

SCAVENGER HUNT



RIGID AND NON-RIGID TRANSFORMATIONS

Rigid or Not? Distance Before and After

A stretch keeps some lengths and changes others · the cards check the answers

FREE

ANSWER

20

The rule $(x, y) \rightarrow (2x, y)$.

R(2, 1) and S(2, 12).

How far apart are R' and S'?

Apply the rule to the points, never to the length.

A

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1. **Tape the 16 cards around the room**, in any order. Send each group to a *different* card. Each card has a large letter in its bottom left corner. **Start each group at one of these eight cards: *N R C L B D P A*.**
2. **Say this once:** “*Apply the rule to both points, then count the squares between the two new points. Never apply it to the length. Eight lines and you are back where you started.*”
3. **Find the distance, then find the card with that number at the top.**

16 cards	pages 3–10, one copy. Two cards on each sheet. Cut the stack once, through the middle.
Record sheet	page 11, one per student. The three properties are on it, and a slide, a mirror image, a stretch and a shear as pictures.
Answers	pages 12–13 — yours. They do not go in the room.

What the cards ask. Every card shows a stretch in one direction, which is not rigid, and two points on one line of the grid. On eight of the 16 cards, the segment runs in the direction of the stretch, so its length changes. On the other eight, it lies across the stretch, so its length stays the same. A student who measures only a segment of this second kind finds the same length. The measurement is correct, but deciding that the rule is rigid is wrong.

Eight of the 16 cards make the ring. The other eight are where a wrong answer goes. They look like every other card. A group that keeps the length where it changes, or multiplies it where it does not, gets the number at the top of one of these cards. The group does that card, and its answer sends the group back to the card it got wrong. A second wrong answer there sends it one card further back, never forward. A group that applies the rule to only one point gets a number that is on no card, so it knows at once that it went wrong.

The check is the length of their row. A clean run is **eight lines**. Every wrong answer adds two more lines. If a group keeps going in circles, do not give the answer. Ask: “*What are the two new points?*” Guessing does not work. Every simple guessing rule, such as always copying the length, gets at most eight of the 16 cards right.



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ANSWER

20

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R(2, 1) and S(2, 12).

How far apart are R' and S'?

Apply the rule to the points, never to the length.

A

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ANSWER

8

The rule $(x, y) \rightarrow (3x, y)$.

J(2, 4) and K(9, 4).

How far apart are J' and K'?

A stretch changes some lengths and leaves others alone.

B

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ANSWER

6

The rule $(x, y) \rightarrow (x, 2y)$.

E(1, 3) and F(1, 8).

How far apart are E' and F'?

Is the segment flat or upright? And which way does the rule stretch?

C

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ANSWER

21

The rule $(x, y) \rightarrow (x, 3y)$.

L(1, 2) and M(10, 2).

How far apart are L' and M'?

Check: the coordinate the rule does not touch stays the same in both images.

D

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ANSWER

7

The rule $(x, y) \rightarrow (x, 2y)$.

E(1, 5) and G(9, 5).

How far apart are E' and G'?

The stretch pulled that segment's two ends apart. Work out both new points and count.

E

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ANSWER

3

The rule $(x, y) \rightarrow (x, 2y)$.

T(1, 4) and U(12, 4).

How far apart are T' and U'?

That segment ran the way its rule stretches, so its length changed too. Find both images, then count.

F

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ANSWER

4

The rule $(x, y) \rightarrow (3x, y)$.

J(2, 3) and L(2, 12).

How far apart are J' and L'?

Both ends of that segment moved with the stretch. Did the gap between them grow?

G

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ANSWER

5

The rule $(x, y) \rightarrow (3x, y)$.

A(4, 1) and C(4, 7).

How far apart are A' and C'?

That segment lay along its stretch. Both of its points moved apart. Count again.

H

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ANSWER

22

The rule $(x, y) \rightarrow (5x, y)$.

K(2, 6) and M(6, 6).

How far apart are K' and M'?

That rule stretched the other way from the segment. Its two images stayed as far apart.

J

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ANSWER

27

The rule $(x, y) \rightarrow (x, 3y)$.

F(5, 1) and H(5, 8).

How far apart are F' and H'?

Multiplying y moves points up only. A flat segment keeps its length.

K

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ANSWER

10

The rule $(x, y) \rightarrow (2x, y)$.

G(3, 1) and H(3, 9).

How far apart are G' and H'?

Write both new points in full before measuring anything.

L

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ANSWER

16

The rule $(x, y) \rightarrow (2x, y)$.

B(3, 2) and D(8, 2).

How far apart are B' and D'?

Multiplying x moves points sideways only. An upright segment keeps its length.

M

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ANSWER

11

The rule $(x, y) \rightarrow (4x, y)$.

A(1, 3) and B(4, 3).

How far apart are A' and B'?

Work out both images first, then count the squares between them.

N

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ANSWER

9

The rule $(x, y) \rightarrow (x, 5y)$.

N(6, 1) and P(6, 5).

How far apart are N' and P'?

Count along the line of squares the two images share.

P

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ANSWER

18

The rule $(x, y) \rightarrow (x, 4y)$.

V(2, 1) and W(2, 4).

How far apart are V' and W'?

Its rule stretched one way only, and that segment lay across it. Its length never changed.

Q

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ANSWER

12

The rule $(x, y) \rightarrow (x, 3y)$.

C(2, 1) and D(8, 1).

How far apart are C' and D'?

Which number does the rule multiply, the x or the y?

R

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Scavenger Hunt — where I went

Distance before and after a stretch

Name _____

Period _____

Date _____

A **rigid motion** keeps lines straight. It keeps the distance between *every* two points of the plane the same. It keeps every angle measure the same. Nothing else is on the list. Not position. Not the way round. A stretch is not rigid, and it does not change every length. **Apply the rule to each point.** For example, $(x, y) \rightarrow (x, 2y)$ sends $(4, 3)$ to $(4, 6)$. Then count the squares between the two new points. A clean run is eight lines. **Wrong answer? Read the line under the question. It says what to check on the card before this one. Right answer? Skip that line.**



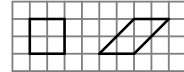
a slide
rigid



a mirror image
rigid, but the other way round



a stretch in one direction
not rigid, though lengths across it
are kept



a shear
not rigid, though the area is kept

Card letter	The two new points	How far apart
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		

Riley measured one flat segment before and after the rule $(x, y) \rightarrow (x, 2y)$. It came out the same length, so Riley said the rule was rigid. What did the first upright segment say?

Write the letter for each answer in the box above it. Leave the other boxes empty. Then read the boxes you filled, left to right. **If they do not spell two words, an answer was wrong.**

3 = G 4 = I 5 = D 6 = N 7 = O 8 = O 9 = T 10 = R 11 = I 12 = G 16 = N 18 = T 20 = I 21 = D 22 = R 27 = I

3	4	5	6	7	8	9	10	11	12	16	18	20	21	22	27



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Scavenger Hunt — answers

For the teacher

The ring, in order. A group can start at any card on it. Eight right answers bring the group back to the card where it started.

N → R → C → L → B → D → P → A → N

Riley measured one flat segment before and after the rule $(x, y) \rightarrow (x, 2y)$. It came out the same length, so Riley said the rule was rigid. What did the first upright segment say?

Answer: *NOT RIGID*. Students read it from the boxes they filled at the foot of the record sheet, left to right.

The answers on the ring, smallest first: 6 = N, 8 = O, 9 = T, 10 = R, 11 = I, 12 = G, 20 = I, 21 = D. The letters spell NOT RIGID.

	Card	Working	Answer	Wrong answer	Letter for the joke
1	N	A'(4, 3) and B'(16, 3). A flat segment along the stretch, so 3 becomes 12.	12	3 (kept the length, but the segment runs along the stretch)	I
2	R	C'(2, 3) and D'(8, 3). A flat segment across the stretch, so it stays 6.	6	18 (multiplied the length, but the segment lies across the stretch)	G
3	C	E'(1, 6) and F'(1, 16). An upright segment along the stretch, so 5 becomes 10.	10	5 (kept the length, but the segment runs along the stretch)	N
4	L	G'(6, 1) and H'(6, 9). An upright segment across the stretch, so it stays 8.	8	16 (multiplied the length, but the segment lies across the stretch)	R
5	B	J'(6, 4) and K'(27, 4). A flat segment along the stretch, so 7 becomes 21.	21	7 (kept the length, but the segment runs along the stretch)	O
6	D	L'(1, 6) and M'(10, 6). A flat segment across the stretch, so it stays 9.	9	27 (multiplied the length, but the segment lies across the stretch)	D
7	P	N'(6, 5) and P'(6, 25). An upright segment along the stretch, so 4 becomes 20.	20	4 (kept the length, but the segment runs along the stretch)	T
8	A	R'(4, 1) and S'(4, 12). An upright segment across the stretch, so it stays 11.	11	22 (multiplied the length, but the segment lies across the stretch)	I

Each wrong answer in the table is the top number of a card on the next page. There are two mistakes. A student keeps the length when the segment runs along the stretch, or multiplies the length when the segment lies across the stretch.

Scavenger Hunt — the cards off the ring

For the teacher

These eight cards are where a wrong answer goes. **A group reaches one of them only by giving a wrong answer.** The answer to each of these cards is the top number of the card where the group went wrong. So the group goes back to that card, and its row is two lines longer. A wrong answer on one of these cards leads to the card listed just before it in this table. So a group that goes wrong twice goes one card further back, never forward.

Card	Working	Answer	Wrong answer	Letter for the joke
F	T'(1, 8) and U'(12, 8). A flat segment across the stretch, so it stays 11.	11	22 (multiplied the length, but the segment lies across the stretch)	G
Q	V'(2, 4) and W'(2, 16). An upright segment along the stretch, so 3 becomes 12.	12	3 (kept the length, but the segment runs along the stretch)	T
H	A'(12, 1) and C'(12, 7). An upright segment across the stretch, so it stays 6.	6	18 (multiplied the length, but the segment lies across the stretch)	D
M	B'(6, 2) and D'(16, 2). A flat segment along the stretch, so 5 becomes 10.	10	5 (kept the length, but the segment runs along the stretch)	N
E	E'(1, 10) and G'(9, 10). A flat segment across the stretch, so it stays 8.	8	16 (multiplied the length, but the segment lies across the stretch)	O
K	F'(5, 3) and H'(5, 24). An upright segment along the stretch, so 7 becomes 21.	21	7 (kept the length, but the segment runs along the stretch)	I
G	J'(6, 3) and L'(6, 12). An upright segment across the stretch, so it stays 9.	9	27 (multiplied the length, but the segment lies across the stretch)	I
J	K'(10, 6) and M'(30, 6). A flat segment along the stretch, so 4 becomes 20.	20	4 (kept the length, but the segment runs along the stretch)	R

Every card has one line under the question, in the same place. It reminds students what to check. It never gives the answer. On a card off the ring, it names the mistake that sent the group there.

One more mistake is to apply the rule to only one point. On a card where the length changes, this gives a number that is on no card (13, 15, 23, 24, 25, 28). The group then knows at once that it went wrong.