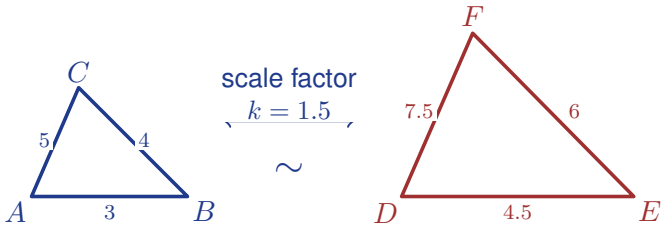
Similar Figures and Proportional Sides

Name: _____	Date: _____	Score: _____ / 17

Similar figures are the same shape, just different sizes—like a photo and its enlarged print! Their corresponding angles are equal and their corresponding sides are **proportional**, meaning every side changes by the same scale factor. This single idea explains how scale drawings, maps, models, and indirect measurement all work. Once you can set up a proportion between matching sides, finding a missing length is a breeze!



$$\frac{DE}{AB} = \frac{EF}{BC} = \frac{DF}{AC} = \frac{3}{2}$$

Key Concepts & Quick Review

Similar ($\sim$): same shape, proportional sides, equal corresponding angles.

Scale factor $k = \dfrac{\text{corresponding side of image}}{\text{corresponding side of original}}$.

Find missing side: set up proportion $\dfrac{a}{b} = \dfrac{c}{x}$ and cross-multiply.

Examples

① Triangles $ABC \sim DEF$. $AB = 6$, $BC = 9$, $DE = 10$. Find EF.

Think It Through: Because the triangles are similar, corresponding sides are proportional. Find the scale factor from triangle ABC to triangle DEF by comparing matching sides: $k = \frac{DE}{AB} = \frac{10}{6} = \frac{5}{3}$. Then multiply the matching side $BC = 9$ by the same factor: $EF = \frac{5}{3} \times 9 = 15$. A single scale factor is the key idea in all similar-figure problems.

Answer: $EF = 15$

② A 6-foot-tall person casts a 9-foot shadow. Nearby, a tree casts a 36-foot shadow at the same time of day. How tall is the tree?

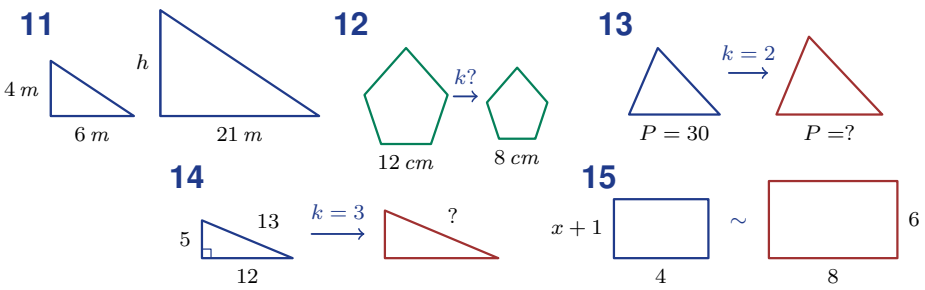
Think It Through: The person's triangle and the tree's triangle are similar because the sun creates the same angle for both. Match height to shadow and write the proportion $\frac{6}{9} = \frac{h}{36}$. Cross-multiplying gives $9h = 216$, so $h = 24$ feet. Similar triangles let us compare a small easy-to-measure object with a much taller one.

Answer: *Tree height* $= 24$ *feet*

Practice Problems

Use proportional reasoning to find missing side lengths in similar figures.

1. $\triangle ABC \sim \triangle DEF$ with $AB \leftrightarrow DE$. If $AB = 4$ and $DE = 8$, find the scale factor from $\triangle ABC$ to $\triangle DEF$. _____
2. A triangle with side lengths $3, 5, 7$ is enlarged by scale factor $k = 2$. Find the three image side lengths. _____
3. In two similar figures, a side of length 6 in the original corresponds to a side of length x in the image. If $k = \frac{4}{3}$, find x. _____
4. An image side is 9 units long after a reduction with scale factor $k = \frac{3}{7}$ from original to image. Find the original side length. _____
5. $\triangle PQR \sim \triangle STU$ with $PQ \leftrightarrow ST$ and $QR \leftrightarrow TU$. If $PQ = 5$, $QR = 8$, and $ST = 10$, find TU. _____
6. Two rectangles are similar. The small rectangle is 4 by 6, and the large rectangle has side 9 corresponding to 6. Find the side corresponding to 4. _____
7. A $10\,cm$ side is enlarged using scale factor $k = \frac{3}{2}$. Find the matching image side length. _____
8. An image side is $6\,cm$ when the scale factor from original to image is $k = \frac{2}{5}$. Find the original side length. _____
9. $\triangle ABC \sim \triangle XYZ$ with $AB \leftrightarrow XY$ and $BC \leftrightarrow YZ$. If $AB = 7$, $BC = 14$, and $XY = 3$, find YZ. _____
10. An original triangle has side lengths $9, 12, 15$. A similar image triangle is made with scale factor $k = \frac{4}{3}$. Find all image side lengths. _____
11. A $4\,m$ post casts a $6\,m$ shadow. At the same time, a flagpole casts a $21\,m$ shadow. Find the flagpole height. _____
12. Two pentagons are similar. A $12\,cm$ side in the original corresponds to an $8\,cm$ side in the image. Find the scale factor from original to image. _____
13. $\triangle ABC \sim \triangle DEF$. The perimeter of $\triangle ABC$ is 30, and the scale factor from $\triangle ABC$ to $\triangle DEF$ is 2. Find the perimeter of $\triangle DEF$. _____
14. A 5–12–13 right triangle is enlarged by scale factor $k = 3$. Find the image hypotenuse. _____
15. In similar figures, side $x + 1$ corresponds to 6 and side 4 corresponds to 8. Use $\frac{x+1}{4} = \frac{6}{8}$ to find x. _____



Study Tips

- Always match **corresponding sides**: the side opposite the largest angle in one triangle matches the side opposite the largest angle in the other.
- Write the proportion with the **same figure** always on top (or always on the bottom): $\frac{\text{small}}{\text{large}} = \frac{\text{small}}{\text{large}}$.
- Perimeters of similar figures scale by factor k; **areas** scale by k^2. (Preview for later geometry.)

Word Problems

16. At $3{:}00$ PM, a 5-foot student and her 15-foot flagpole both cast shadows. The student's shadow is 8 feet long. How long is the flagpole's shadow? If the sun shifts and the student's shadow grows to 12 feet, how long would the flagpole's shadow be then?

_____

17. Two similar triangular garden plots are being planted. Plot A has sides $12\,m$, $16\,m$, and $20\,m$. Plot B is similar to Plot A with a scale factor of $\frac{3}{4}$. Find all three side lengths of Plot B and the perimeters of both plots. The plots need the same type of fence ($\$8$/m). How much more does fencing Plot A cost than Plot B?

_____

Answer Keys

1) 2
2) 6, 10, 14
3) 8
4) 21
5) 16
6) 6
7) 15
8) 15
9) 6
10) 12, 16, 20
11) $14\,m$
12) $\frac{2}{3}$
13) 60
14) 39
15) 2
16) $24\,ft$ at 3 PM; $36\,ft$ later
17) Plot B sides $9, 12, 15\,m$; perimeters $48\,m$ and $36\,m$; cost difference \$96

Step-by-Step Explanations

Strategy: For Writing and Graphing Inequalities, translate the words into an inequality symbol first, then graph the solution with the correct open or closed endpoint. Keep the inequality sign visible through every operation, especially when the graph is drawn.

Practice 1: Write a word description for the inequality $x > 5$. **Answer:** greater than 5
In the first inequality example, isolate the variable first; the direction of the symbol only changes if a negative multiplication or division is used.

Practice 15: Write an inequality for the phrase "between -5 and 5, exclusive." **Answer:** $-5 < x < 5$
Toward the end, read the graph endpoint as carefully as the algebra: open means not included, closed means included.

Word-problem notes:

16. Answer: $6 < d \leq 20$; allowed: $7, 12, 20$; not allowed: 6 (boundary), 21.
Translate each phrase separately. "More than 6 feet" means $d > 6$, and "at most 20 feet" means $d \leq 20$. Put them together to get $6 < d \leq 20$. That means values such as 7, 12, and 20 are allowed. But 6 is not allowed because "more than" does not include the boundary, and 21 is not allowed because it is too far.

17. Answer: $90 \leq w \leq 250$; $87\,lb$: No; $260\,lb$: No; range: $[90, 250]$ pounds.
A minimum of 90 pounds means the rider must weigh at least 90, so $w \geq 90$. A maximum of 250 pounds means $w \leq 250$. Together that gives the compound inequality $90 \leq w \leq 250$. A rider weighing 87 pounds does not qualify because $87 < 90$, and a rider weighing 260 pounds does not qualify because $260 > 250$. The qualifying range is from 90 to 250 pounds, including both endpoints.

18. Answer: Graph A: $x > -1$ (open at -1, -1 excluded); Graph B: $-2 \leq x \leq 3$ (closed at -2 and 3, both included).
In Graph A, the open circle at -1 means -1 is not part of the solution, and the arrow points right, so the inequality is $x > -1$. In Graph B, the closed circles at -2 and 3 mean both endpoints are included, and the segment between them represents all values in between, giving the compound inequality $-2 \leq x \leq 3$.

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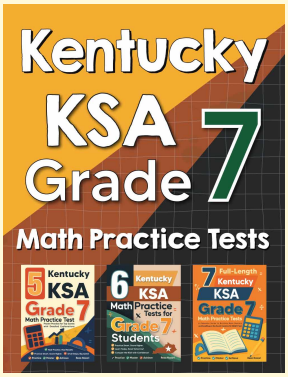

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