It is $0.025 = 1/40$ less than 0.4.
2. -0.35; the rounded value is exact. -35%.
3. $0.8\overline{3}$; the rounded value is not exact. Exact sum 1.
4. $0.\overline{18}$; the rounded value is not exact. $99d = 18$, so $d = 18/99 = 2/11$.
5. $-0.\overline{4}$; the rounded value is not exact. Distance $1/18$.
6. $0.58\overline{3}$; the rounded value is not exact. $x = 7/12$ is the reading.
7. Not exact. Rounding error $\frac{1}{400}$.
8. $-0.36 = -\frac{9}{25}$.
9. Not exact. Rounding error $\frac{1}{300}$.
10. $0.\overline{63} = \frac{7}{11}$.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. Divide the magnitude, carrying the remainders: $30 = 8(3) + 6$, $60 = 8(7) + 4$, $40 = 8(5) + 0$.
2. The reduced denominator is 8; removing factors 2 and 5 leaves 1, so the decimal terminates.
3. The exact signed decimal is $0.375 = \frac{3}{8}$. The displayed rounding is only an approximation.
4. $0.4 - 0.375 = 0.025 = 1/40$.

Problem 2

1. Divide the magnitude, carrying the remainders: $70 = 20(3) + 10$, $100 = 20(5) + 0$.
2. The reduced denominator is 20; removing factors 2 and 5 leaves 1, so the decimal terminates.
3. The exact signed decimal is $-0.35 = -\frac{7}{20}$. The displayed rounding is exact.
4. $-7/20 = -35/100 = -35\%$.

Problem 3

1. Divide the magnitude, carrying the remainders: $50 = 6(8) + 2$, $20 = 6(3) + 2$.
2. The reduced denominator is 6; removing factors 2 and 5 leaves 3, so the decimal repeats.
3. The exact signed decimal is $0.8\overline{3} = \frac{5}{6}$. The displayed rounding is only an approximation.
4. $5/6 + 1/6 = 6/6 = 1$, while $0.83 + 0.17$ happens to give 1 only because the rounding errors cancel.

Problem 4

1. Divide the magnitude, carrying the remainders: $20 = 11(1) + 9$, $90 = 11(8) + 2$.
2. The reduced denominator is 11; removing factors 2 and 5 leaves 11, so the decimal repeats.
3. The exact signed decimal is $0.\overline{18} = \frac{2}{11}$. The displayed rounding is only an approximation.
4. For $d = 0.\overline{18}$, subtract d from $100d$: $99d = 18$, giving $2/11$.

Problem 5

1. Divide the magnitude, carrying the remainders: $40 = 9(4) + 4$.
2. The reduced denominator is 9; removing factors 2 and 5 leaves 9, so the decimal repeats.
3. The exact signed decimal is $-0.\overline{4} = -\frac{4}{9}$. The displayed rounding is only an approximation.
4. $|-4/9 - (-1/2)| = |-8/18 + 9/18| = 1/18$.

Problem 6

1. Divide the magnitude, carrying the remainders: $70 = 12(5) + 10$, $100 = 12(8) + 4$, $40 = 12(3) + 4$.
2. The reduced denominator is 12; removing factors 2 and 5 leaves 3, so the decimal repeats.
3. The exact signed decimal is $0.58\overline{3} = \frac{7}{12}$. The displayed rounding is only an approximation.
4. $x = 1 - 5/12 = 7/12$, whose decimal is $0.58\overline{3}$.

Problem 7

1. Long division of the magnitude: $70 = 16(4) + 6$, $60 = 16(3) + 12$, $120 = 16(7) + 8$, $80 = 16(5) + 0$.
2. A zero remainder ends the decimal.
3. Absolute error $= |\frac{7}{16} - (0.44)| = \frac{1}{400}$; it is nonzero, so rounding is not equality.

Problem 8

1. The last written place is $1/100$ because there are 2 decimal places.
2. The digits give a signed count of -36 of those units: $-0.36 = \frac{-36}{100}$.
3. Divide the numerator and denominator by 4 to get $-\frac{9}{25}$.

Problem 9

1. Long division of the magnitude: $110 = 30(3) + 20$, $200 = 30(6) + 20$.
2. A repeated remainder repeats the same quotient digits.
3. Absolute error $= |\frac{11}{30} - (0.37)| = \frac{1}{300}$; it is nonzero, so rounding is not equality.

Problem 10

1. Long division of the magnitude: $70 = 11(6) + 4$, $40 = 11(3) + 7$.
2. A repeated remainder repeats the same quotient digits.
3. Therefore $\frac{7}{11} = 0.\overline{63}$ exactly.

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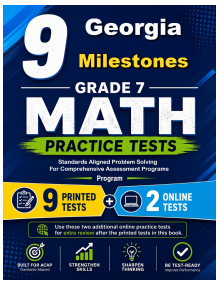

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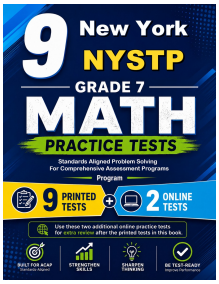

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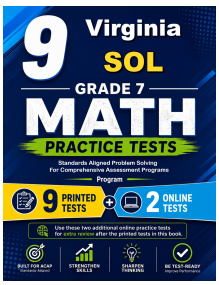

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