Fractions, Decimals, and Rational Numbers

Name: _____	Date: _____	Score: _____ / 17

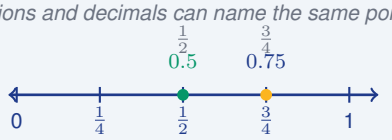
Welcome to the big picture of numbers! A **rational number** is any number you can write as a fraction $\frac{p}{q}$ where p and q are integers and $q \neq 0$—so whole numbers, fractions, terminating decimals, and repeating decimals are all part of the same family. Numbers like $\sqrt{2}$ and π cannot be written that way, so they are called **irrational**. Once you see that a fraction, a decimal, and a percent can all represent the *exact same value*, converting between forms becomes second nature and the rest of this chapter clicks into place.

Key Concepts & Quick Review

Rational number: $\frac{p}{q}$, where $p, q \in \mathbb{Z}$ and $q \neq 0$. **Includes:** integers, fractions, terminating & repeating decimals.

Fraction → Decimal: divide numerator by denominator. **Terminating:** $\frac{3}{8} = 0.375$ **Repeating:** $\frac{1}{3} = 0.\overline{3}$

Fractions and decimals can name the same point.



Examples

① Is $-\frac{7}{4}$ a rational number? If so, write it as a decimal.

Think It Through: Think of it this way: a number is rational if you can write it as a fraction with integers on top and bottom. Here we have -7 on top and 4 on bottom; both are integers, and the bottom is not zero, so it works. To turn $-\frac{7}{4}$ into a decimal, divide $7 \div 4 = 1.75$, then bring the negative sign: -1.75. Notice that the decimal stops. When a decimal terminates like this, that is a strong clue that the number is rational.

Answer: *Yes;* -1.75

② A bag of trail mix weighs $\frac{5}{8}$ pound. Show that this weight is rational by converting it to a decimal. Then determine whether the decimal terminates or repeats.

Think It Through: Start by dividing: $5 \div 8 = 0.625$. The decimal stops, so it is called a terminating decimal. That matters because any terminating decimal can be written as a fraction. In fact, $0.625 = \frac{625}{1000} = \frac{5}{8}$. So the weight is rational. A useful pattern to remember is that fractions with denominators built from only 2s and 5s often turn into terminating decimals.

Answer: 0.625*; terminates*

Practice Problems

Convert each fraction or mixed number to a decimal.

1. $\frac{1}{4} =$ _____
2. $\frac{3}{5} =$ _____
3. $\frac{7}{8} =$ _____
4. $\frac{1}{3} =$ _____
5. $\frac{5}{6} =$ _____
6. $\frac{2}{9} =$ _____
7. $\frac{11}{20} =$ _____
8. $-\frac{3}{4} =$ _____
9. $\frac{5}{11} =$ _____
10. $\frac{7}{12} =$ _____
11. $1\frac{1}{2} =$ _____
12. $2\frac{3}{4} =$ _____
13. $-1\frac{3}{5} =$ _____
14. $3\frac{1}{8} =$ _____
15. $-2\frac{5}{6} =$ _____

Study Tips

- If the denominator's only prime factors are 2s and 5s, the decimal **terminates**. Otherwise it **repeats**.
- A repeating decimal is written with a bar: $\frac{1}{6} = 0.1\overline{6}$ (only the 6 repeats).
- Every integer is rational: $-5 = \frac{-5}{1}$. Zero is rational: $0 = \frac{0}{1}$.

Word Problems

16. Three students measure the same length of ribbon. Anya records $\frac{7}{9}\ m$, Ben records $0.\overline{7}\ m$, and Carlos records $0.78\ m$. Convert Anya's fraction to a repeating decimal. Which two students measured the same length? Is Carlos's measurement rational? _____

17. A trail map lists four distances: $\frac{3}{8}\ mi$, $0.3\overline{7}\ mi$, $\sqrt{5}\ mi$, and $-\frac{5}{4}\ mi$. Identify which distance is *irrational*, explain why, and convert the remaining rational distances to decimals. Order the three rational values from least to greatest. _____

Answer Keys

1) 0.25
2) 0.6
3) 0.875
4) $0.\overline{3}$
5) $0.8\overline{3}$
6) $0.\overline{2}$
7) 0.55
8) -0.75
9) $0.\overline{45}$
10) $0.58\overline{3}$
11) 1.5
12) 2.75
13) -1.6
14) 3.125
15) $-2.8\overline{3}$
16) $0.\overline{7}$; Anya and Ben; yes
17) $\sqrt{5}$ is irrational; rationals: $-1.25,\ 0.375,\ 0.3\overline{7}$; order: $-1.25 < 0.375 < 0.3\overline{7}$.

Step-by-Step Explanations

Strategy: For Fractions, Decimals, and Rational Numbers, move between fractions and decimals by using division, place value, or familiar benchmark fractions, keeping the sign attached throughout. When the rational-number numbers look busy, the structure is what keeps the work simple.

Practice 1: $\frac{1}{4} =$ **Answer:** 0.25

For the first sample, use the form that makes the comparison or conversion easiest, then simplify the final form.

Practice 15: $-2\frac{5}{6} =$ **Answer:** $-2.8\overline{3}$

Late in the set, use the form that makes the comparison or conversion easiest, then simplify the final form.

Word-problem notes:

16. Answer: $\frac{7}{9} = 0.\overline{7}$; Anya and Ben; yes, $0.78 = \frac{78}{100}$.

Start by converting Anya's fraction: $7 \div 9 = 0.\overline{7}$, so Anya and Ben recorded the same repeating decimal. That means they measured the same length. Carlos wrote 0.78, which is different because it ends instead of repeating. But it is still rational because $0.78 = \frac{78}{100} = \frac{39}{50}$. So all three numbers are rational, but only Anya and Ben have matching measurements.

17. Answer: $\sqrt{5}$ is irrational; rationals: $-1.25,\ 0.375,\ 0.3\overline{7}$; order: $-1.25 < 0.375 < 0.3\overline{7}$.

First identify the irrational number: $\sqrt{5}$ cannot be written exactly as a fraction, so it is irrational. It goes on forever without repeating. The other three are rational. Convert them to decimals: $\frac{3}{8} = 0.375$, $0.3\overline{7}$ is already a repeating decimal, and $-\frac{5}{4} = -1.25$. To order them, remember that the negative value is always the least. Then compare the positive decimals: $0.375 < 0.3\overline{7}$. So the order is $-1.25 < 0.375 < 0.3\overline{7}$.

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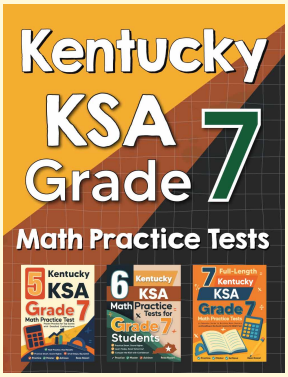

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