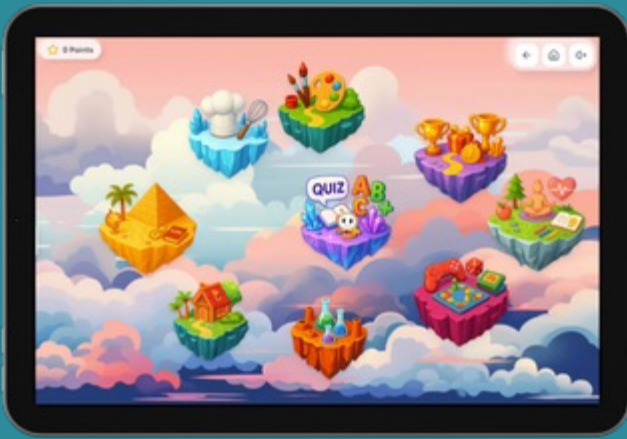


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Understanding Transformations - Year 6

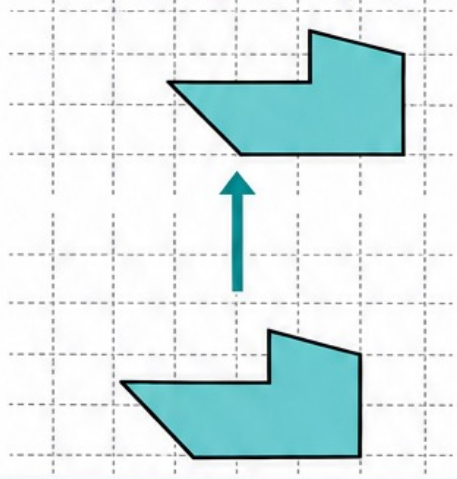
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TRANSFORMATIONS TOOLKIT

TRANSLATION

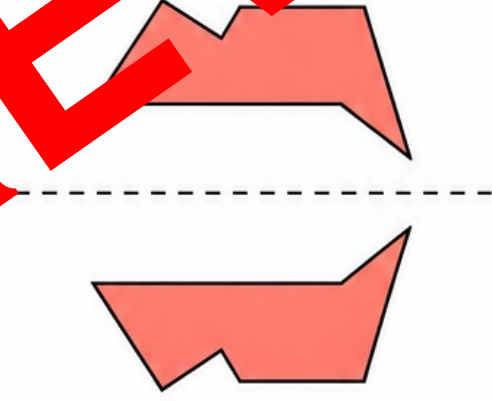
Slide every point the same distance and direction.



$$(x, y) \rightarrow (x + a, y + b)$$

REFLECTION

Flip across a mirror line

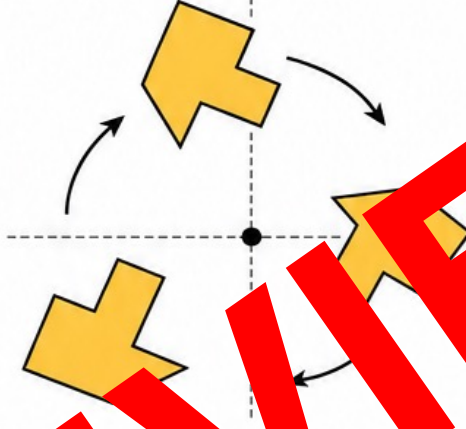


$$y\text{-axis: } (-x, y)$$

$$x\text{-axis: } (x, -y)$$

ROTATION

Turn around a fixed centre.



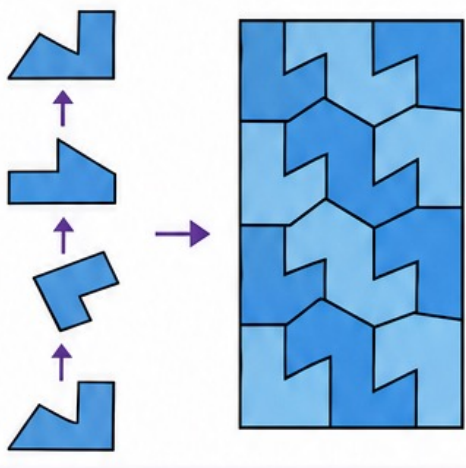
$$90^\circ \text{ clockwise: } (x, -y)$$

$$180^\circ: (-x, -y)$$

$$90^\circ \text{ anticlockwise: } (y, x)$$

COMBINATIONS

Apply moves in order.

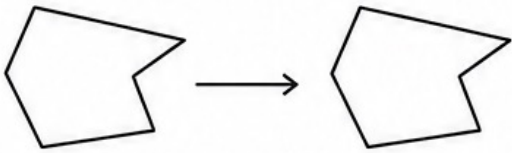
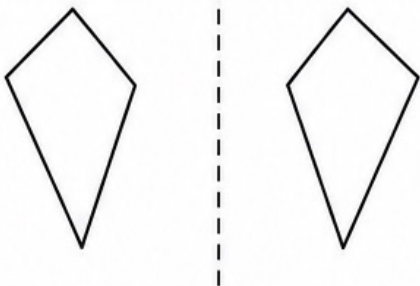
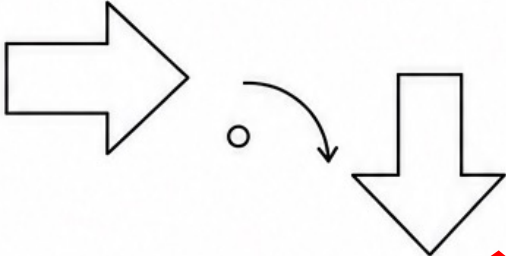
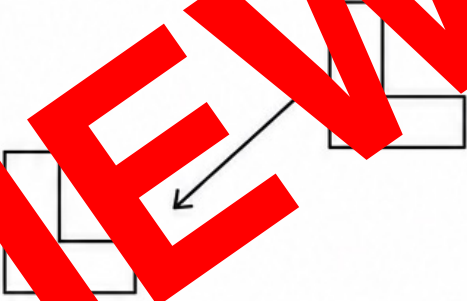
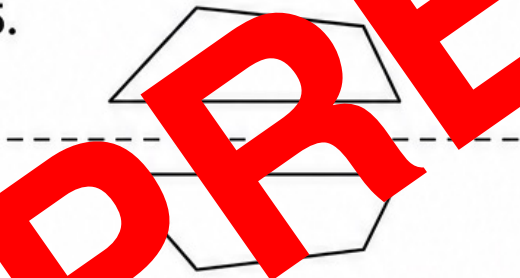
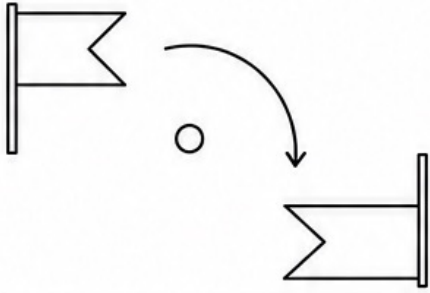


Tessellation = repeated shapes with no gaps or overlaps.

TRANSFORMATION FOUNDATIONS

Name: _____

Write T for translation, F for reflection or R for rotation.

1.  _____	2.  _____
3.  _____	4.  _____
5.  _____	6.  _____

What stays the same after every rigid transformation?

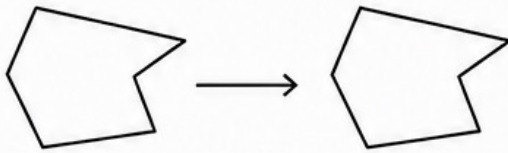
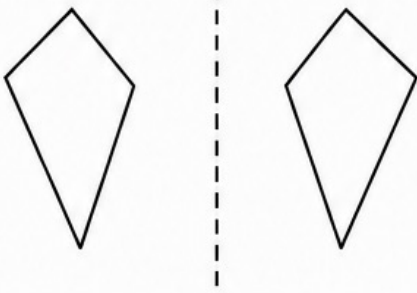
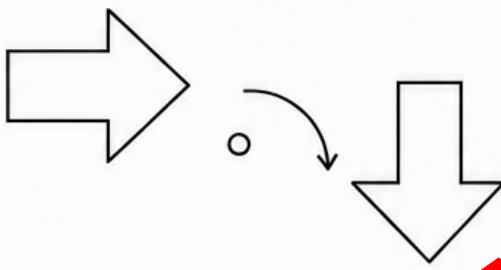
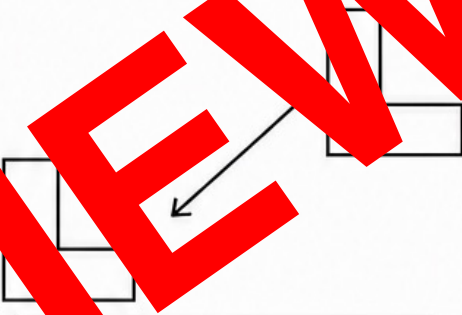
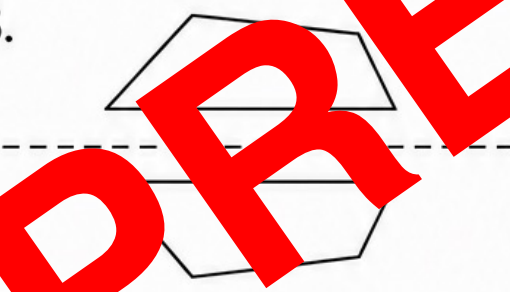
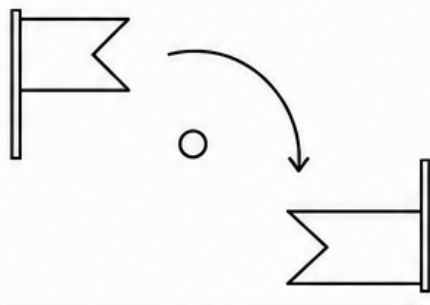
Which transformation reverses orientation?

How can you recognise a rotation?

TRANSFORMATION FOUNDATIONS

Name: **ANSWERS**

Write T for translation, F for reflection or R for rotation.

1.  T	2.  F
3.  R	4.  T
5.  F	6.  R

What stays the same after every rigid transformation?

Side lengths, angle sizes, shape and area.

Which transformation reverses orientation?

Reflection.

How can you recognise a rotation?

Every point turns through the same angle around a fixed centre.

TRANSLATION COORDINATES

Name: _____

1. Triangle ABC: A(-5,-2), B(-2,-2), C(-4,1).

Translate by vector (+6,+3).

Record A', B', C'. Check on the grid.

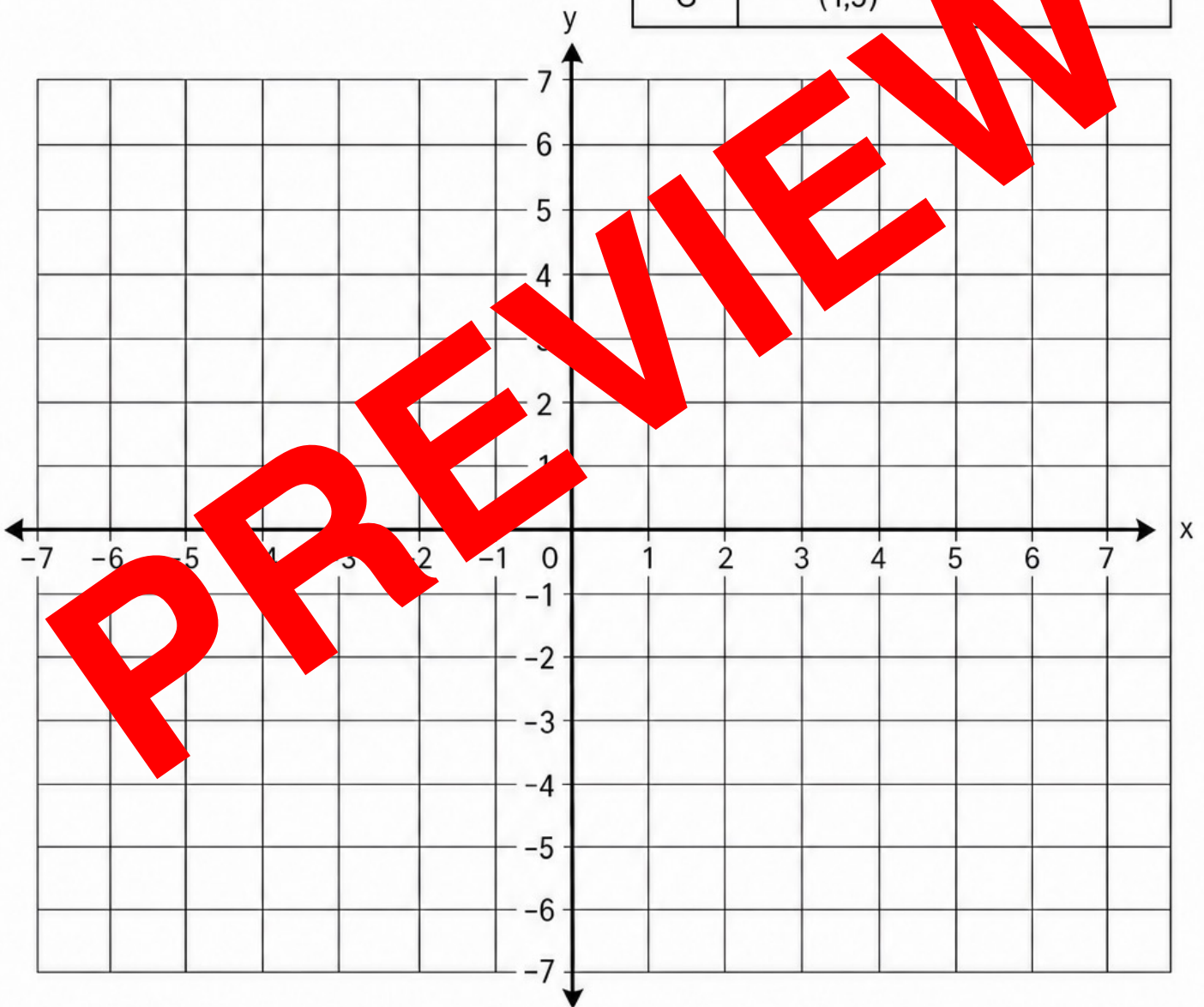
	Original	Image
A	(-5,-2)	
B	(-2,-2)	
C	(-4,1)	

2. Rectangle DEFG: D(1,3), E(4,3), F(4,5), G(1,5).

Translate by vector (-5,-6).

Record D', E', F', G'. Check on the grid.

	Original	Image
D	(1,3)	
E	(4,3)	
F	(4,5)	
G	(1,5)	



Write one sentence explaining how you checked the translation.

TRANSLATION COORDINATES

Name: **ANSWERS**

1. Triangle ABC: A(-5,-2), B(-2,-2), C(-4,1).

Translate by vector (+6,+3).

Record A', B', C'. Check on the grid.

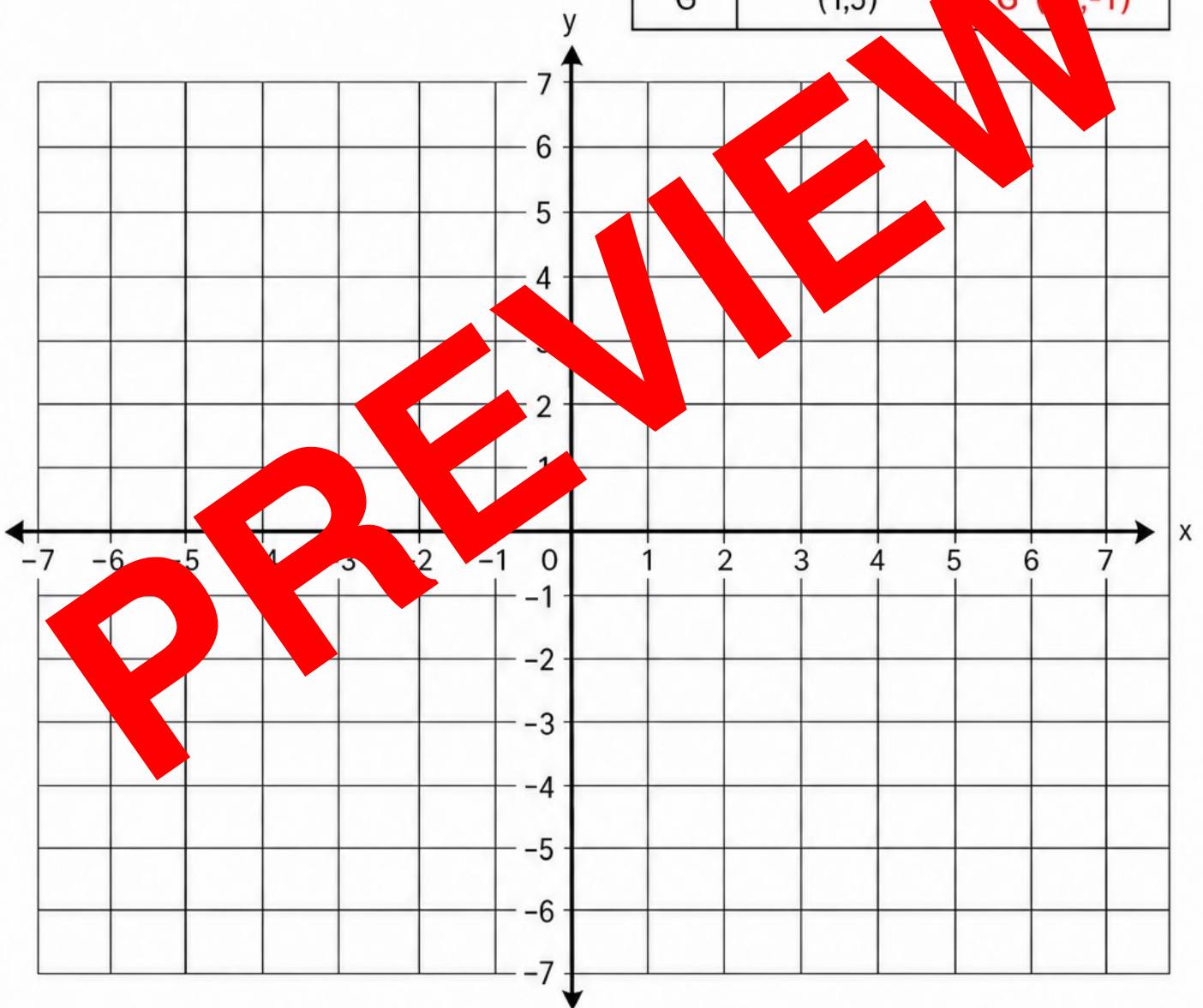
	Original	Image
A	$(-5, -2)$	A' (1,1)
B	$(-2, -2)$	B' (4,1)
C	$(-4, 1)$	C' (2,4)

2. Rectangle DEFG: D(1,3), E(4,3), F(4,5), G(1,5).

Translate by vector (-5,-6).

Record D', E', F', G'. Check on the grid.

	Original	Image
D	$(1, 3)$	D' (-4, -3)
E	$(4, 3)$	E' (-1, -3)
F	$(4, 5)$	F' (-1, -1)
G	$(1, 5)$	G' (-4, -1)



Write one sentence explaining how you checked the translation.

Every vertex moved the same vector.

REFLECTION COORDINATES

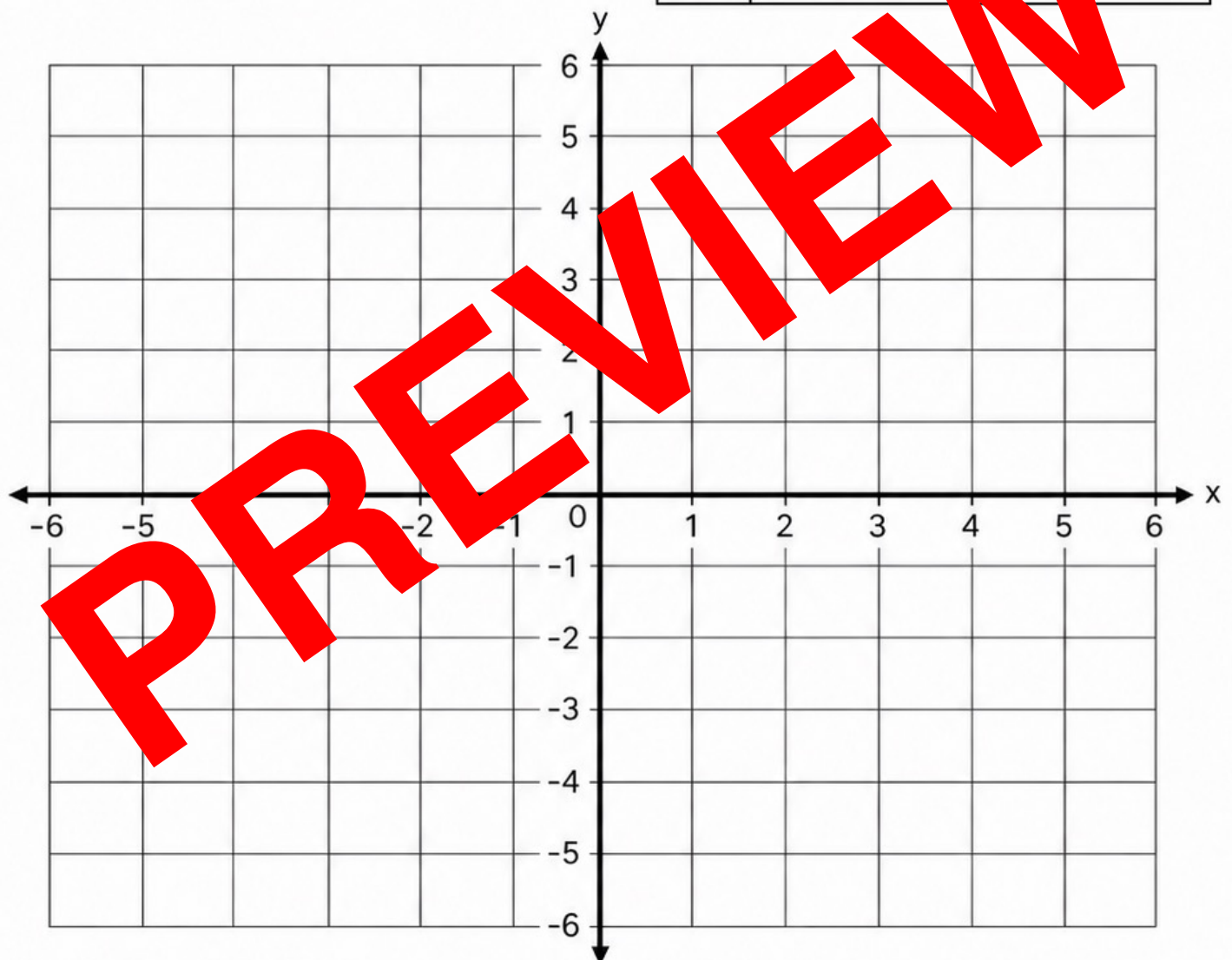
Name: _____

1. Triangle PQR: P(-5,1), Q(-2,1), R(-3,4).
Reflect in the y-axis.

	Original	Image
P	(-5,1)	
Q	(-2,1)	
R	(-3,4)	

2. Trapezium STUV: S(1,-1), T(5,-1),
U(4,-4), V(2,-4). Reflect in the x-axis.

	Original	Image
S	(1,-1)	
T	(5,-1)	
U	(4,-4)	
V	(2,-4)	



Which coordinate changes in Task 1?

Which coordinate changes in Task 2?

REFLECTION COORDINATES

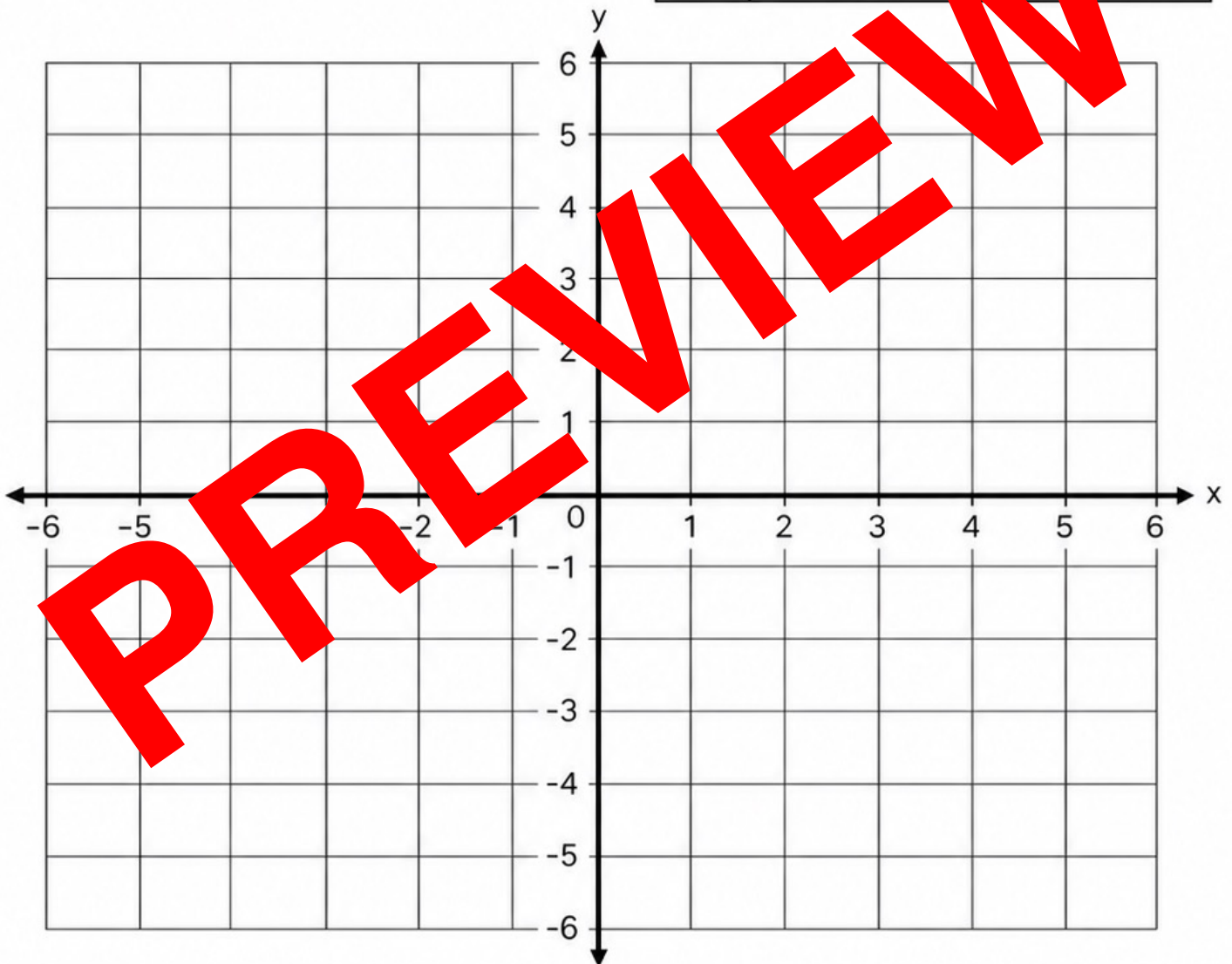
Name: ANSWERS

1. Triangle PQR: P(-5,1), Q(-2,1), R(-3,4).
Reflect in the y-axis.

	Original	Image
P	(-5,1)	P' (5,1)
Q	(-2,1)	Q' (2,1)
R	(-3,4)	R' (3,4)

2. Trapezium STUV: S(1,-1), T(5,-1),
U(4,-4), V(2,-4). Reflect in the x-axis.

	Original	Image
S	(1,-1)	S' (1,1)
T	(5,-1)	T' (5,1)
U	(4,-4)	U' (4,4)
V	(2,-4)	V' (2,4)



Which coordinate changes in Task 1?

The x-coordinate changes sign.

Which coordinate changes in Task 2?

The y-coordinate changes sign.

ROTATION COORDINATES

Name: _____

1. Triangle LMN: L(1,1), M(4,1), N(2,3).

Rotate 90° anticlockwise about the origin.

Record L', M', N'. Check on the grid.

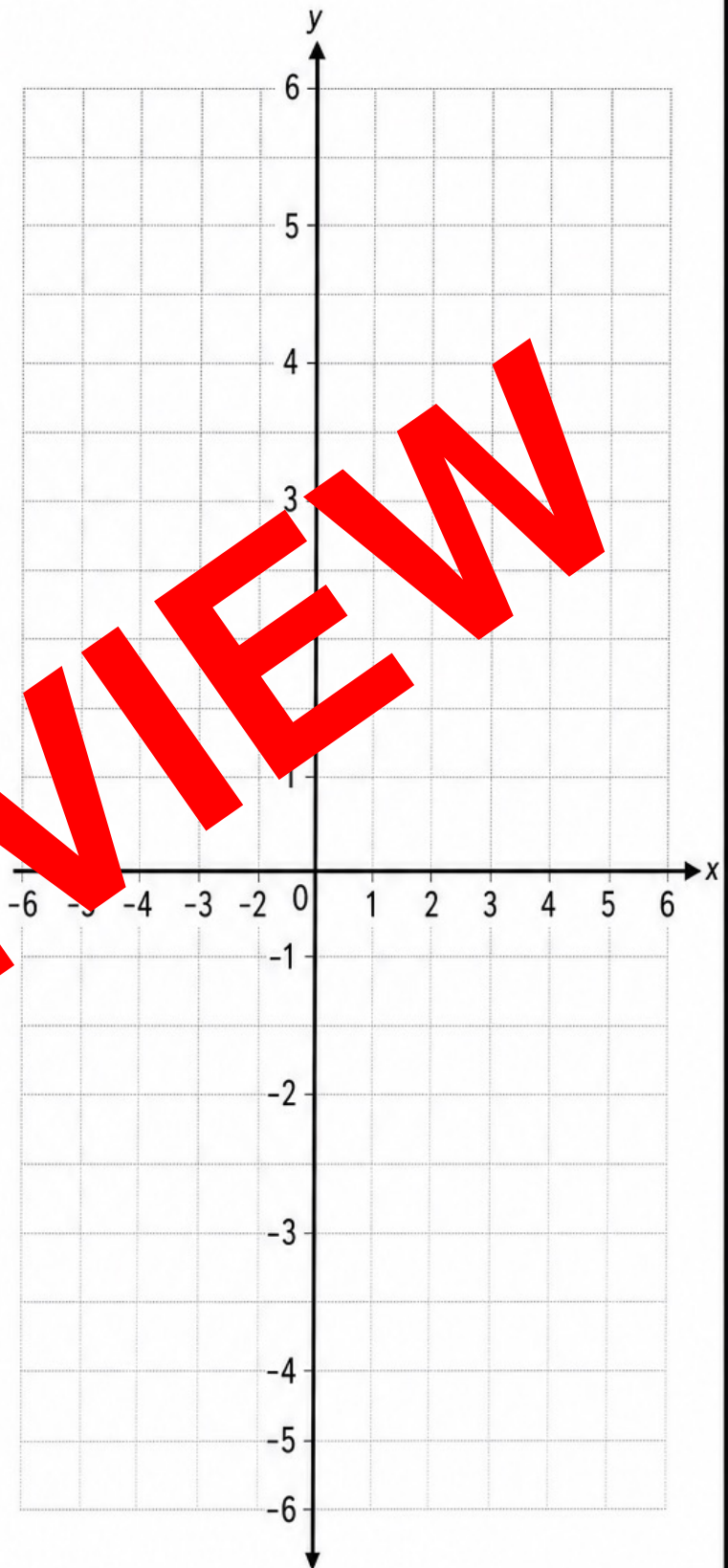
Point	Original	Image
L	(1,1)	
M	(4,1)	
N	(2,3)	

2. Rectangle WXYZ: W(-4,-1), X(-1,-1), Y(-1,-3), Z(-4,-3).

Rotate 180° about the origin.

Record W', X', Y', Z'. Check on the grid.

Point	Original	Image
W	(-4,-1)	
X	(-1,-1)	
Y	(-1,-3)	
Z	(-4,-3)	



Write the coordinate rule used for each task.

Task 1: _____

Task 2: _____

ROTATION COORDINATES

Name: **ANSWERS**

1. Triangle LMN: L(1,1), M(4,1), N(2,3).

Rotate 90° anticlockwise about the origin.

Record L', M', N'. Check on the grid.

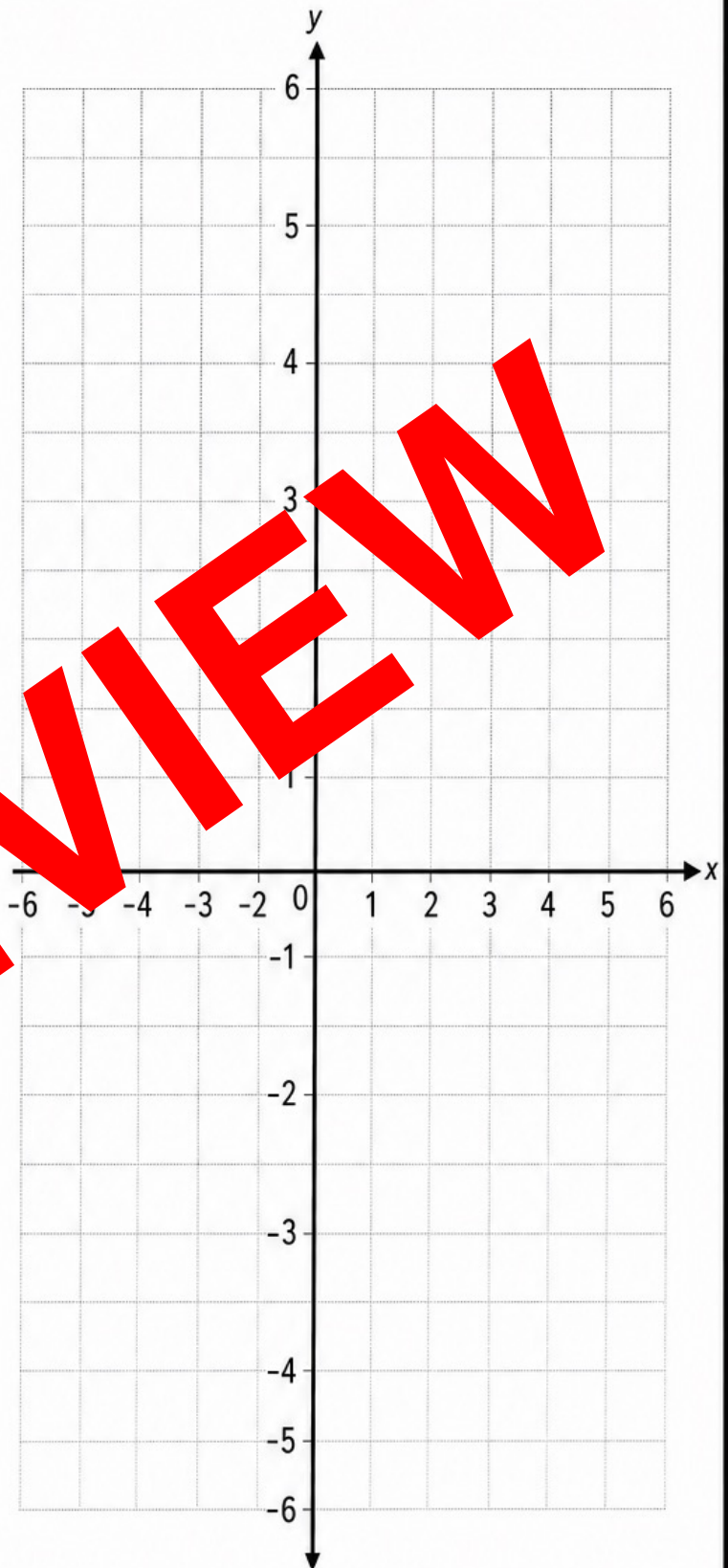
Point	Original	Image
L	(1,1)	L' (-1,1)
M	(4,1)	M' (-1,4)
N	(2,3)	N' (-3,2)

2. Rectangle WXYZ: W(-4,-1), X(-1,-1), Y(-1,-3), Z(-4,-3).

Rotate 180° about the origin.

Record W', X', Y', Z'. Check on the grid.

Point	Original	Image
W	(-4,-1)	W' (4,1)
X	(-1,-1)	X' (1,1)
Y	(-1,-3)	Y' (1,3)
Z	(-4,-3)	Z' (4,3)



Write the coordinate rule used for each task.

Task 1: **90° anticlockwise: $(x, y) \rightarrow (-y, x)$**

Task 2: **180° : $(x, y) \rightarrow (-x, -y)$**

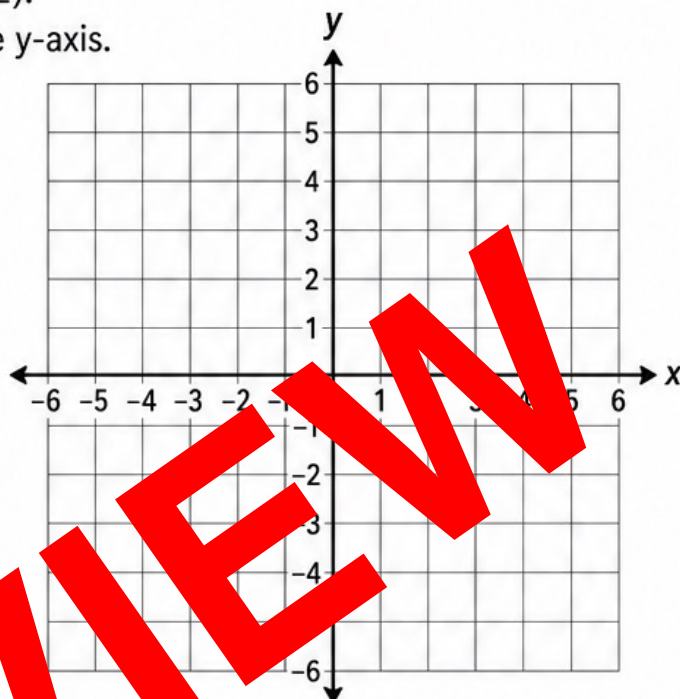
COMBINED TRANSFORMATION SEQUENCES

PAGE 1 - APPLY EACH STEP IN ORDER

Name: _____

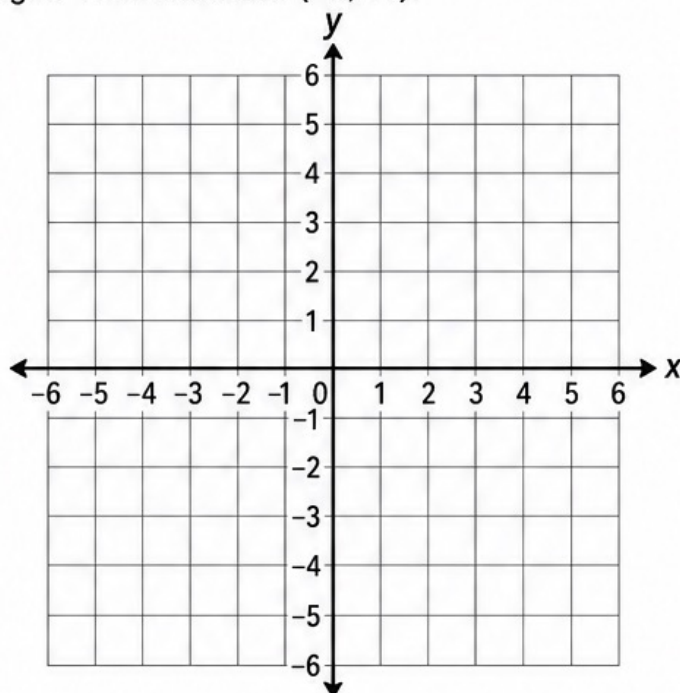
1. Triangle ABC: A(-5,-1), B(-3,-1), C(-4,2).
First translate (+6, +2). Then reflect in the y-axis.

Point	Original	Image 1	Image 2
A	(-5,-1)		
B	(-3,-1)		
C	(-4,2)		



2. Rectangle DEFG: D(1, -1), E(4, -4), F(4, -2), G(1, -2).
First rotate 90° anticlockwise about the origin. Then translate (-3, +1).

Point	Original	Image 1	Image 2
D	(1, -1)		
E	(4, -4)		
F	(4, -2)		
G	(1, -2)		



Why must Image 1 be completed before Image 2?

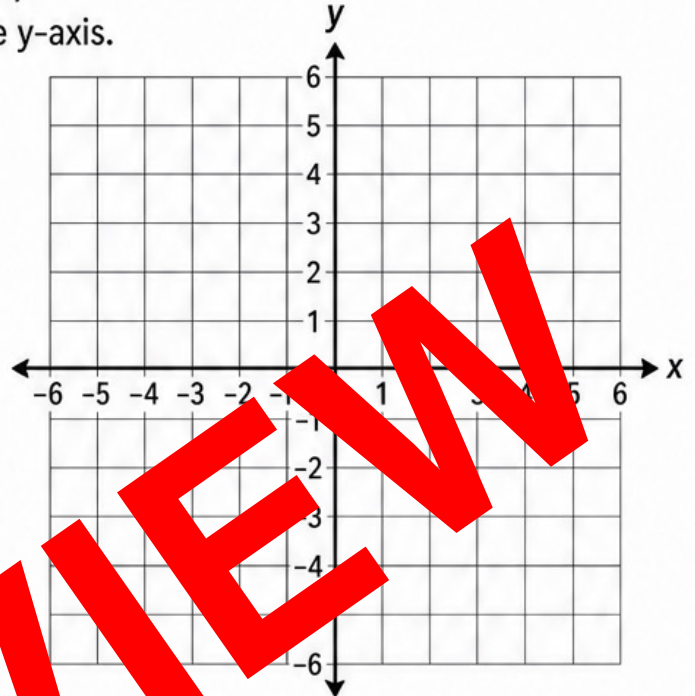
COMBINED TRANSFORMATION SEQUENCES

PAGE 1 - APPLY EACH STEP IN ORDER

Name: ANSWERS

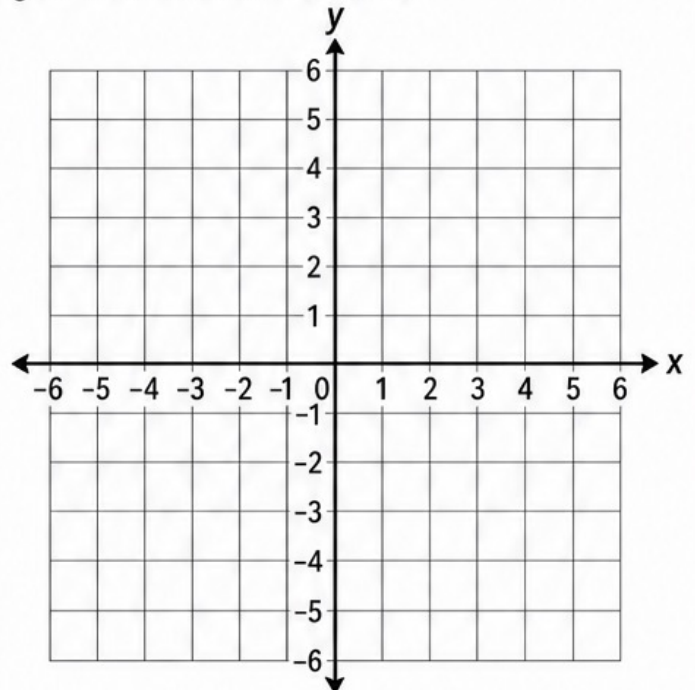
1. Triangle ABC: A(-5,-1), B(-3,-1), C(-4,2).
First translate (+6,+2). Then reflect in the y-axis.

Point	Original	Image 1	Image 2
A	$(-5, -1)$	$A' (1, 1)$	$A'' (-1, 1)$
B	$(-3, -1)$	$B' (3, 1)$	$B'' (-3, 1)$
C	$(-4, 2)$	$C' (2, 4)$	$C'' (-2, 4)$



2. Rectangle DEFG: D(1,-4), E(4,-4), F(4,-2), G(1,-2).
First rotate 90° anticlockwise about the origin. Then translate (-3,+1).

Point	Original	Image 1	Image 2
D	$(1, -4)$	$D' (4, 1)$	$D'' (1, 2)$
E	$(4, -4)$	$E' (4, 4)$	$E'' (1, 5)$
F	$(4, -2)$	$F' (2, 4)$	$F'' (-1, 5)$
G	$(1, -2)$	$G' (2, 1)$	$G'' (-1, 2)$



Why must Image 1 be completed before Image 2?

The second rule acts on the first image, not the original.

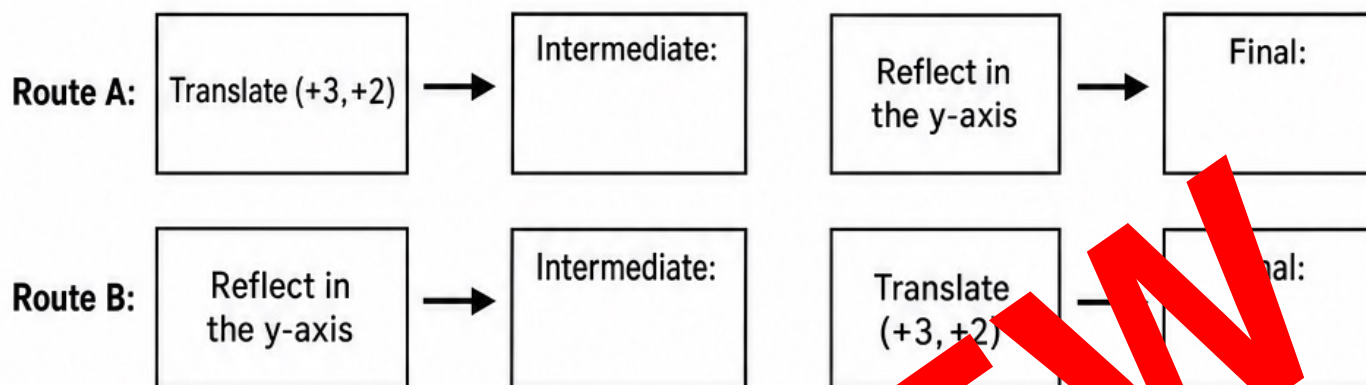
COMBINED TRANSFORMATION SEQUENCES

PAGE 2 - ORDER MATTERS

Name: _____

A. SAME MOVES, DIFFERENT ORDER

Start P(2,1).



Compare the final points. What does this prove?

B. NAME EACH TRANSFORMATION

Point	Original	Image 1	Image 2
A	(-1,1)	A' (1,-1)	A'' (-2,1)
B	(3,1)	B' (1,-3)	B'' (-2,-1)
C	(2,3)	C' (3,-2)	C'' (0,0)

Transformation 1: _____

Transformation 2: _____

Point	Original	Image 1	Image 2
P	(-4,1)	P' (4,1)	P'' (5,-2)
Q	(-2,1)	Q' (2,1)	Q'' (3,-2)
R	(-3,3)	R' (3,3)	R'' (4,0)

Transformation 1: _____

Transformation 2: _____

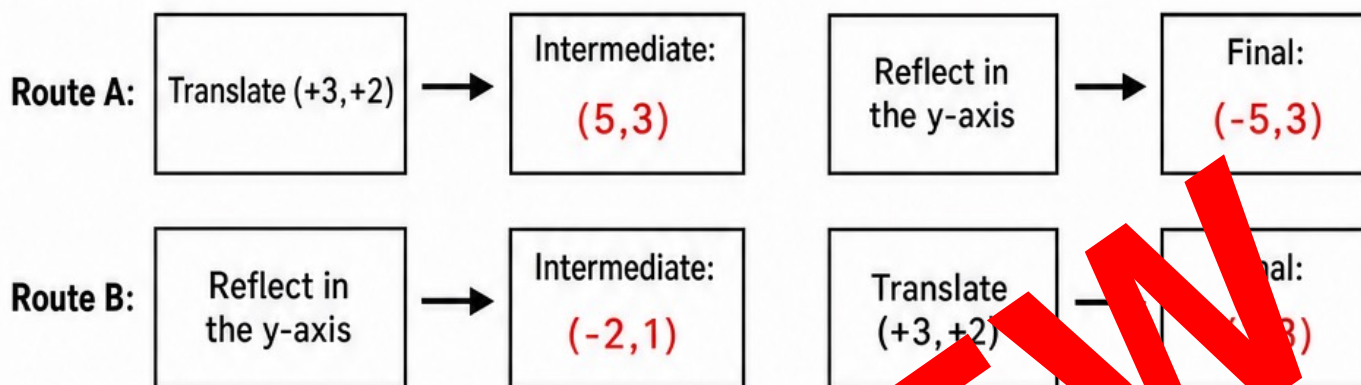
COMBINED TRANSFORMATION SEQUENCES

PAGE 2 - ORDER MATTERS

Name: ANSWERS

A. SAME MOVES, DIFFERENT ORDER

Start P(2,1).



Compare the final points. What does this prove?

The same transformations in a different order give a different final position.

B. NAME EACH TRANSFORMATION

Point	Original	Image 1	Image 2
A	(1,1)	A' (1,-1)	A'' (-2,1)
B	(3,1)	B' (1,-3)	B'' (-2,-1)
C	(2,3)	C' (3,-2)	C'' (0,0)

Transformation 1: 90° clockwise rotation about the origin

Transformation 2: translation (-3,+2)

Point	Original	Image 1	Image 2
P	(-4,1)	P' (4,1)	P'' (5,-2)
Q	(-2,1)	Q' (2,1)	Q'' (3,-2)
R	(-3,3)	R' (3,3)	R'' (4,0)

Transformation 1: reflection in the y-axis

Transformation 2: translation (+1,-3)

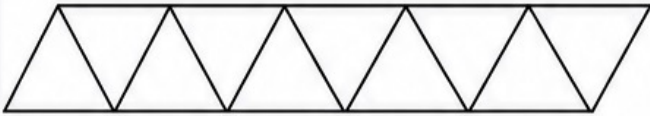
TESSELLATION DETECTIVES

PAGE 1 - TEST THE PATTERN

Name: _____

A tessellation covers a region with no gaps and no overlaps.

A.

☐

Tessellation

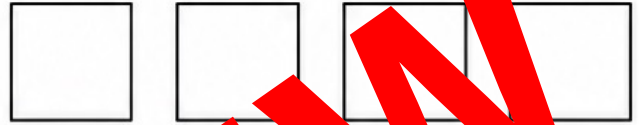
☐

Not a tessellation

Transformation(s): _____

Evidence: _____

B.

☐

Tessellation

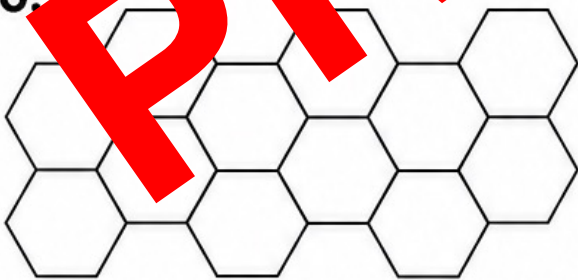
☐

Not a tessellation

Transformation(s): _____

Evidence: _____

C.

☐

Tessellation

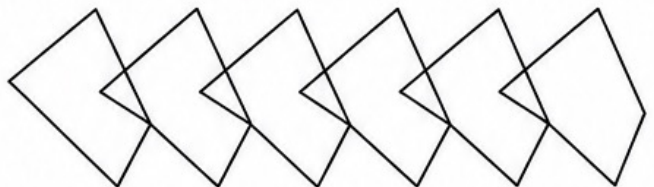
☐

Not a tessellation

Transformation(s): _____

Evidence: _____

D.

☐

Tessellation

☐

Not a tessellation

Transformation(s): _____

Evidence: _____

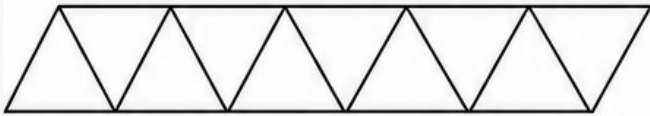
TESSELLATION DETECTIVES

PAGE 1 - TEST THE PATTERN

Name: ANSWERS

A tessellation covers a region with no gaps and no overlaps.

A.



Tessellation

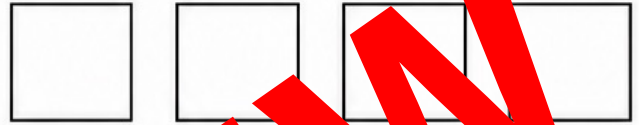


Not a tessellation

Transformation(s): translation and reflection

Evidence: edge-to-edge, no gaps or overlaps

B.



Tessellation

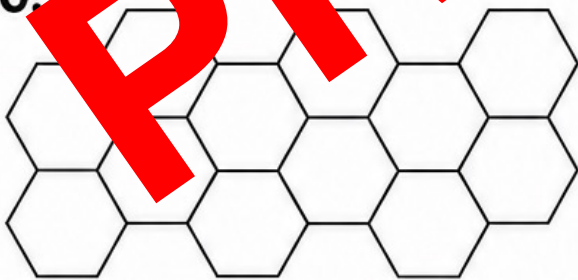


Not a tessellation

Transformation(s): translation

Evidence: gaps remain

C.



Tessellation

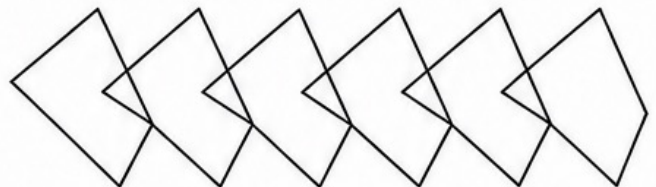


Not a tessellation

Transformation(s): translation

Evidence: hexagons cover the region

D.



Tessellation



Not a tessellation

Transformation(s): translation

Evidence: motifs overlap

TESSELLATION BLUEPRINT

PAGE 2 - CREATE AND EXPLAIN

Name: _____

1. Repeat the motif to cover the grid.
2. Use at least two transformation types.
3. Draw arrows and label each move T, F or R.
4. Check that there are no gaps or overlaps.



My repeat sequence is:

The transformations I used are:

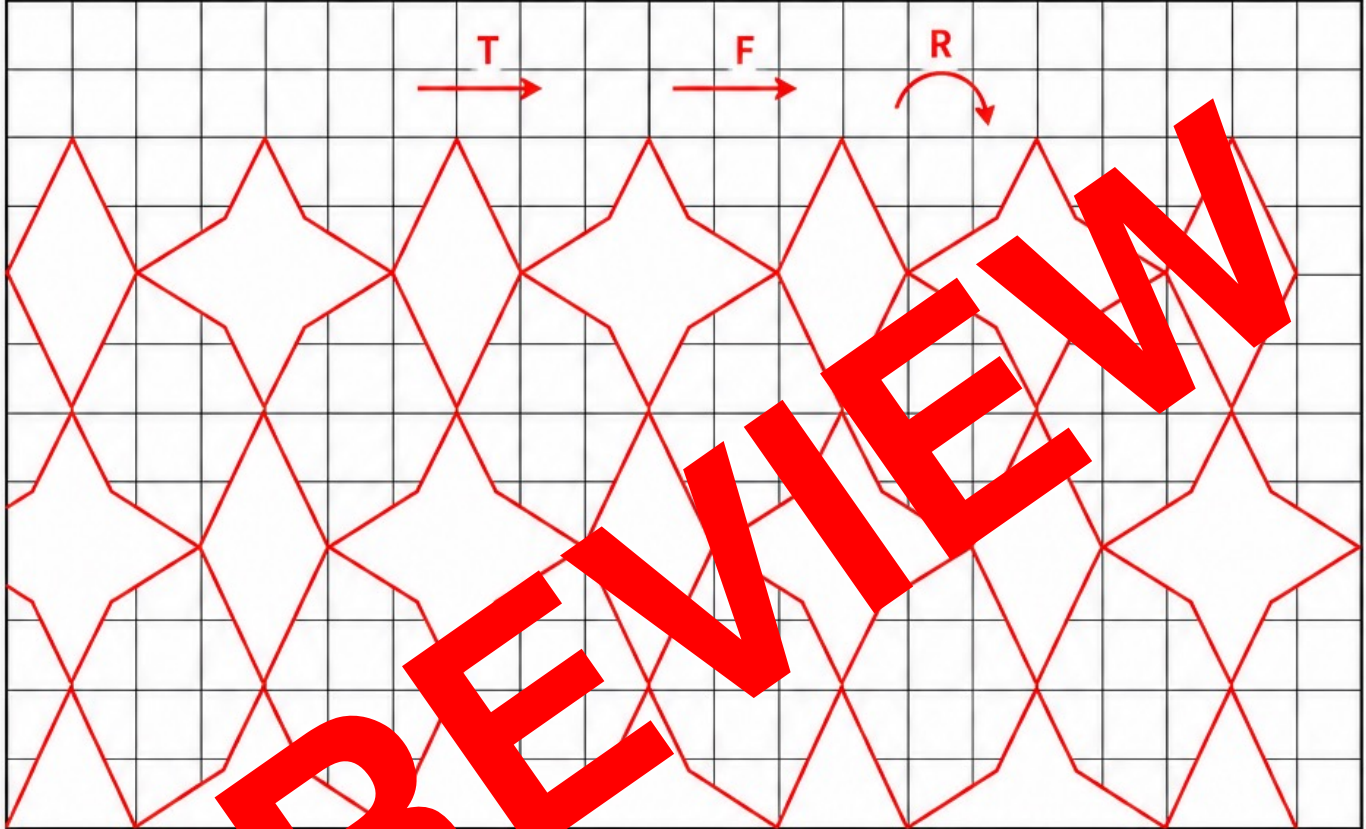
My pattern is a tessellation because:

TESSELLATION BLUEPRINT

PAGE 2 - CREATE AND EXPLAIN

Name: **ANSWERS**

1. Repeat the motif to cover the grid.
2. Use at least two transformation types.
3. Draw arrows and label each move T, F or R.
4. Check that there are no gaps or overlaps.



My repeat sequence is:

- Translate right, reflect, translate right, rotate 180°, repeat.

The transformations I used are:

- translation, reflection and rotation

My pattern is a tessellation because:

- the motifs cover the region with no gaps or overlaps.



TRANSFORMATION TRAIL



RULES

1. Roll and move.
2. Draw a challenge card.
3. Correct: stay.
Incorrect: move back one space.
4. First to FINISH wins.

T	Translation
F	Reflection
R	Rotation
C	Combination

Counters for 2-4 players



TRANSFORMATION TRAIL - CHALLENGE CARDS 1-12

1

T: Translate
(-3,2) by
(+5,-1).

2

F: Reflect
(4,-2) in the
y-axis.

3

R: Rotate
(2,5) 180°
about the origin.

4

F: Reflect
(-1,6) in the
x-axis.

5

R: Rotate
(-3,2) 90°
clockwise.

6

T: Translate
(5,-4) by
(-7,+3).

7

F: Name the
move: same
orientation,
4 right.

8

F: Name the
move: mirror
image across a
vertical line.

9

R: Name the
move: quarter-
turn
anticlockwise.

10

R: True or
false: rotations
change size.

11

T: True or
false: a
translation
changes
orientation.

12

F: Which
transformation
maps (3,1) to
(-3,1)?

TRANSFORMATION TRAIL - CHALLENGE CARDS 13-24

13

F: Reflect $(-5, -3)$
in the x-axis.

14

R: Rotate $(4, -1)$
 90° anticlockwise.

15

T: Translate $(-2, 0)$
by $(+6, +4)$.

16

R: Rotate $(-2, -5)$
 180° about
the origin.

17

F: Give the rule
for reflection
in the x-axis.

18

R: Give the rule
for 90° clockwise
rotation.

19

C: Can regular
polygons
tessellate?

20

C: Can circles
alone tessellate
without gaps?

21

C: Name one
boundary condition
for a tessellation.

22

C: Reflect $(2, 1)$
in the y-axis,
then translate
 $(+3, 0)$.

23

C: Rotate $(1, 3)$
 180° , then
translate $(0, +2)$.

24

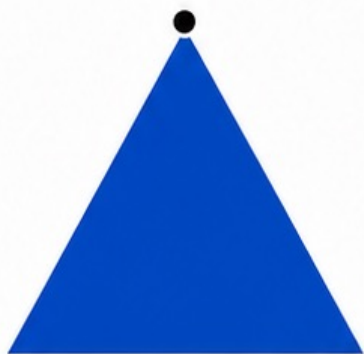
C: Why can
transformation
order matter?

TRANSFORMATION TRAIL - ANSWER KEY

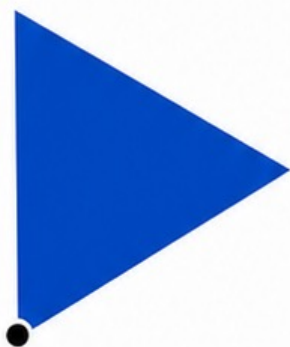
- ★ ————— ★ ————— ★
- | | |
|-----------------------------|---|
| 1 (2,1) | 13 (-5,3) |
| 2 (-4,-2) | 14 (1,4) |
| 3 (-2,-5) | 15 (4,4) |
| 4 (-1,-6) | 16 (2,5) |
| 5 (2,3) | 17 $(x, y) \rightarrow (x, -y)$ |
| 6 (-2,-1) | 18 $(x, y) \rightarrow (y, -x)$ |
| 7 translation | 19 yes |
| 8 reflection | 20 no |
| 9 rotation | 21 no gaps or no overlaps |
| 10 false | 22 (1,1) |
| 11 false | 23 (-1,-1) |
| 12 reflection in the y-axis | 24 the second move acts on the first image, so changing order can change the result |

Accept equivalent precise wording for explanation items.

TESSELLATION BUILDERS - MOTIF TILES



Equilateral triangle



Equilateral triangle



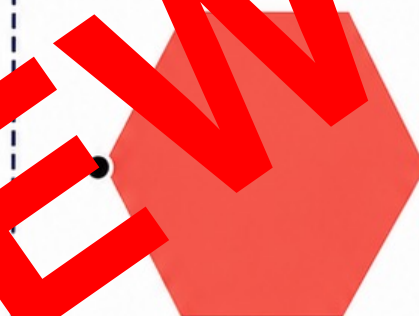
Square



Square



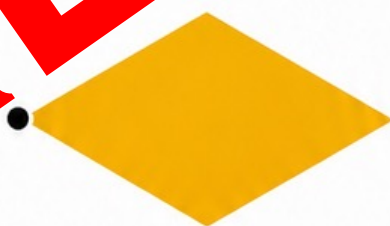
Regular hexagon



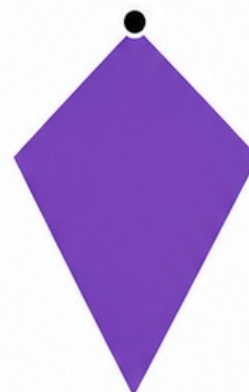
Regular hexagon



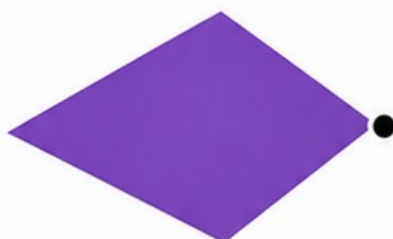
Rhombus



Rhombus



Kite



Kite



Right-angled triangle



Right-angled triangle

TESSELLATION BUILDERS - CHALLENGES

1



Make a strip using translations only.

2



Make a mirror band using reflection.

3



Create a quarter-turn rosette.

4



Cover a region with one shape and no gaps.

5



Use two shapes in one repeating pattern.

6



Create a motif, then translate it.

7



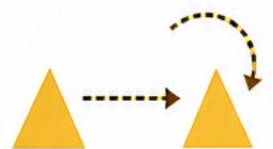
Rotate a motif 180 degrees around a marked point.

8



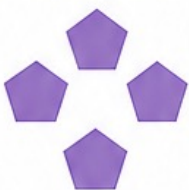
Reflect a motif across a vertical line.

9



Combine a translation and a rotation.

10



Make a non-tessellation and explain the gap.

11



Compare two patterns. Which uses fewer transformations?

12



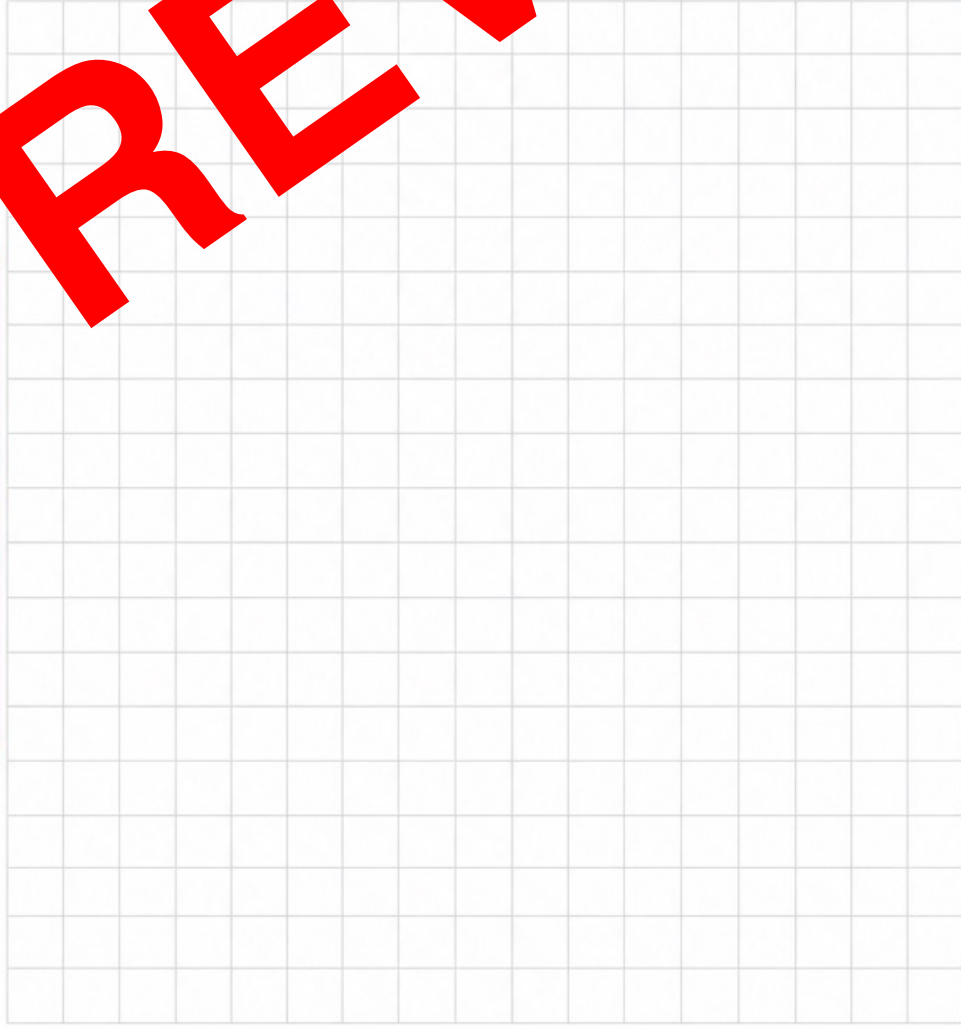
Create a tessellation and label three transformations.

TESSELLATION BUILDERS - PATTERN MAT



Use motif tiles to build a repeating pattern. Label each move T, F or R. Check: no gaps, no overlaps.

SQUARE GRID



TRIANGULAR GRID

☐

motif repeated

☐

transformations labelled

☐

no gaps

☐

no overlaps

PATTERN PAVILION DESIGN CHALLENGE

PAGE 1 - COORDINATE ACCURACY

Name: _____

1. Triangle ABC: A(-5,-2), B(-2,-2), C(-4,1).

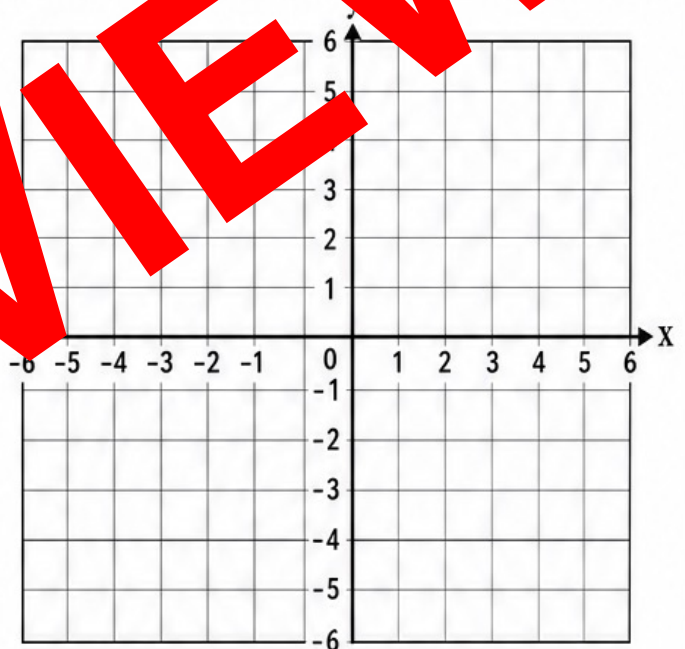
Translate (+6,+3), then reflect in the y-axis.

Point	Original	Image 1	Image 2
A	(-5,-2)		
B	(-2,-2)		
C	(-4,1)		

2. Square DEFG: D(1,1), E(3,1), F(3,3), G(1,3).

Rotate 90° clockwise about the origin,
then translate (-1,+4).

Point	Original	Image 1	Image 2
D	(1,1)		
E	(3,1)		
F	(3,3)		
G	(1,3)		



How did you check each intermediate image?

Why can changing the order change the final image?

PATTERN PAVILION DESIGN CHALLENGE

PAGE 1 - COORDINATE ACCURACY

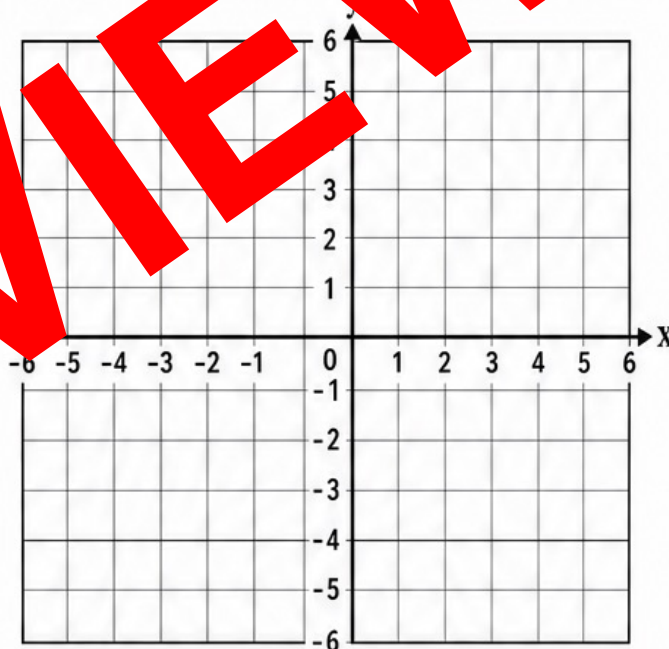
Name: _____ **ANSWERS**

1. Triangle ABC: A(-5,-2), B(-2,-2), C(-4,1).
Translate (+6,+3), then reflect in the y-axis.

Point	Original	Image 1	Image 2
A	(-5,-2)	A' (1,1)	A'' (-1,1)
B	(-2,-2)	B' (4,1)	B'' (-4,1)
C	(-4,1)	C' (2,4)	C'' (-2,4)

2. Square DEFG: D(1,1), E(3,1), F(3,3), G(1,3).
Rotate 90° clockwise about the origin,
then translate (-1,+4).

Point	Original	Image 1	Image 2
D	(1,1)	D' (1,-1)	D'' (0,3)
E	(3,1)	E' (1,-3)	E'' (0,1)
F	(3,3)	F' (3,-3)	F'' (2,1)
G	(1,3)	G' (3,-1)	G'' (2,3)



How did you check each intermediate image?

I applied and checked one rule at a time for every vertex.

Why can changing the order change the final image?

The second transformation acts on a different first image when the order changes.

PATTERN PAVILION DESIGN CHALLENGE

PAGE 2 - TESSELLATION DESIGN

Name: _____

Context:

Design a floor pattern for a new community pavilion.

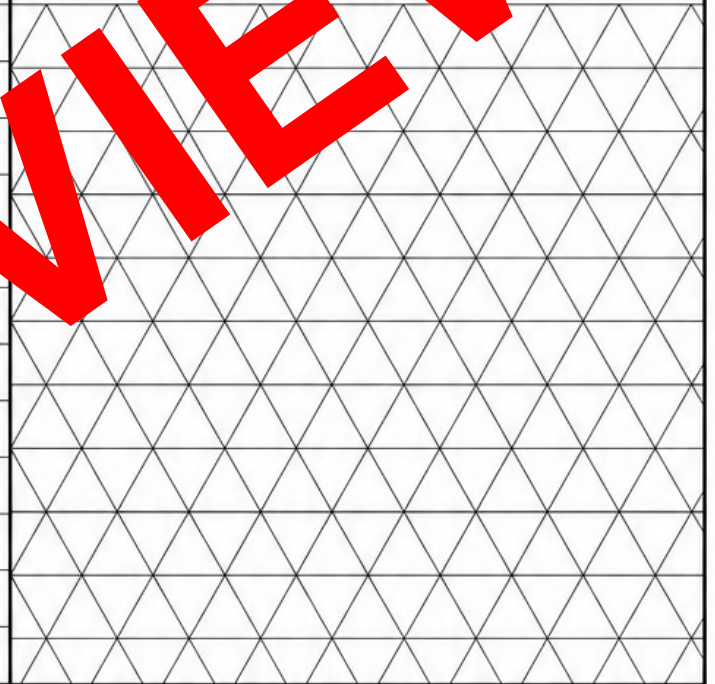
Exact requirements (tick all):

- ☐ Use one clear motif.
- ☐ Use at least two transformation types.
- ☐ Cover the design region with no gaps or overlaps.
- ☐ Label one translation vector, one mirror line or one rotation centre.
- ☐ Describe the repeating sequence.

SQUARE GRID



TRIANGULAR GRID



Motif:

Transformations used:

Repeating sequence:

Evidence that it tessellates:

PATTERN PAVILION DESIGN CHALLENGE

PAGE 2 - TESSELLATION DESIGN

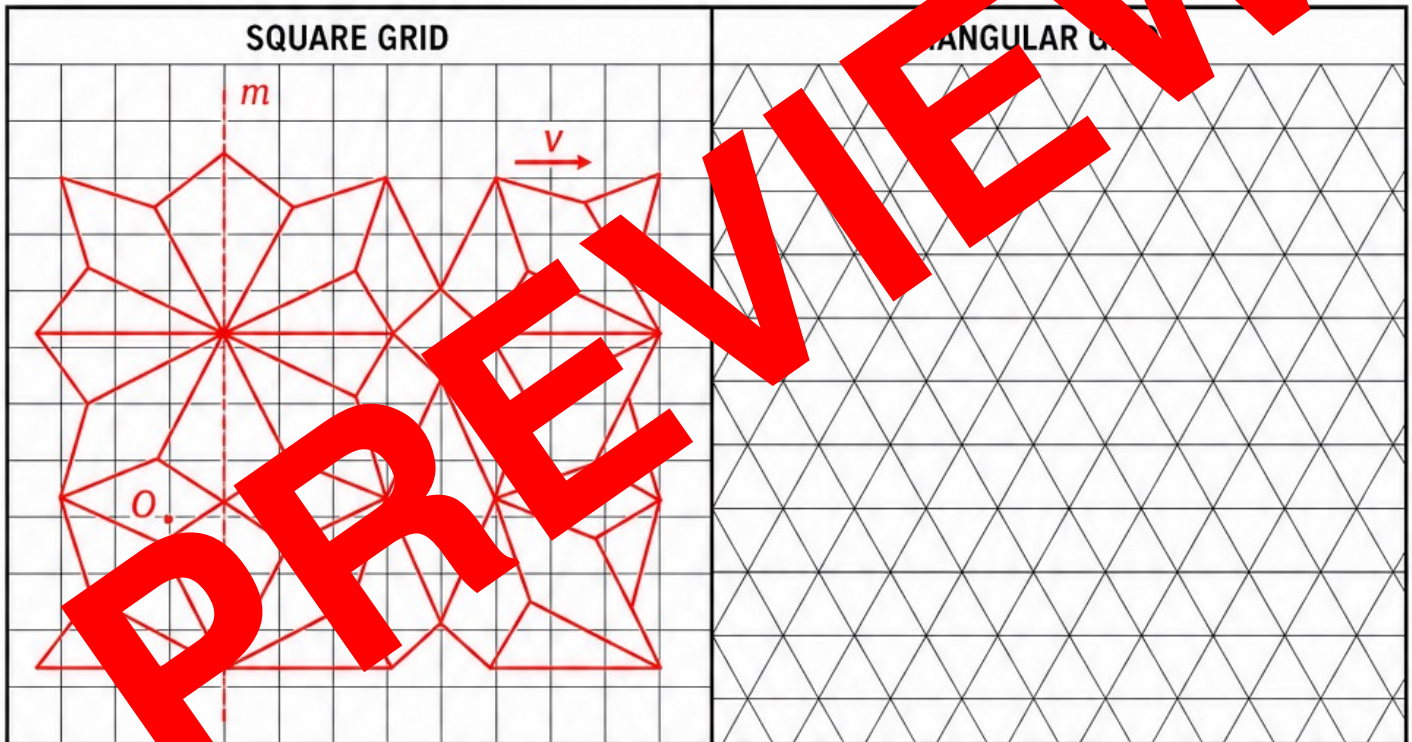
Name: **ANSWERS**

Context:

Design a floor pattern for a new community pavilion.

Exact requirements (tick all):

- ☐ Use one clear motif.
- ☐ Use at least two transformation types.
- ☐ Cover the design region with no gaps or overlaps.
- ☐ Label one translation vector, one mirror line or one rotation centre.
- ☐ Describe the repeating sequence.



Motif:

a pair of congruent kites.

Transformations used:

translation, reflection and 180° rotation.

Repeating sequence:

reflect the kite, rotate the pair 180° , then translate the pair across the row; repeat.

Evidence that it tessellates:

every edge meets another edge and the region has no gaps or overlaps.

UNDERSTANDING TRANSFORMATIONS RUBRIC

CRITERIA	BEGINNING	DEVELOPING	ACHIEVING	CONFIDENT	EXCEEDING
Identifies transformations	Identifies with substantial support.	Identifies common examples.	Accurately identifies translation, reflection and rotation.	Distinguishes varied and combined examples.	Generalises features in unfamiliar patterns.
Applies coordinate rules	Applies rules with substantial support.	Finds some correct image coordinates.	Applies standard coordinate rules accurately.	Uses rules accurately and efficiently.	Analyses and generalises unfamiliar rules.
Combines transformations	Sequence is incomplete.	Records part of a sequence.	Produces correct intermediate and final images.	Explains why order matters.	Compares and evaluates transformation sequences.
Creates a tessellation	Pattern has gaps or overlaps.	Creates a partly repeating pattern.	Creates a valid tessellation using two transformations.	Labels a well-controlled tessellation.	Creates and refines a complex tessellation.
Explains and checks reasoning	Gives a limited explanation.	Gives a basic explanation.	Explains and checks clearly.	Justifies transformations and boundaries.	Communicates rigorous, transferable reasoning.

Understanding Transformations



Understanding Transformations Quiz

