

Geometry • Unit 1 Worksheet

Constructions and Rigid Transformations

Name: _____

Date: _____

Think carefully about WHY each construction works and what makes a transformation rigid. The point of this unit is precision in reasoning, not just precision in drawing.

Part A • Warm-up Vocabulary

Briefly define each term in your own words.

1. Define each term so that another student could use it to identify the object on a diagram.

a. Perpendicular bisector of a segment:

b. Rigid transformation:

c. Congruent figures:

Part B • Construction Steps

2. Describe — in step-by-step instructions a partner could follow with ONLY a compass and unmarked straightedge — how to construct the perpendicular bisector of segment AB.

Include WHY each step works.

Steps:

Justification — why are the two arc intersection points equidistant from A and B?

3. An equilateral triangle is constructed by drawing two circles, each centered at one endpoint of segment AB with radius AB. The triangle has vertices A, B, and an intersection point C.

Explain why $AC = AB$.

Explain why $BC = AB$.

Why does this prove triangle ABC is equilateral and NOT just isosceles?

Part C • Rigid Transformations

4. Point A is at (2, 5). Apply each transformation and give the image. Then say what about A is preserved.

a. Translation by the vector $(-3, 1)$: $A' = (\quad , \quad)$

b. Reflection over the x-axis: $A' = (\quad , \quad)$

c. Rotation 90 degrees counterclockwise about the origin: $A' = (\quad , \quad)$

All three of these are rigid transformations. What does that GUARANTEE about distances and angles? Why?

5. Off the coordinate grid: triangle ABC is reflected across line m. The image is triangle A'B'C'. Without drawing, answer:

a. Is AB equal to A'B'? Why?

b. Is line m the perpendicular bisector of AA' ? Why?

c. If C happens to lie ON line m, where is C'? Explain.

Part D • Two Methods

6. A square is to be constructed on segment AB. Give TWO different methods.

Method 1 — using perpendicular bisectors / perpendiculars	Method 2 — using a different idea (rotations, circles, etc.)

Which method is more efficient? Why?

Part E • Error Analysis

7. Tyler says: "Any transformation that keeps the shape looking the same is rigid." Mai says: "A dilation by scale factor 1 is rigid; a dilation by scale factor 2 is NOT rigid."

Who is correct?

Explain what is wrong with the other student's reasoning. Use the definition of 'rigid' in your answer.

8. Andre is asked: "Use a compass to copy segment AB onto ray CD." He measures AB with a ruler, gets 6.3 cm, and marks 6.3 cm from C with the ruler. Has he done a valid construction?

Yes / No:

Why does the IM curriculum insist on compass-and-straightedge moves rather than a ruler?

Part F • Symmetry and Proof

9. List ALL the symmetries (rigid transformations that map the figure to itself) for each shape:

a. An equilateral triangle:

b. A non-square rectangle:

c. A regular hexagon:

What pattern do you notice about the number of symmetries of a regular n -gon?

10. Prove the Triangle Angle Sum Theorem: the three angles of any triangle add up to 180 degrees.

Hint: through the vertex C, draw a line parallel to side AB. Use the fact that a straight angle measures 180 degrees plus what you know about alternate interior angles formed by parallel lines cut by a transversal.

Write a narrative proof — sentences, in your own words, not just two columns:

11. OPEN: A designer wants to make a logo using exactly TWO circles. Describe (with construction steps) a way to construct two circles where each circle passes through the other's center, AND the two intersection points and the two centers form a rhombus.

Steps and justification:
