

Name _____

Date _____

14.4 Reflection — worked answers

Reflect 2D shapes and points in a given mirror line on a coordinate grid, identify the mirror line, and recognise that the image is congruent to the object. · 66 questions

A · Fluency — Reflect in the axes, and name the mirror line.

- 1 Reflect the point (3, 2) in the **x-axis**.

Answer: (3, -2)

The x-axis is the line $y = 0$. Reflecting in it leaves x alone and changes the sign of y : $(3, 2) \rightarrow (3, -2)$.

- 2 Reflect the point (-1, 4) in the **x-axis**.

Answer: (-1, -4)

The x-axis is the line $y = 0$. Reflecting in it leaves x alone and changes the sign of y : $(-1, 4) \rightarrow (-1, -4)$.

- 3 Reflect the point (5, -3) in the **x-axis**.

Answer: (5, 3)

The x-axis is the line $y = 0$. Reflecting in it leaves x alone and changes the sign of y : $(5, -3) \rightarrow (5, 3)$.

- 4 Reflect the point (-4, -2) in the **x-axis**.

Answer: (-4, 2)

The x-axis is the line $y = 0$. Reflecting in it leaves x alone and changes the sign of y : $(-4, -2) \rightarrow (-4, 2)$.

- 5 Reflect the point (2, 6) in the **x-axis**.

Answer: (2, -6)

The x-axis is the line $y = 0$. Reflecting in it leaves x alone and changes the sign of y : $(2, 6) \rightarrow (2, -6)$.

- 6 Reflect the point (-6, 1) in the **x-axis**.

Answer: (-6, -1)

The x-axis is the line $y = 0$. Reflecting in it leaves x alone and changes the sign of y : $(-6, 1) \rightarrow (-6, -1)$.

- 7 Reflect the point (0, 5) in the **x-axis**.

Answer: (0, -5)

The x-axis is the line $y = 0$. Reflecting in it leaves x alone and changes the sign of y : $(0, 5) \rightarrow (0, -5)$.

- 8 Reflect the point (4, 0) in the **x-axis**.

Answer: (4, 0)

The x-axis is the line $y = 0$. Reflecting in it leaves x alone and changes the sign of y : $(4, 0) \rightarrow (4, 0)$.

- 9 Reflect the point (-3, 3) in the **x-axis**.

Answer: (-3, -3)

The x-axis is the line $y = 0$. Reflecting in it leaves x alone and changes the sign of y : $(-3, 3) \rightarrow (-3, -3)$.

- 10 Reflect the point (6, -5) in the **x-axis**.

Answer: (6, 5)

The x-axis is the line $y = 0$. Reflecting in it leaves x alone and changes the sign of y : $(6, -5) \rightarrow (6, 5)$.

- 11** Reflect the point $(-5, -6)$ in the **x-axis**.

Answer: $(-5, 6)$

The x-axis is the line $y = 0$. Reflecting in it leaves x alone and changes the sign of y : $(-5, -6) \rightarrow (-5, 6)$.

- 12** Reflect the point $(1, -1)$ in the **x-axis**.

Answer: $(1, 1)$

The x-axis is the line $y = 0$. Reflecting in it leaves x alone and changes the sign of y : $(1, -1) \rightarrow (1, 1)$.

- 13** Reflect the point $(3, 2)$ in the **y-axis**.

Answer: $(-3, 2)$

The y-axis is the line $x = 0$. Reflecting in it leaves y alone and changes the sign of x : $(3, 2) \rightarrow (-3, 2)$.

- 14** Reflect the point $(-1, 4)$ in the **y-axis**.

Answer: $(1, 4)$

The y-axis is the line $x = 0$. Reflecting in it leaves y alone and changes the sign of x : $(-1, 4) \rightarrow (1, 4)$.

- 15** Reflect the point $(5, -3)$ in the **y-axis**.

Answer: $(-5, -3)$

The y-axis is the line $x = 0$. Reflecting in it leaves y alone and changes the sign of x : $(5, -3) \rightarrow (-5, -3)$.

- 16** Reflect the point $(-4, -2)$ in the **y-axis**.

Answer: $(4, -2)$

The y-axis is the line $x = 0$. Reflecting in it leaves y alone and changes the sign of x : $(-4, -2) \rightarrow (4, -2)$.

- 17** Reflect the point $(2, 6)$ in the **y-axis**.

Answer: $(-2, 6)$

The y-axis is the line $x = 0$. Reflecting in it leaves y alone and changes the sign of x : $(2, 6) \rightarrow (-2, 6)$.

- 18** Reflect the point $(-6, 1)$ in the **y-axis**.

Answer: $(6, 1)$

The y-axis is the line $x = 0$. Reflecting in it leaves y alone and changes the sign of x : $(-6, 1) \rightarrow (6, 1)$.

- 19** Reflect the point $(0, 5)$ in the **y-axis**.

Answer: $(0, 5)$

The y-axis is the line $x = 0$. Reflecting in it leaves y alone and changes the sign of x : $(0, 5) \rightarrow (0, 5)$.

- 20** Reflect the point $(4, 0)$ in the **y-axis**.

Answer: $(-4, 0)$

The y-axis is the line $x = 0$. Reflecting in it leaves y alone and changes the sign of x : $(4, 0) \rightarrow (-4, 0)$.

- 21** Reflect the point $(-3, 3)$ in the **y-axis**.

Answer: $(3, 3)$

The y-axis is the line $x = 0$. Reflecting in it leaves y alone and changes the sign of x : $(-3, 3) \rightarrow (3, 3)$.

- 22** Reflect the point $(6, -5)$ in the **y-axis**.

Answer: $(-6, -5)$

The y-axis is the line $x = 0$. Reflecting in it leaves y alone and changes the sign of x : $(6, -5) \rightarrow (-6, -5)$.

- 23** Reflect the point $(-5, -6)$ in the **y-axis**.

Answer: $(5, -6)$

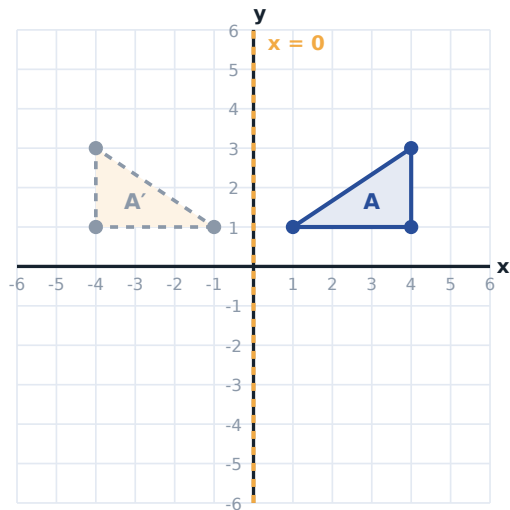
The y-axis is the line $x = 0$. Reflecting in it leaves y alone and changes the sign of x : $(-5, -6) \rightarrow (5, -6)$.

- 24** Reflect the point $(1, -1)$ in the **y-axis**.

Answer: $(-1, -1)$

The y-axis is the line $x = 0$. Reflecting in it leaves y alone and changes the sign of x: $(1, -1) \rightarrow (-1, -1)$.

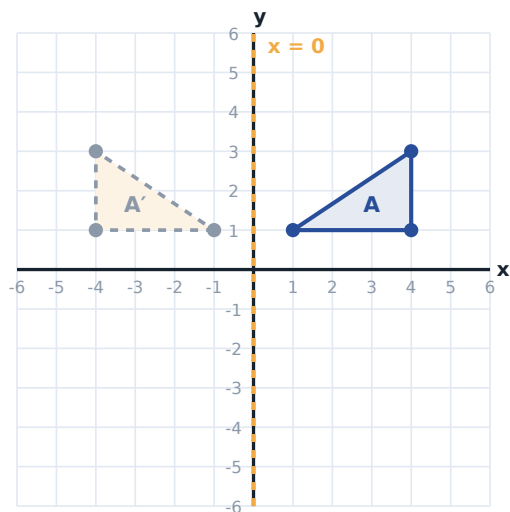
- 25** Triangle A has vertices $(1, 1)$, $(4, 1)$ and $(4, 3)$. It is reflected in the y-axis. Where does $(1, 1)$ go?



Answer: $(-1, 1)$

Reflecting in the y-axis changes the sign of x, so $(1, 1) \rightarrow (-1, 1)$. Every vertex is the same distance from the mirror line as its image, on the opposite side.

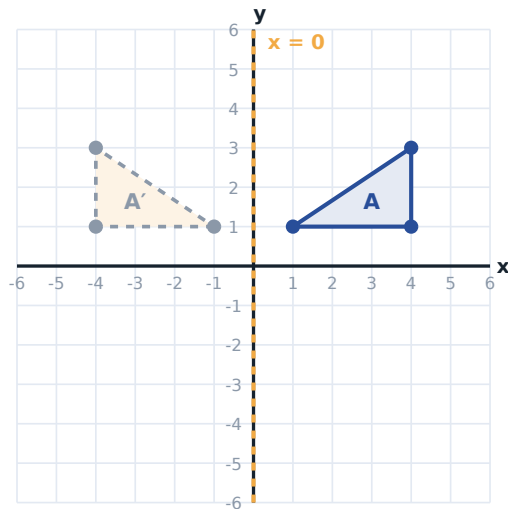
- 26** Triangle A has vertices $(1, 1)$, $(4, 1)$ and $(4, 3)$. It is reflected in the y-axis. Where does $(4, 1)$ go?



Answer: $(-4, 1)$

Reflecting in the y-axis changes the sign of x, so $(4, 1) \rightarrow (-4, 1)$. Every vertex is the same distance from the mirror line as its image, on the opposite side.

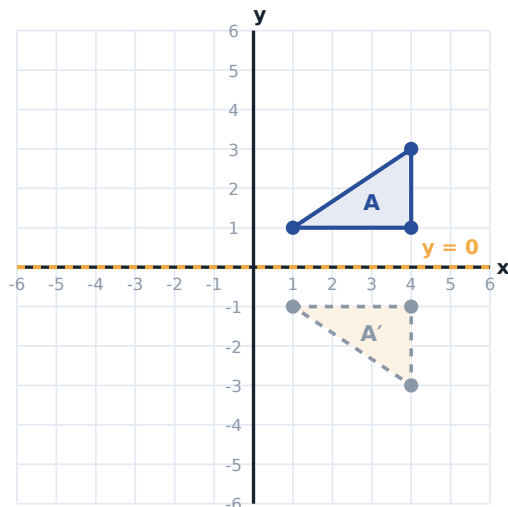
- 27** Triangle A has vertices $(1, 1)$, $(4, 1)$ and $(4, 3)$. It is reflected in the y -axis. Where does $(4, 3)$ go?



Answer: $(-4, 3)$

Reflecting in the y -axis changes the sign of x , so $(4, 3) \rightarrow (-4, 3)$. Every vertex is the same distance from the mirror line as its image, on the opposite side.

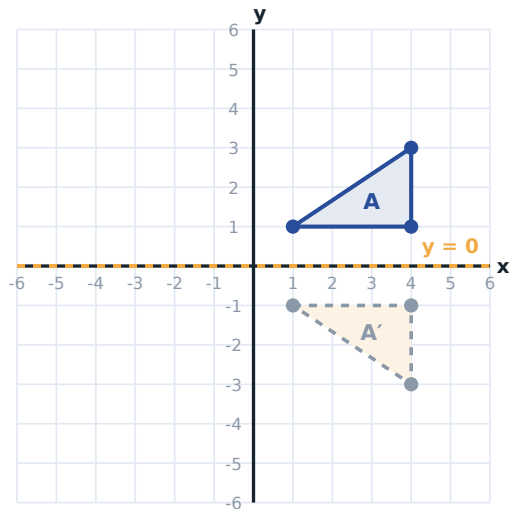
- 28** Triangle A has vertices $(1, 1)$, $(4, 1)$ and $(4, 3)$. It is reflected in the x -axis. Where does $(1, 1)$ go?



Answer: $(1, -1)$

Reflecting in the x -axis changes the sign of y , so $(1, 1) \rightarrow (1, -1)$. Every vertex is the same distance from the mirror line as its image, on the opposite side.

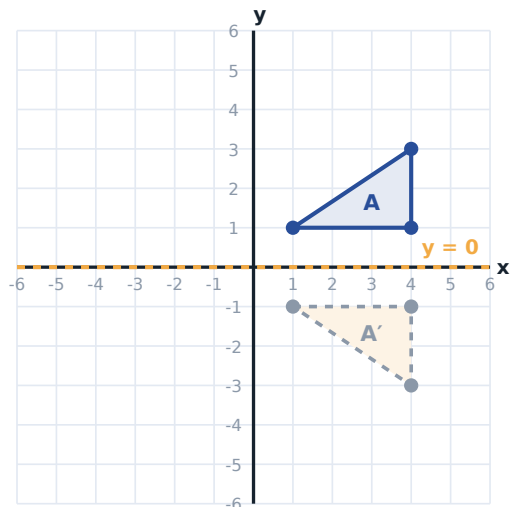
- 29** Triangle A has vertices $(1, 1)$, $(4, 1)$ and $(4, 3)$. It is reflected in the x -axis. Where does $(4, 1)$ go?



Answer: $(4, -1)$

Reflecting in the x -axis changes the sign of y , so $(4, 1) \rightarrow (4, -1)$. Every vertex is the same distance from the mirror line as its image, on the opposite side.

- 30** Triangle A has vertices $(1, 1)$, $(4, 1)$ and $(4, 3)$. It is reflected in the x -axis. Where does $(4, 3)$ go?



Answer: $(4, -3)$

Reflecting in the x -axis changes the sign of y , so $(4, 3) \rightarrow (4, -3)$. Every vertex is the same distance from the mirror line as its image, on the opposite side.

- 31** A point moves from $(3, 4)$ to $(3, -4)$. Which line is the mirror?

- ☐ the x -axis
- ☐ the y -axis
- ☐ the line $y = x$
- ☐ the line $y = -x$

Answer: the x -axis

The x -coordinate is unchanged and the y -coordinate has changed sign. That is a reflection in the x -axis.

32 A point moves from $(-2, 5)$ to $(2, 5)$. Which line is the mirror?

- ☐ the x-axis
- ☐ the y-axis
- ☐ the line $y = x$
- ☐ the line $y = -x$

Answer: the y-axis

The y-coordinate is unchanged and the x-coordinate has changed sign. That is a reflection in the y-axis.

33 A point moves from $(6, -1)$ to $(6, 1)$. Which line is the mirror?

- ☐ the x-axis
- ☐ the y-axis
- ☐ the line $y = x$
- ☐ the line $y = -x$

Answer: the x-axis

The x-coordinate is unchanged and the y-coordinate has changed sign. That is a reflection in the x-axis.

34 A point moves from $(-4, -3)$ to $(4, -3)$. Which line is the mirror?

- ☐ the x-axis
- ☐ the y-axis
- ☐ the line $y = x$
- ☐ the line $y = -x$

Answer: the y-axis

The y-coordinate is unchanged and the x-coordinate has changed sign. That is a reflection in the y-axis.

35 A point moves from $(1, 7)$ to $(1, -7)$. Which line is the mirror?

- ☐ the x-axis
- ☐ the y-axis
- ☐ the line $y = x$
- ☐ the line $y = -x$

Answer: the x-axis

The x-coordinate is unchanged and the y-coordinate has changed sign. That is a reflection in the x-axis.

36 A point moves from $(-5, 2)$ to $(5, 2)$. Which line is the mirror?

- ☐ the x-axis
- ☐ the y-axis
- ☐ the line $y = x$
- ☐ the line $y = -x$

Answer: the y-axis

The y-coordinate is unchanged and the x-coordinate has changed sign. That is a reflection in the y-axis.

B · Reasoning — What a flip preserves, and what it reverses.

37 After a reflection, the image is ...

- ☐ larger than the object
- ☐ congruent to the object
- ☐ smaller than the object
- ☐ similar but not congruent

Answer: congruent to the object

Same shape and same size. It is turned over, but nothing is stretched, so every length and every angle is unchanged.

38 Reflecting in the x-axis does what to the coordinates?

- ☐ $(x, y) \rightarrow (-x, y)$
- ☐ $(x, y) \rightarrow (x, -y)$
- ☐ $(x, y) \rightarrow (y, x)$
- ☐ $(x, y) \rightarrow (-x, -y)$

Answer: $(x, y) \rightarrow (x, -y)$

The x-axis is horizontal, so across is unchanged and up becomes down.

39 Reflecting in the y-axis does what to the coordinates?

- ☐ $(x, y) \rightarrow (-x, y)$
- ☐ $(x, y) \rightarrow (x, -y)$
- ☐ $(x, y) \rightarrow (y, x)$
- ☐ $(x, y) \rightarrow (-x, -y)$

Answer: $(x, y) \rightarrow (-x, y)$

The y-axis is vertical, so up is unchanged and left becomes right.

40 A point sits **on** the mirror line. Where is its image?

- ☐ Somewhere else on the line
- ☐ In exactly the same place
- ☐ On the other side
- ☐ It disappears

Answer: In exactly the same place

Its distance from the mirror is 0, so it does not move. Such points are called invariant.

41 Is a reflection the same as a rotation of 180° ?

- ☐ Yes
- ☐ No

Answer: No

A reflection turns the shape over, so the vertices run the other way round. A rotation does not.

42 Why is the image the same distance from the mirror as the object?

- ☐ It looks better
- ☐ That is what reflecting means
- ☐ Because of the axes
- ☐ It is not

Answer: That is what reflecting means

Perpendicular to the mirror, and the same distance on the other side. That is the definition.

43 Does reflecting a shape twice in the same line return it to the start?

- ☐ Yes
- ☐ No

Answer: Yes

The second reflection undoes the first, exactly as a second translation by the reverse vector does.

44 The point $(0, 4)$ is reflected in the y-axis. Where is the image?

- ☐ $(0, -4)$
- ☐ $(0, 4)$
- ☐ $(4, 0)$
- ☐ $(-4, 0)$

Answer: $(0, 4)$

It is already on the y-axis, so it does not move.

45 A shape and its image are drawn. How do you find the mirror line?

- ☐ Guess
- ☐ Join matching points and find the halfway line perpendicular to them
- ☐ Draw the x-axis
- ☐ Measure the angles

Answer: Join matching points and find the halfway line perpendicular to them

The mirror is the perpendicular bisector of the join between any point and its image.

46 Which of these is unchanged by a reflection?

- ☐ The position of every point
- ☐ The lengths of the sides
- ☐ Which way round the vertices run
- ☐ Nothing

Answer: The lengths of the sides

Lengths and angles survive; position and orientation do not.

C · Challenge — Mirrors that are not axes, and pairs of reflections.

47 Reflect the point (3, 2) in the line $x = 1$.

Answer: (−1, 2)

The mirror is a vertical line. The point is 2 away from it, so the image is the same distance on the other side: $(3, 2) \rightarrow (-1, 2)$.

48 Reflect the point (−2, 4) in the line $x = -1$.

Answer: (0, 4)

The mirror is a vertical line. The point is 1 away from it, so the image is the same distance on the other side: $(-2, 4) \rightarrow (0, 4)$.

49 Reflect the point (5, 1) in the line $y = 3$.

Answer: (5, 5)

The mirror is a horizontal line. The point is 2 away from it, so the image is the same distance on the other side: $(5, 1) \rightarrow (5, 5)$.

50 Reflect the point (0, −2) in the line $y = 1$.

Answer: (0, 4)

The mirror is a horizontal line. The point is 3 away from it, so the image is the same distance on the other side: $(0, -2) \rightarrow (0, 4)$.

51 Reflect the point (4, 6) in the line $x = 2$.

Answer: (0, 6)

The mirror is a vertical line. The point is 2 away from it, so the image is the same distance on the other side: $(4, 6) \rightarrow (0, 6)$.

52 Reflect the point (−3, −1) in the line $y = -2$.

Answer: (−3, −3)

The mirror is a horizontal line. The point is 1 away from it, so the image is the same distance on the other side: $(-3, -1) \rightarrow (-3, -3)$.

53 Reflect the point (3, 1) in the line $y = x$.

Answer: (1, 3)

Reflecting in $y = x$ swaps the coordinates: $(3, 1) \rightarrow (1, 3)$.

- 54 Reflect the point $(-2, 4)$ in the line $y = x$.

Answer: $(4, -2)$

Reflecting in $y = x$ swaps the coordinates: $(-2, 4) \rightarrow (4, -2)$.

- 55 Reflect the point $(5, -3)$ in the line $y = x$.

Answer: $(-3, 5)$

Reflecting in $y = x$ swaps the coordinates: $(5, -3) \rightarrow (-3, 5)$.

- 56 Reflect the point $(0, 6)$ in the line $y = x$.

Answer: $(6, 0)$

Reflecting in $y = x$ swaps the coordinates: $(0, 6) \rightarrow (6, 0)$.

- 57 A triangle with area 12 is reflected in the y -axis. What is the area of the image?

Answer: 12

A reflection is congruent, so the area is unchanged at 12.

- 58 The point $(4, -5)$ is reflected in the x -axis and then in the y -axis. Give the final position.

Answer: $(-4, 5)$

First $(4, -5) \rightarrow (4, 5)$, then $(4, 5) \rightarrow (-4, 5)$. Both signs have changed, which is the same as a rotation of 180° about the origin.

D · Word problems — Charts, logos, water and wallpaper.

- 59 A boat at $(5, 3)$ on a chart is reflected in the shoreline, which lies along the x -axis. Where is the reflection?

Answer: $(5, -3)$

Reflecting in the x -axis changes the sign of y : $(5, 3) \rightarrow (5, -3)$.

- 60 A logo has a mark at $(-2, 6)$. The design is mirrored in the y -axis. Where is the mark now?

Answer: $(2, 6)$

The sign of x changes: $(-2, 6) \rightarrow (2, 6)$.

- 61 A kite floats at $(3, 7)$ above still water along the x -axis. Where does its reflection appear?

Answer: $(3, -7)$

Straight down, the same distance below: $(3, -7)$.

- 62 A wallpaper pattern is made by reflecting a shape of area 9 cm^2 in a line, over and over, 8 times. What is the total area covered, in square centimetres?

Answer: 72

Each copy is congruent, so each has area 9 cm^2 . $8 \times 9 = 72 \text{ cm}^2$.

- 63 A tile has a corner at $(-4, -1)$. It is flipped in the y -axis to make the next tile. Where is that corner now?

Answer: $(4, -1)$

$(-4, -1) \rightarrow (4, -1)$. Only the sign of x changes.

- 64 A point at $(6, 2)$ has an image at $(6, -2)$. Name the mirror line.

Answer: the x -axis

The x -coordinate is unchanged and the y has changed sign, so the mirror is the x -axis, the line $y = 0$.

- 65** A shape has a perimeter of 30 cm. It is reflected. What is the perimeter of the image, in centimetres?

Answer: 30

Reflection preserves every length, so the perimeter is still 30 cm.

- 66** A pattern is built by reflecting the point (2, 5) in the x-axis, then reflecting that image in the y-axis. Give the final point.

Answer: (-2, -5)

$(2, 5) \rightarrow (2, -5) \rightarrow (-2, -5)$.