Unit Rates and Complex Fractions

Name: _____	Date: _____	Score: _____ / 17

A **rate** compares two quantities with different units—miles per hour, dollars per pound, problems per minute—and a **unit rate** zooms in on the amount for exactly *one* unit, which makes comparisons quick and fair. Sometimes the numbers show up as a fraction divided by another fraction, called a **complex fraction**—that looks messy, but the trick is to treat it as plain division and simplify! Once you can pull a clean unit rate out of any situation, you will be the person who always knows which deal at the store is actually the best.

Key Concepts & Quick Review

Unit rate: divide the first quantity by the second so the denominator equals 1. **Example:** $\frac{150\ mi}{3\ hr} = 50\ mi/\text{hr}$.

Complex fraction: Rewrite first as division: $\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c}$. Simplify the resulting fraction and attach units.

Examples

① A car travels $\frac{3}{4}$ of a mile in $\frac{1}{2}$ a minute. What is the car's unit rate in miles per minute?

Think It Through: A unit rate means the denominator should be 1, so we divide miles by minutes: $\frac{3}{4} \div \frac{1}{2}$. Use Keep, Change, Flip: $\frac{3}{4} \times \frac{2}{1} = \frac{6}{4} = \frac{3}{2}$. That is $1.5\ mi$ per minute. The idea is to ask, "How far does the car travel in one minute?"

Answer: $\frac{3}{2}\ mi/min = 1.5\ mi/min$

② A hiker walks $\frac{5}{2}\ mi$ in $\frac{5}{4}$ hours. What is her unit rate in miles per hour? Which is faster: this hiker or one who walks $2\ mi$ in $\frac{3}{4}\ hr$?

Think It Through: Find each unit rate separately so the comparison is fair. For Hiker 1, $\frac{5}{2} \div \frac{5}{4} = \frac{5}{2} \times \frac{4}{5} = 2\ mi$ per hour. For Hiker 2, $2 \div \frac{3}{4} = 2 \times \frac{4}{3} = \frac{8}{3} \approx 2.67\ mi$ per hour. Since 2.67 is greater than 2, Hiker 2 is faster. Comparing unit rates is better than comparing the original fractions because everything is converted to the same "per 1 hour" form.

Answer: *Hiker 1:* $2\ mi/\text{hr}$*; Hiker 2 is faster at* $\approx 2.67\ mi/\text{hr}$

Practice Problems

Simplify each complex fraction or find the unit rate.

1. $\frac{150}{6} =$ _____

2. $\frac{84}{7} =$ _____

3. $\frac{45}{9} =$ _____

4. $\left(\frac{3}{4}\right) \div \left(\frac{1}{2}\right) =$ _____

Scan Me

5. $\left(\frac{5}{6}\right) \div \left(\frac{1}{3}\right) =$ _____

6. $\left(\frac{7}{8}\right) \div \left(\frac{1}{4}\right) =$ _____

7. $\left(\frac{4}{5}\right) \div \left(\frac{2}{3}\right) =$ _____

8. $\left(\frac{7}{4}\right) \div \left(\frac{7}{12}\right) =$ _____

9. $\left(\frac{3}{4}\right) \div \left(\frac{9}{8}\right) =$ _____

10. $\left(\frac{5}{2}\right) \div \left(\frac{5}{4}\right) =$ _____

11. $\left(\frac{3}{8}\right) \div \left(\frac{3}{4}\right) =$ _____

12. $\left(\frac{11}{6}\right) \div \left(\frac{11}{3}\right) =$ _____

13. $\left(\frac{1}{2}\right) \div \left(\frac{3}{8}\right) =$ _____

14. $\left(\frac{7}{4}\right) \div \left(\frac{7}{16}\right) =$ _____

15. $\left(\frac{9}{4}\right) \div \left(\frac{3}{8}\right) =$ _____

Study Tips

- A **unit rate** always has denominator 1. Ask yourself: "How much per one?" — per hour, per pound, per item.
- For a **complex fraction**, rewrite as division first: $\frac{a}{b} \div \frac{c}{d}$, then apply Keep-Change-Flip.
- To compare rates, convert both to **unit rates** first — never compare rates that still have different denominators.

Word Problems

16. A faucet drips $\frac{3}{4}\ gal$ of water in $\frac{1}{2}$ hour. Write a complex fraction for the drip rate, simplify it to a unit rate in gallons per hour, and calculate how many gallons would drip in 8 hours. _____

17. Store A sells $\frac{5}{2}$ pounds of trail mix for $\$\frac{15}{4}$. Store B sells 3 pounds for $\$5.40$. Find the unit price (dollars per pound) at each store and determine which store offers the better deal. _____

Answer Keys

1) 25
2) 12
3) 5
4) $\frac{3}{2}$
5) $\frac{5}{2}$
6) $\frac{7}{2}$
7) $\frac{6}{5}$
8) 3
9) $\frac{2}{3}$
10) 2
11) $\frac{1}{2}$
12) $\frac{1}{2}$
13) $\frac{4}{3}$
14) 4
15) 6
16) Unit rate: $\frac{3}{2}$ gal/hr; in 8 hours: 12 gal.
17) Store A: $\$1.50$/lb; Store B: $\$1.80$/lb; Store A is the better deal.

Step-by-Step Explanations

Strategy: For Adding and Subtracting Rational Numbers, rewrite subtraction as adding the opposite whenever signs get crowded, then combine the positive and negative parts carefully. Once the rational-operation setup is right, the calculation usually becomes the easy part.

Practice 1: $-\frac{3}{4}+\frac{1}{4}=$ **Answer:** $-\frac{1}{2}$

At the beginning of the practice, rewrite the subtraction as an addition problem so the fraction signs are easier to track.

Practice 15: $\frac{7}{8}-\left(-\frac{3}{8}\right)-\frac{5}{4}=$ **Answer:** 0

For the later model problem, keep the rational numbers in a common form first; then add the opposite and simplify.

Word-problem notes:

16. Answer: $-\frac{7}{8}+\frac{5}{6}=-\frac{21}{24}+\frac{20}{24}=-\frac{1}{24}$ km lower.

These numbers have different signs, so think of it as opposite movements. First find a common denominator: 24. Then rewrite the fractions as $-\frac{21}{24}+\frac{20}{24}$. Since the absolute values are close, most of the movement cancels, leaving $-\frac{1}{24}$. The negative sign tells us the climber finished lower than the starting point, by $\frac{1}{24}$ kilometer.

17. Answer: Total: $-1.5°\text{F}=-\frac{3}{2}°\text{F}$; average: $-0.3°\text{F}=-\frac{3}{10}°\text{F}$ per day.

Work through the temperature changes one step at a time so the signs stay clear. First, $-2.25+1.75=-0.5$. Then $-0.5-0.375=-0.875$. Add 0.5 to get -0.375. Finally, subtract 1.125 to get $-1.5°\text{F}$ total change. To find the average daily change, divide by 5: $-1.5\div 5=-0.3°\text{F}$ per day. The negative average means the overall trend was downward.

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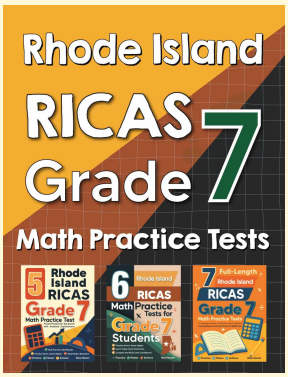

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