

Unit Rates and Complex Fractions

Name: _____

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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:** $\frac{150 \text{ mi}}{3 \text{ hr}} = 50 \text{ mi/hr}$.

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

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, $\frac{5}{2} \div \frac{5}{4} = \frac{5}{2} \times \frac{4}{5} = 2 \text{ mi}$ per hour. For Hiker 2, $2 \div \frac{3}{4} = 2 \times \frac{4}{3} = \frac{8}{3} \approx 2.67 \text{ mi}$ 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/hr*; Hiker 2 is faster at $\approx 2.67 \text{ mi/hr}$

Practice Problems

Simplify each complex fraction or find the unit rate.

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

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

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

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



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

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

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: $-1.5^\circ\text{F} = -\frac{3}{2}^\circ\text{F}$; average: $-0.3^\circ\text{F} = -\frac{3}{10}^\circ\text{F}$ 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°F total change. To find the average daily change, divide by 5: $-1.5 \div 5 = -0.3^\circ\text{F}$ per day. The negative average means the overall trend was downward.



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