Name & Surname: _____ Class: _____ Date: _____

Rigid Transformations

Verify what stays the same

About 60 minutes Level ★★★☆☆



Translations, reflections, rotations

A translation slides a figure, a reflection flips it, and a rotation turns it. All three are **rigid** moves, so the image is congruent to the original.

- Matching **lengths** stay equal: A′B′ = AB.
- Matching **angles** stay equal: angle A′ = angle A.
- Lines stay straight and parallel lines stay parallel.
- Rules about the origin: translation (x, y) to (x + a, y + b); reflect over y-axis (x, y) to (-x, y); rotate 90 degrees counterclockwise (x, y) to (-y, x).

Task A

/2

Study each example, then try the matching problem with the same method.

WORKED EXAMPLE

Segment AB is 4 units long. It is translated 5 right and 2 up to A′B′. What is the length of A′B′?

1. A translation slides every point the same way.
2. It does not stretch or shrink the figure.
3. So A′B′ = AB = 4.

Answer: 4

YOUR TURN

Segment CD is 6 units long. It is translated 2 left and 3 down to C′D′. What is the length of C′D′?

Answer: _____

WORKED EXAMPLE

Triangle PQR has angle Q = 50 degrees. It is reflected over the y-axis to P′Q′R′. What is angle Q′ in degrees?

1. A reflection flips the figure over a line.
2. A rigid move does not change angle size.
3. So angle Q′ = angle Q = 50.

Answer: 50

YOUR TURN

Triangle LMN has angle M = 70 degrees. It is rotated 90 degrees counterclockwise about the origin to L′M′N′. What is angle M′ in degrees?

Answer: _____

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Slide and Check

Practice translations and verify lengths and angles.

Key words

translation: a slide that moves every point the same way

image: the new figure after a move

pre-image: the original figure before a move

rigid: keeps size and shape the same

congruent: same size and same shape

parallel: lines that never meet

Task B /12

Translate figures and measure to verify what stays the same.

WARM UP

1. Point A(2, 3) is translated by (x, y) to (x + 4, y - 2). What are the coordinates of the **image** A′?

   Answer: _____

2. Point B(-3, 1) is translated 5 right and 4 up. What are the coordinates of the **image** B′?

   Answer: _____

3. Segment EF is 7 units long. After a **translation**, what is the length of E′F′ in units?

   Answer: _____

4. Angle S measures 45 degrees. After a **translation**, what is the measure of angle S′ in degrees?

   Answer: _____

PRACTICE

5. Triangle ABC has A(-2, 0), B(1, 0), C(1, 3). Translate it 3 right and 1 down. What are the coordinates of the **image** A′, B′, C′?

   Answer: _____

6. For the triangle above, what is the **length** of B′C′ in units?

   Answer: _____

7. Line m is parallel to line n. After translating both, are m′ and n′ parallel? Explain how you **know**.

   Answer: _____

8. A student says a translation flips a figure over. Is the student correct about the **translation**? Explain.

   Answer: _____

PROBLEM SOLVING

9. A game piece is at (5, 5). It slides 4 left and 2 down. Where is the **image** now?

   Answer: _____

10. A photo is 3 in by 5 in. After sliding it on a table, what is the area of the **image** in square inches?

    Answer: _____

11. Two benches are 10 ft apart. The map showing them is translated. What is the distance between the **images** of the benches in feet?

    Answer: _____

12. How can you verify experimentally that a translation preserves **length**? Explain how you know.

    Answer: _____

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Flip Turn Verify

Practice reflections and rotations and verify properties.

Task C /12

Reflect and rotate figures, then verify lengths and angles.

WARM UP

1. Point P(4, 2) is reflected over the y-axis. What are the coordinates of the **image** P′?

   Answer: _____

2. Point Q(-3, -5) is reflected over the x-axis. What are the coordinates of the **image** Q′?

   Answer: _____

3. Point R(3, 0) is rotated 90 degrees counterclockwise about the origin. What are the coordinates of the **image** R′?

   Answer: _____

4. Segment GH is 8.5 units long. After a **reflection**, what is the length of G′H′ in units?

   Answer: _____

PRACTICE

5. Triangle DEF has D(2, 1), E(5, 1), F(5, 4). Reflect it over the y-axis. What are the coordinates of the **image** D′, E′, F′?

   Answer: _____

6. For the triangle above, what is the **length** of E′F′ in units?

   Answer: _____

7. Point S(2, -3) is rotated 180 degrees about the origin. What are the coordinates of the **image** S′?

   Answer: _____

8. A student says a reflection keeps clockwise order the same. Is the student correct about **reflection**? Explain how you know.

   Answer: _____

PROBLEM SOLVING

9. A quilt piece is a triangle with angles 60, 60, and 60 degrees. After reflection, what is the largest angle of the **image** in degrees?

   Answer: _____

10. A seat on a ride is 12 ft from the center. After a 90-degree rotation about the center, how far is the **image** of the seat from the center in feet?

    Answer: _____

11. Segment JK is parallel to segment LM. After a 180-degree rotation, are J′K′ and L′M′ parallel? Explain how you **know**.

    Answer: _____

12. How can you verify with tracing paper that a rotation preserves **angle** size? Explain.

    Answer: _____

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Mark the Work

Mark a sample answer about reflection.

Task D

Mark Student A's work like an examiner and say how to improve it.

Triangle ABC has A(-1, 1), B(2, 1), C(2, 4) is reflected over the x-axis to A′B′C′. Measure AB and A′B′ and angles B and B′ to verify that length and angle are preserved. Explain your check. **(6)**

A student's answer:

I reflected it and got A′(-1, -1), B′(2, -1), C′(2, -4). AB is 3 and A′B′ is 3 so lengths are the same. Angles are the same too because it looks the same. So reflection preserves.

Marks	What the answer does
5-6	Correct images, measured lengths and angles with values, and clear verification.
3-4	Correct images and one correct measurement, but missing values or explanation.
1-2	Incorrect images or no real measurement, only looking.

A good answer includes:

- [ ] Correct images: (-1, -1), (2, -1), (2, -4)
- [ ] Measured AB = 3 and A′B′ = 3 with ruler or coordinates
- [ ] Measured angle B = 90 degrees and angle B′ = 90 degrees with protractor
- [ ] Clear statement that lengths and angles match, so reflection preserves them

My mark

____ / 6

One way to improve this answer

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Pyramid and Grid

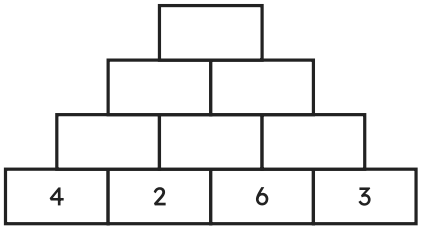
Finish with number fluency and a coordinate plot.

Task E

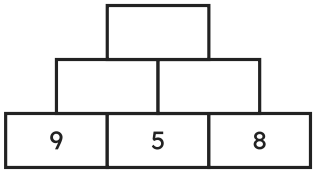
/9

Work out each pyramid: each brick is the sum of the two below it.

1



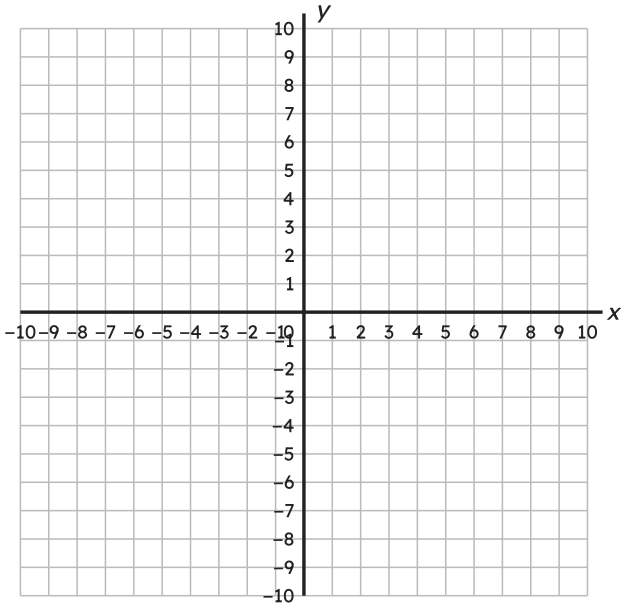
2



Task F

/4

Plot the triangle and join the points in order, then measure its sides.



A (−3, 2)

B (2, 2)

C (2, 6)

Join the points in order to make a shape. What shape have you made?

Shape: _____

How did I do?

Circle a face for each line.

I can verify that translations preserve lengths and angles	☹	😐	☺
I can verify that reflections and rotations preserve lengths and angles	☹	😐	☺
I can describe images with coordinates and explain my check	☹	😐	☺

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Answer sheet: Rigid Transformations

Task A

1. 6
2. 70

Task B

1. (6, 1)
2. (2, 5)
3. 7
4. 45
5. A′(1, -1), B′(4, -1), C′(4, 2)
6. 3
7. Yes - translation keeps direction, so parallel lines stay parallel.
8. No - translation slides without flipping; a reflection flips.
9. (1, 3)
10. 15
11. 10
12. Trace the figure, slide the tracing, then measure matching sides with a ruler to show they are equal.

Task C

1. (-4, 2)
2. (-3, 5)
3. (0, 3)
4. 8.5
5. D′(-2, 1), E′(-5, 1), F′(-5, 4)
6. 3
7. (-2, 3)
8. No - reflection reverses order, like a mirror; clockwise becomes counterclockwise.
9. 60
10. 12
11. Yes - rotation keeps lines straight and keeps parallel lines parallel.
12. Trace the angle, pin the center, turn the tracing, then measure both angles with a protractor to show they are equal.

Task D

3 - correct images and correct length check, but angle is not measured, only looks the same. To improve, measure angle B and angle B′ with a protractor and record both as 90 degrees.

Task E

1. 31 | 14, 17 | 6, 8, 9 | 4, 2, 6, 3 (top to bottom)
2. 27 | 14, 13 | 9, 5, 8 (top to bottom)

Task F

A (–3, 2), B (2, 2), C (2, 6). The shape is a right-angled triangle.

Pictures: Microsoft Fluent Emoji (MIT)

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