



Rigid motions

GRADE 8 MATH

Answer keys for the exit ticket, practice worksheet, and homework, plus notes for the lesson slides. Each answer shows the steps and the most likely wrong answer (“If wrong”), so you can tell what a mistake means, not just that it is one. Questions go from **fluency** to **application** to **reasoning**.

Exit Ticket — answer key

Use: End of the rigid motions lesson and the first Grade 8 Geometry exit ticket. 5–8 min, independent, tracing paper available. Item 2 is the diagnostic: lengths and angles are identical under a reflection and a rotation, so ORIENTATION is the only thing that separates them, and a class that has only transformed symmetric shapes has never needed to notice.

Timing: 5–8 min · independent · tracing paper and a ruler.

1. Translate a triangle **FLUENCY**

Answer: **both unchanged**

1. A translation slides every point by the same amount.
2. Side lengths: identical. Angles: identical.
3. Only the position changed, which is what rigid means.

If wrong: Said the shape gets bigger or the angles change. Children expect a transformation to visibly DO something, so “nothing changed” feels like a wrong answer.

2. Order reversed **REASONING**

Answer: **that it really was a reflection, not a rotation**

1. A reflection reverses the order the corners are read in.
2. A rotation and a translation both preserve it, however far the shape turns.
3. So a reversed order can only have come from a reflection (or an odd number of them).
4. This is the only reliable way to tell a flip from a turn — the lengths and angles are identical either way, so they cannot distinguish them.

If wrong: Said it means the shape changed, or that it was rotated. The lengths and angles are the SAME for both transformations, so nothing except orientation can separate them.

3. Correct Jo REASONING

Answer: **the angles are unchanged — only the shape's position on the page turned**

1. Rotating turns the whole shape together, angles included.
2. An angle is the amount of turn BETWEEN two sides, and both sides turned by the same amount, so the angle between them is untouched.
3. Tracing the shape and laying it back on top after the turn shows every angle fitting exactly.
4. Looking tilted and having different angles are different things.

If wrong: Agreed, or corrected the answer without saying why. The both-sides-turned-equally argument is the reason, and the tracing-paper check is what makes it convincing rather than asserted.

4. Parallel lines reflected REASONING

Answer: **yes — still parallel**

1. Rigid motions preserve parallelism, so the images cannot meet.
2. To check: reflect both lines, then measure the perpendicular distance between the images in two different places. Equal distances means parallel.
3. Or trace both lines and the mirror line, flip the tracing, and lay it back down.

If wrong: Said they might cross. Worth asking HOW they would check — the standard asks for experimental verification, so “because the rule says so” is a weaker answer than a measurement.

Quick answers for fast checking:

#	Level	Answer
1	fluency	both unchanged
2	reasoning	it was a reflection
3	reasoning	angles unchanged
4	reasoning	yes, and a stated way to check

Practice Worksheet — answer key

Use: In-class practice after the deck. Items 4, 5 and 6 are one set: the reflection and the rotation of the SAME triangle, then the question of how to tell them apart. A child who compares lengths finds no difference — correctly — and only the corner order separates them.

Timing: 15–20 min · pairs · tracing paper, ruler, protractor · items 6 and 9 on the board.

1. The three motions FLUENCY

Answer: **translation slides, reflection flips, rotation turns**

1. Translation: every point the same distance and direction.
2. Reflection: across a mirror line, same distance the other side.
3. Rotation: about a fixed point, through an angle.

If wrong: Included dilation, which is NOT rigid — it resizes, and arrives in G-04.

2. Translate APPLICATION

Answer: **(6,3), (9,3), (6,5)**

1. Add 5 to every x and 2 to every y.

If wrong: Added to only one coordinate, or moved each point differently.

3. Measure before and after APPLICATION

Answer: **the side is exactly the same length**

1. Measuring is the point: the standard asks for experimental verification.
2. Any difference is a measuring error, not a property of the transformation.

If wrong: Asserted “the same” without measuring. Correct, and it does not answer the question asked.

4. Reflect in the x-axis APPLICATION

Answer: **(1,-1), (4,-1), (1,-3)**

1. Across the x-axis, y changes sign and x stays.

If wrong: Changed both signs, which is the 180° rotation from item 5 — and confusing those two is the whole point of the pair.

5. Rotate 180° about the origin APPLICATION

Answer: **(-1,-1), (-4,-1), (-1,-3)**

1. Both coordinates change sign.

If wrong: Changed only y, which is the reflection.

6. Telling them apart REASONING

Answer: **label the corners and check the order — the reflection reverses it, the rotation does not**

1. Both images have identical side lengths and identical angles, so those cannot distinguish them.
2. Read the corners round: $A \rightarrow B \rightarrow C$ runs one way in the original.
3. The rotation keeps that direction. The reflection reverses it.
4. With tracing paper: the rotated image can be laid on the original by turning; the reflected one cannot without flipping the paper over.

If wrong: Compared side lengths or angles and found no difference — correctly, because there is none. The tracing-paper version of the test is the most convincing form: you have to turn the paper OVER.

7. Why a rectangle hides it REASONING

Answer: **because a rectangle has symmetry, so its reflected image can be identical to a rotated one**

1. A rectangle looks the same after certain flips and certain turns.
2. So the two transformations can produce the same picture, even though they are different motions.
3. A scalene triangle has no symmetry, so nothing is hidden.
4. Which is why a class that only ever transforms rectangles never learns to tell a flip from a turn.

If wrong: Said a rectangle is “just simpler”. The reason is its symmetry specifically, and naming that explains why the choice of shape matters when testing.

8. Angles after a 90° rotation FLUENCY

Answer: **40° , 60° and 80° — unchanged**

1. Rotation preserves angle measures.
2. The whole shape turned; the angles inside it did not.

If wrong: Added 90° to each, or said they cannot be known. The 90° is how far the SHAPE turned, not something added to its angles.

9. An experiment for angles REASONING

Answer: **trace the shape, reflect it, then measure corresponding angles with a protractor — or lay the tracing on the image and check they coincide**

1. Draw a shape and mark one angle clearly.
2. Reflect it across a line, and measure the same angle in the image.
3. Repeat for the other angles; they should match every time.
4. Better still, flip the tracing paper over and lay it on the image — if the angles coincide exactly, they are equal, with no protractor error to argue about.

If wrong: Described the rule instead of an experiment. The standard asks for verification, so the answer has to say what you would DO and what would count as evidence.

Quick answers for fast checking:

#	Level	Answer
1	fluency	slide, flip, turn
2	application	(6,3), (9,3), (6,5)
3	application	exactly the same
4	application	(1,-1), (4,-1), (1,-3)
5	application	(-1,-1), (-4,-1), (-1,-3)
6	reasoning	corner order reverses under reflection
7	reasoning	because a rectangle is symmetric
8	fluency	unchanged
9	reasoning	a stated procedure and what counts as evidence

Homework — answer key

Use: Homework after the practice sheet. Item 7 deserves a real answer rather than a correction: “nothing happened” is precisely what a rigid motion of zero should look like, and the objection shows a child taking the definition seriously. Item 8 asks why the standard says VERIFY, which is worth reading aloud — it is the difference between a list and a tool.

Timing: 20–25 min · independent · tracing paper · items 5, 7 and 8 first when marking.

1. Translate 3 left, 1 down APPLICATION

Answer: **(-1,0), (2,0), (-1,3)**

1. Subtract 3 from x, 1 from y.

If wrong: Added instead of subtracting; left means negative.

2. Two reflections of (2,3) APPLICATION

Answer: **in the x-axis: (2,-3); in the y-axis: (-2,3)**

1. x-axis flips y. y-axis flips x.
2. The axis you reflect in is the one that STAYS.

If wrong: Swapped them. The rule worth keeping is that the mirror axis is the coordinate that survives.

3. Sides after a translation FLUENCY

Answer: **5, 7 and 9 cm — unchanged**

1. Rigid.

If wrong: Added the translation amounts to the side lengths.

4. Angles after a reflection FLUENCY

Answer: **30°, 60°, 90° — unchanged**

1. Reflection preserves angle measures.
2. The orientation reversed; the measures did not.

If wrong: Made them negative, or reordered them as though the reflection changed which angle was which.

5. Reflected or rotated? REASONING

Answer: **label the corners and check whether the order reversed**

1. Lengths and angles are identical for both, so they cannot tell you.
2. Read the corners round the shape: reversed order means a reflection.
3. With tracing paper: if you must turn the paper OVER to match the image, it was a reflection.

If wrong: Suggested measuring sides. There is nothing to find — both preserve them — and noticing that is part of the answer.

6. Parallel after a rotation REASONING

Answer: **yes — rotations preserve parallelism**

1. Both lines turn by the same angle about the same point, so the angle between them is unchanged.
2. They were never going to meet, and they still do not.
3. Check by measuring the perpendicular gap in two places after rotating.

If wrong: Said they might cross. Both lines turning by the SAME amount is the reason.

7. A translation of zero REASONING

Answer: **no — it is a transformation, it just leaves everything where it was**

1. A translation moves every point by the same vector. Here the vector is zero.
2. Every property is preserved, trivially, so it satisfies the definition.
3. It is a fair question: it feels like nothing happened, and “nothing happened” is exactly what a rigid motion of zero should look like.

If wrong: Agreed with him. Worth taking seriously rather than correcting flatly — the objection is reasonable and the answer is that the definition does not require anything to LOOK different.

8. Why verify rather than learn REASONING

Answer: **because a property you have measured is one you can use and rebuild, while a memorised list is only recall**

1. Measuring shows you the property is true rather than telling you.
2. It also shows you HOW to check, which is what you need when a question is unfamiliar.
3. And it makes the surprising parts believable — that a rotation changes no angle at all is hard to accept until the tracing paper lands on top exactly.
4. Recall fails under pressure; a check you can perform does not.

If wrong: Said “because the standard says so”. The useful answer is about what verification gives you that memorising does not.

Quick answers for fast checking:

#	Level	Answer
1	application	(-1,0), (2,0), (-1,3)
2	application	(2,-3) and (-2,3)
3	fluency	5, 7, 9 unchanged
4	fluency	30°, 60°, 90° unchanged

5	reasoning	check the corner order
6	reasoning	yes — both lines turn equally
7	reasoning	no — a zero translation is still one
8	reasoning	a measured property can be rebuilt and reused

Lesson slides — teaching notes & timing

Mini-lesson slides, then the practice worksheet. Slide numbers match the deck.

Slide	~Time	Note
1/8	0:00	Frame it as position-only. Children expect a transformation to DO something to the shape, so “nothing changed except where it is” needs saying plainly.
2/8	1:00	Hand out tracing paper before any talking. The standard says verify experimentally, and a class that only hears the property list can recite it and cannot use it.
3/8	2:00	Translation. Every point by the same vector — and check a length.
4/8	3:00	Reflection, with the mirror line drawn. Equal distances either side.
5/8	4:00	Rotation about a point. Use the tracing paper and a pin or a fingertip.
6/8	5:00	Now collect the properties, AFTER the doing: lengths, angles, parallelism, straightness. This order matters — the list is a summary of what they measured, not a fact handed down.
7/8	6:30	THE slide. Label the vertices and watch the ORDER. Use a scalene triangle: on a rectangle a reflection and a rotation can look identical, which is exactly why a class that only transforms rectangles never learns to tell them apart.
8/8	8:00	Both transformations on one traced triangle, then the exit ticket.