

Dilations and Similarity: practice solutions, Grade 8

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Written solutions to the chapter problems. Check each step, then correct yourself.

1 Enlargement, reduction, or neither?



- a. $3 > 1$: enlargement.
- b. $0 < 0.4 < 1$: reduction.
- c. $k = 1$: the figure does not change.
- d. $\frac{5}{4} = 1.25 > 1$: enlargement.
- e. $0 < 0.9 < 1$: reduction.

2 Distance from the center



- a. $OP' = 3 \times 5 = 15$ cm.
- b. $OQ' = \frac{1}{4} \times 12 = 3$ cm.
- c. $k = \frac{OR'}{OR} = \frac{20}{8} = 2.5$. It is an enlargement.

3 Dilating points from the origin



Use $(x, y) \rightarrow (kx, ky)$.

- a. $(2 \cdot 3, 2 \cdot 4) = (6, 8)$
- b. $(3 \cdot (-5), 3 \cdot 2) = (-15, 6)$
- c. $(\frac{1}{2} \cdot 8, \frac{1}{2} \cdot (-6)) = (4, -3)$
- d. $(\frac{1}{3} \cdot (-9), \frac{1}{3} \cdot 12) = (-3, 4)$

4 Resizing a photo



- a. $4 \times 2.5 = 10$ and $6 \times 2.5 = 15$: the enlarged photo is **10** in by **15** in.
- b. $10 \times 2.54 = 25.4$ cm and $15 \times 2.54 = 38.1$ cm.
- c. $4 \times 0.5 = 2$ and $6 \times 0.5 = 3$: the wallet photo is **2** in by **3** in.

5 Angles in a triangle



- a. $180 - (38 + 74) = 180 - 112 = 68$. The third angle is **68°** .
- b. The angles are **90°** , **35°** , and the missing one: $180 - 125 = 55$. It is **55°** .
- c. The two base angles are equal and share $180 - 40 = 140$ degrees, so each is $140 \div 2 = 70^\circ$.

6 True or false?



- a. **False.** A dilation keeps all angle measures.
- b. **True.** The center is the one point with $OP' = k \cdot OP$ and $OP = 0$, so it is fixed.
- c. **True.** Every side is multiplied by **2**, so the sum of the sides is multiplied by **2**.
- d. **False.** Since $k < 1$, lengths are halved and the figure gets smaller.

7 Exterior angles

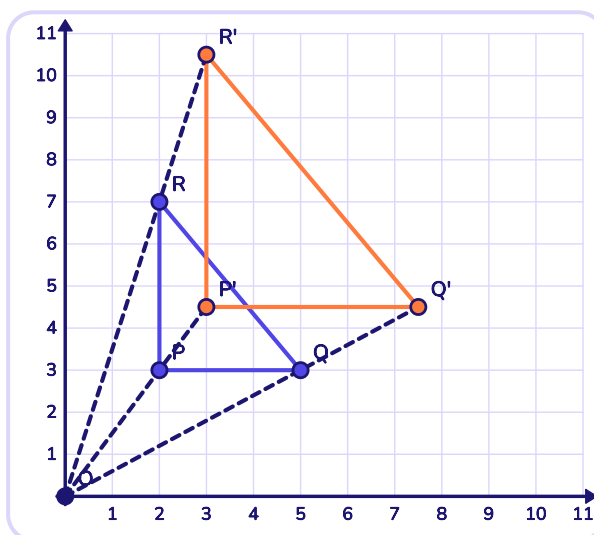


- The exterior angle equals $35 + 85 = 120$. It measures 120° .
- The other remote angle is $140 - 90 = 50$, so it measures 50° .

8 Dilating a right triangle



- Multiply each coordinate by 1.5: $P'(3, 4.5)$, $Q'(7.5, 4.5)$, $R'(3, 10.5)$.
- $PQ = 5 - 2 = 3$, $PR = 7 - 3 = 4$, $P'Q' = 7.5 - 3 = 4.5$,
 $P'R' = 10.5 - 4.5 = 6$. Each length was multiplied by 1.5.



9 Find the scale factor



For A : $\frac{3}{2} = 1.5$ and $\frac{6}{4} = 1.5$. For B : $\frac{9}{6} = 1.5$ and $\frac{6}{4} = 1.5$. For C : $\frac{9}{6} = 1.5$ and $\frac{12}{8} = 1.5$. Every coordinate was multiplied by the same number, so the scale factor is $k = 1.5$.

10 Are these rectangles similar?



- a. $\frac{8}{12} = \frac{2}{3}$ and $\frac{12}{18} = \frac{2}{3}$: similar, scale factor $\frac{2}{3}$.
- b. $\frac{15}{5} = 3$ and $\frac{27}{9} = 3$: similar, scale factor 3.
- c. $\frac{9}{6} = 1.5$ but $\frac{14}{10} = 1.4$: the ratios differ, so the rectangles are not similar.

11 Missing sides



The scale factor from ABC to DEF is $\frac{DE}{AB} = \frac{10}{6} = \frac{5}{3}$.

$$EF = \frac{5}{3} \times 9 = 15 \text{ and } DF = \frac{5}{3} \times 12 = 20.$$

Answer: $EF = 15$ and $DF = 20$.

12 A post and a tower



The sun's rays are parallel and both objects are vertical, so the two right triangles share two angles: they are similar by AA.

$$\frac{h}{27} = \frac{1.2}{1.8} = \frac{2}{3}, \text{ so } h = 27 \times \frac{2}{3} = 18.$$

The tower is 18 m tall, which is $18 \div 0.3048 \approx 59$ ft.

13 Parallel lines and a transversal



- a. Vertical angles are equal: 112° .
- b. Alternate interior angles are equal: 112° .
- c. Same-side interior angles add up to 180° : $180 - 112 = 68^\circ$.
- d. Corresponding angles are equal: 112° .

14 Solve for x in a triangle



The angles add up to 180° : $3x + 4x + 5 + 5x - 17 = 180$, so $12x - 12 = 180$ and $x = 16$.

The angles are $3 \times 16 = 48^\circ$, $4 \times 16 + 5 = 69^\circ$, and $5 \times 16 - 17 = 63^\circ$. Check: $48 + 69 + 63 = 180$.

15 Exterior angle with algebra



By the Exterior Angle Theorem, $5x + 10 = (2x + 20) + (x + 50) = 3x + 70$. So $2x = 60$ and $x = 30$.

The exterior angle is $5 \times 30 + 10 = 160^\circ$. The remote angles are 80° and 80° (sum 160°). The adjacent interior angle is $180 - 160 = 20^\circ$; check: $80 + 80 + 20 = 180$.

16 A dilation with a different center



$$P' = (1 + 3 \cdot 1, 1 + 3 \cdot 2) = (4, 7).$$

$$Q' = (1 + 3 \cdot 3, 1 + 3 \cdot 0) = (10, 1).$$

$$R' = (1 + 3 \cdot 1, 1 + 3 \cdot 0) = (4, 1).$$

Check: $PR = 3 - 1 = 2$ and $P'R' = 7 - 1 = 6 = 3 \times 2$. Also $RQ = 2$ and $R'Q' = 10 - 4 = 6$.

17 Reflect, then dilate



- a. Reflection across the x -axis: $(x, y) \rightarrow (x, -y)$, giving $(1, -1)$, $(3, -1)$, $(3, -2)$.
Dilation: $(2, -2)$, $(6, -2)$, $(6, -4)$.
- b. Yes. Dilating first gives $(2, 2)$, $(6, 2)$, $(6, 4)$, and reflecting gives $(2, -2)$, $(6, -2)$, $(6, -4)$, the same image.
- c. They are similar (a dilation is part of the sequence). They are not congruent because the legs went from **2** and **1** to **4** and **2**.

18 Prove similarity with a sequence



Rotate X by 90° counterclockwise about the origin, using $(x, y) \rightarrow (-y, x)$: the vertices become $(0, 0)$, $(0, 3)$, $(-4, 0)$.

Then dilate by $k = 2$ about the origin: $(0, 0)$, $(0, 6)$, $(-8, 0)$, which are the vertices of Y .

Since a rotation and a dilation send X onto Y , the triangles are similar with scale factor **2**.

Check: the hypotenuse goes from **5** to **10**.

19 A line parallel to a side



- a. Because $DE \parallel BC$, the angles $\angle ADE$ and $\angle ABC$ are corresponding angles, so they are equal; likewise $\angle AED = \angle ACB$. The triangles also share angle A . Two pairs of equal angles suffice: similar by AA.

- b. $AB = 4 + 6 = 10$, so the scale factor from ADE to ABC is $\frac{10}{4} = 2.5$. Then
 $BC = 5 \times 2.5 = 12.5$ and $AC = 3 \times 2.5 = 7.5$.

20 The mirror on the ground



Light reflects with equal angles, so the ray makes the same angle with the ground on Maya's side and on the tree's side. Both triangles also have a right angle (person and tree are vertical). Two equal angles: the triangles are similar by AA.

$$\frac{h}{14.4} = \frac{1.5}{2.4}, \text{ so } h = \frac{14.4 \times 1.5}{2.4} = 9.$$

The tree is **9** m tall (about **29.5** ft).

21 Why the exterior angle theorem works



- a. $\angle ACB = 180 - 52 - 66 = 62^\circ$.
- b. $CE \parallel BA$ with transversal AC : $\angle ACE$ and $\angle BAC$ are alternate interior angles, so $\angle ACE = 52^\circ$. With transversal BD : $\angle ECD$ and $\angle ABC$ are corresponding angles, so $\angle ECD = 66^\circ$.
- c. $\angle ACD = \angle ACE + \angle ECD = 52 + 66 = 118^\circ$. Also $180 - 62 = 118^\circ$. So the exterior angle equals $\angle A + \angle B$.

22 Perimeter and area after a dilation



- a. Original: $2(5 + 8) = 26$ m. Image: **15** m by **24** m, so $2(15 + 24) = 78$ m.
 $78 \div 26 = 3$: the perimeter is multiplied by **3**.
- b. Original: $5 \times 8 = 40$ m². Image: $15 \times 24 = 360$ m². $360 \div 40 = 9$: the area is multiplied by **9** = **3²**.
- c. Conjecture: lengths are multiplied by **k** and areas by **k²**.



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