Converting Rational Numbers to Decimals

Apply the skill to decisions and designs

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 sensor reading is 0.375 m. Write it as an exact fraction, then decide whether its distance from zero is more than $1/2$ m. Compare the exact reading with 0.4 and find their exact difference.

2. A sensor reading is -0.35 m. Write it as an exact fraction, then decide whether its distance from zero is more than $1/2$ m. What signed percent of 1 m is this reading?

3. A sensor reading is $0.8\overline{3}$ m. Write it as an exact fraction, then decide whether its distance from zero is more than $1/2$ m. Add $1/6$ exactly; explain why using rounded hundredths can lose the exact sum.

4. A sensor reading is $0.\overline{18}$ m. Write it as an exact fraction, then decide whether its distance from zero is more than $1/2$ m. Use $100d - d$ to verify the repeating decimal as an exact fraction.

5. A sensor reading is $-0.\overline{4}$ m. Write it as an exact fraction, then decide whether its distance from zero is more than $1/2$ m. Find the positive distance between this value and $-1/2$.

6. A sensor reading is $0.58\overline{3}$ m. Write it as an exact fraction, then decide whether its distance from zero is more than $1/2$ m. Recover the missing fraction x in $x + 5/12 = 1$ and relate it to this reading.

7. Signal record: compare 0.4375 with $1/2$ using exact fractions. Find the positive distance between them.

8. Distance marker: a marker is at -0.36 m and a target is at $1/2$ m. Find the signed correction needed to reach the target.

9. Balance check: add 1 m to the exact reading $0.3\overline{6}$ m. Report an exact fraction and decimal.

10. Reference scale: a marker is at $0.\overline{63}$ m and a target is at $1/2$ m. Find the signed correction needed to reach the target.

Answer Key

1. $\frac{3}{8}$ m; not more than $1/2$ m. It is $0.025 = 1/40$ less than 0.4.
2. $-\frac{7}{20}$ m; not more than $1/2$ m. -35%.
3. $\frac{5}{6}$ m; more than $1/2$ m. Exact sum 1.
4. $\frac{2}{11}$ m; not more than $1/2$ m. $99d = 18$, so $d = 18/99 = 2/11$.
5. $-\frac{4}{9}$ m; not more than $1/2$ m. Distance $1/18$.
6. $\frac{7}{12}$ m; more than $1/2$ m. $x = 7/12$ is the reading.
7. $\frac{7}{16}$ is less than $1/2$; distance $\frac{1}{16}$.
8. $\frac{43}{50}$ m.
9. $\frac{41}{30} = 1.3\overline{6}$ m.
10. $-\frac{3}{22}$ m.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. The reading has 3 decimal places, so express it in units of $1/1000$.
2. $0.375 = 375/1000 = \frac{3}{8}$ m after reducing.
3. The distance from zero is $\frac{3}{8}$ m, not greater than $1/2$ m.
4. $0.4 - 0.375 = 0.025 = 1/40$.

Problem 2

1. The reading has 2 decimal places, so express it in units of $1/100$.
2. $-0.35 = -35/100 = -\frac{7}{20}$ m after reducing.
3. The distance from zero is $\frac{7}{20}$ m, not greater than $1/2$ m.
4. $-7/20 = -35/100 = -35\%$.

Problem 3

1. Let $d = |0.8\overline{3}|$. Shift the decimal: $10d = 8.\overline{3}$ and $100d = 83.\overline{3}$.
2. Subtract to cancel the repeated tail: $90d = 75$, so $d = \frac{5}{6}$.
3. The original sign gives the reading $\frac{5}{6}$ m.
4. The distance from zero is $\frac{5}{6}$ m, greater than $1/2$ m.
5. $5/6 + 1/6 = 6/6 = 1$, while $0.83 + 0.17$ happens to give 1 only because the rounding errors cancel.

Problem 4

1. Let $d = |0.\overline{18}|$. Shift the decimal: $1d = 0.\overline{18}$ and $100d = 18.\overline{18}$.
2. Subtract to cancel the repeated tail: $99d = 18$, so $d = \frac{2}{11}$.
3. The original sign gives the reading $\frac{2}{11}$ m.
4. The distance from zero is $\frac{2}{11}$ m, not greater than $1/2$ m.
5. For $d = 0.\overline{18}$, subtract d from $100d$: $99d = 18$, giving $2/11$.

Problem 5

1. Let $d = |-0.\overline{4}|$. Shift the decimal: $1d = 0.\overline{4}$ and $10d = 4.\overline{4}$.
2. Subtract to cancel the repeated tail: $9d = 4$, so $d = \frac{4}{9}$.
3. The original sign gives the reading $-\frac{4}{9}$ m.
4. The distance from zero is $\frac{4}{9}$ m, not greater than $1/2$ m.
5. $|-4/9 - (-1/2)| = |-8/18 + 9/18| = 1/18$.

Problem 6

1. Let $d = |0.58\overline{3}|$. Shift the decimal: $100d = 58.\overline{3}$ and $1000d = 583.\overline{3}$.
2. Subtract to cancel the repeated tail: $900d = 525$, so $d = \frac{7}{12}$.
3. The original sign gives the reading $\frac{7}{12}$ m.
4. The distance from zero is $\frac{7}{12}$ m, greater than $1/2$ m.
5. $x = 1 - 5/12 = 7/12$, whose decimal is $0.58\overline{3}$.

Problem 7

1. The last written place is $1/10000$ because there are 4 decimal places.
2. The digits give a signed count of 4375 of those units: $0.4375 = \frac{4375}{10000}$.
3. Divide the numerator and denominator by 625 to get $\frac{7}{16}$.
4. With denominator 16, subtract $\frac{7}{16} - \frac{8}{16} = -\frac{1}{16}$. The reading is below $1/2$, at distance $\frac{1}{16}$.

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 $-\frac{9}{25}$.
4. Correction $= 1/2 - (-\frac{9}{25}) = \frac{43}{50}$ m; check $-\frac{9}{25} + (\frac{43}{50}) = 1/2$ m.

Problem 9

1. Let $d = 0.3\overline{6}$ be the magnitude. Shift to line up the repeating digits: $100d = 36.\overline{6}$ and $10d = 3.\overline{6}$.
2. Subtract: $100d - 10d = 33$, so $90d = 33$.
3. Divide both sides: $d = \frac{33}{90} = \frac{11}{30}$.
4. Add exactly: $\frac{11}{30} + 1 = \frac{41}{30}$ m. Adding 1 to the reading increases its whole part by one, giving $1.3\overline{6}$ m.

Problem 10

1. Let $d = 0.\overline{63}$ be the magnitude. Shift to line up the repeating digits: $100d = 63.\overline{63}$ and $1d = 0.\overline{63}$.
2. Subtract: $100d - 1d = 63$, so $99d = 63$.
3. Divide both sides: $d = \frac{63}{99} = \frac{7}{11}$.
4. Correction $= 1/2 - (\frac{7}{11}) = -\frac{3}{22}$ m; check $\frac{7}{11} + (-\frac{3}{22}) = 1/2$ m.

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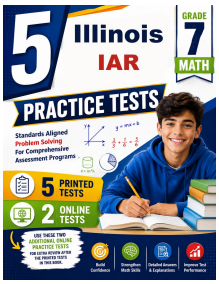

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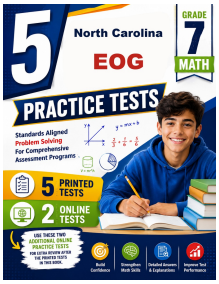

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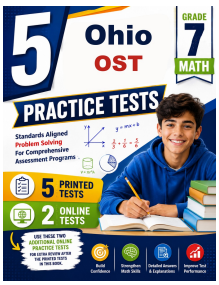

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