Proportional vs. Non-Proportional Relationships

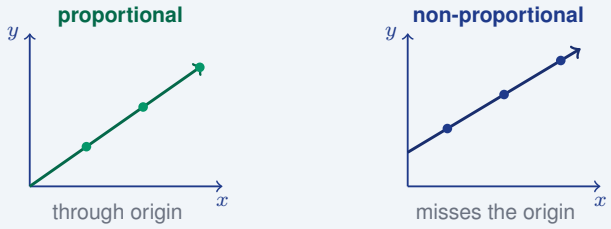
Name: _____	Date: _____	Score: _____ / 13

Not all relationships play by the same rules, and this topic teaches you how to tell them apart! In a **proportional relationship**, the ratio $\frac{y}{x}$ stays the same for every pair, the table passes through $(0, 0)$, and the graph is a straight line through the origin. In a **non-proportional** relationship, there is usually an extra starting amount or the ratios keep changing. Once you can spot the difference, you will always know which equation or graph to reach for.

Key Concepts & Quick Review

Proportional: $\frac{y}{x}$ is the same for every pair (x, y) in the table; graph passes through $(0, 0)$. **Non-proportional:** ratios differ, or $y \neq 0$ when $x = 0$.

Quick test: compute $\frac{y}{x}$ for each row. If all values match, the relationship is proportional. If even one differs, it is non-proportional.



Examples

① Determine if the table is proportional or non-proportional:

x	y
1	4
2	8
3	12
4	16

Think It Through: Check whether the ratio $\frac{y}{x}$ stays the same in every row. Here, $\frac{4}{1} = 4$, $\frac{8}{2} = 4$, $\frac{12}{3} = 4$, and $\frac{16}{4} = 4$. Since the ratio is constant, the relationship is proportional. The constant of proportionality is $k = 4$, which means y is always 4 times x.

Answer: *Proportional;* $k = 4$

② A plumber charges a \$40 flat fee plus \$30 per hour. Make a table for 1–4 hours and determine if the relationship is proportional.

Think It Through: The cost rule is $y = 30x + 40$ because there is a $\$40$ starting fee and then $\$30$ for each hour. That gives the table $(1, 70)$, $(2, 100)$, $(3, 130)$, and $(4, 160)$. If you divide y by x in each row, the ratios are not the same, so the relationship is not proportional. Another quick check is the origin test: when $x = 0$, the cost would still be 40, not 0, so the graph does not pass through $(0, 0)$.

Answer: *Non-proportional (flat fee shifts the ratio)*

Practice Problems

Check whether each table shows a proportional relationship. Record P for proportional or NP for non-proportional.

1.

x	2	4	6
y	6	12	18

_____

2.

x	1	3	5
y	4	10	16

_____

3.

x	2	5	8
y	10	25	40

_____

4.

x	3	6	9
y	12	24	36

_____

5.

x	1	2	4
y	5	9	17

_____

6.

x	4	8	12
y	3	6	9

_____

7.

x	2	3	5
y	7	10	16

_____

8.

x	5	10	15
y	8	16	24

_____

9.

x	1	4	7
y	0	12	21

_____

10.

x	6	9	12
y	2	3	4

_____

Study Tips

- The fastest check: does the table include the point $(0, 0)$? A proportional relationship **must** pass through the origin.
- A **flat fee, starting balance, or one-time charge** is a dead giveaway for a non-proportional relationship.
- In a proportional table, every y value equals $k \times x$ for the same constant k — you only need to find k once.

Word Problems

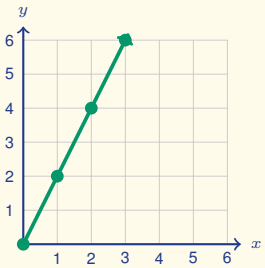
11. Two cell-phone plans are available. Plan A costs \$0.10 per text message. Plan B costs \$5.00 per month plus \$0.05 per text. Create a y/x table for $10,\ 20,\ 30,$ and 40 texts under each plan. Which plan is proportional?

_____

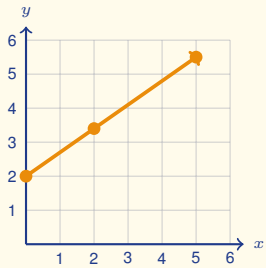
12. A swimming pool is filled at a constant rate of $200\ gal$ per hour starting from empty. A second pool already has $500\ gal$ and is filled at $150\ gal$/hr. Write an equation for each pool's volume after x hours. Which relationship is proportional?

_____

13. Two relationships are graphed here. Decide which graph (**Graph A** or **Graph B**) shows a proportional relationship, and justify your choice using *both* criteria for proportionality (passes through the origin AND is a straight line). For the proportional graph, give the constant of proportionality.



Graph A



Graph B

Answer Keys

1) P
2) NP
3) P
4) P
5) NP
6) P
7) NP
8) P
9) NP
10) P
11) Plan A is proportional ($y/x = 0.10$ always); Plan B is non-proportional (flat fee).
12) Pool 1 proportional; Pool 2 non-proportional
13) Graph A is proportional (line through origin); $k = 2$. Graph B is not (does not pass through the origin).

Step-by-Step Explanations

Strategy: For Dividing Integers and Rational Numbers, divide by the rational number using reciprocals when needed, then finish with the correct sign. A quotient in context should say whether it is a rate, a time, a distance, or a signed change.

Practice 1: $(-6) \div \frac{3}{4} =$ **Answer:** -8

For the first sample, rewrite division by $\frac{3}{4}$ as multiplication by $\frac{4}{3}$, then keep the quotient negative.

Practice 15: $5\frac{1}{2} \div \left(-2\frac{3}{4}\right) =$ **Answer:** -2

Late in the set, convert both mixed numbers to improper fractions; the signs differ, so the simplified quotient is negative.

Word-problem notes:

16. Answer: Rate: $-10\frac{1}{2} \div 3\frac{1}{2} = -3$ °F/hr; final temp: $-5 + (-10.5) = -15.5$°F.

Convert the mixed numbers first: $-10\frac{1}{2} = -\frac{21}{2}$ and $3\frac{1}{2} = \frac{7}{2}$. To find the hourly rate, divide total change by total time: $\left(-\frac{21}{2}\right) \div \left(\frac{7}{2}\right)$. Use Keep, Change, Flip: $\left(-\frac{21}{2}\right) \times \left(\frac{2}{7}\right) = -3$. So the freezer changes by -3°F per hour. Starting at -5°F and dropping another 10.5°F gives $-5 + (-10.5) = -15.5$°F. The negative rate tells us the freezer is getting colder over time.

17. Answer: Drain alone: $12\ min$; combined rate: $-\frac{13}{30}\ gal$/min; combined time: $\approx 23.1\ min$.

If the pipe drains $\frac{5}{6}\ gal$ each minute, then the time to drain $10\ gal$ is $10 \div \frac{5}{6} = 10 \times \frac{6}{5} = 12\ min$. Now include the second pipe. The drain rate is $-\frac{5}{6}\ gal$ per minute and the fill rate is $+\frac{2}{5}\ gal$ per minute. Add them to get the combined rate: $-\frac{5}{6} + \frac{2}{5} = -\frac{25}{30} + \frac{12}{30} = -\frac{13}{30}\ gal$ per minute. The negative sign means the tank is still losing water overall. To find the time to drain $10\ gal$ at that net rate, divide the amount by the rate's magnitude: $10 \div \frac{13}{30} = \frac{300}{13} \approx 23.1\ min$.

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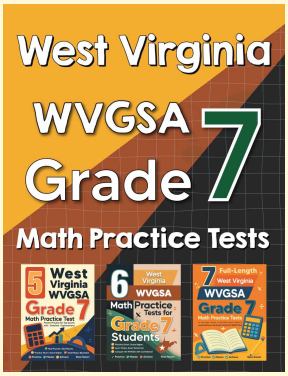

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