Shape-sorting rules and simple algorithms

6 questions | 14 marks

Equivalent correct methods earn the corresponding marks.

1. Use the sorting table for a four-sided shape with four right angles but not four equal sides. State the output. [2 marks]

An ordered algorithm for four-sided shapes. Stop at the first output.

Step	Condition	Output or next step
1	Not exactly four sides	Not a quadrilateral; stop
2	Four right angles AND four equal sides	Square; stop
3	Four right angles	Rectangle; stop
4	Four equal sides	Rhombus; stop
5	None of the earlier conditions	Other quadrilateral; stop

Step 2 fails because the sides are not all equal.

Step 3 succeeds because all four angles are right.

Answer: Rectangle.

2. Use the sorting table for a four-sided shape with four equal sides but no right angles. State the output. [2 marks]

An ordered algorithm for four-sided shapes. Stop at the first output.

Step	Condition	Output or next step
1	Not exactly four sides	Not a quadrilateral; stop
2	Four right angles AND four equal sides	Square; stop
3	Four right angles	Rectangle; stop
4	Four equal sides	Rhombus; stop
5	None of the earlier conditions	Other quadrilateral; stop

Steps 2 and 3 fail because the angles are not all right.

Step 4 succeeds because all four sides are equal.

Answer: Rhombus.

3. The rule “If a shape has four equal sides, output Square” is incorrect. Give a counterexample and repair the condition. [3 marks]

A rhombus can have four equal sides without any right angles.

Adding the right-angle condition distinguishes a square.

Answer: A non-square rhombus is a counterexample. Require four equal sides AND four right angles.

4. A five-sided polygon is given to the table. At which step does it stop, and what is the output? [2 marks]

An ordered algorithm for four-sided shapes. Stop at the first output.

Step	Condition	Output or next step
1	Not exactly four sides	Not a quadrilateral; stop
2	Four right angles AND four equal sides	Square; stop
3	Four right angles	Rectangle; stop
4	Four equal sides	Rhombus; stop
5	None of the earlier conditions	Other quadrilateral; stop

Five is not exactly four.

The first condition is true, so no later step is used.

Answer: Step 1; Not a quadrilateral.

5. Write an ordered side-based algorithm that gives the most specific name Equilateral, Isosceles or Scalene for a triangle. [3 marks]

An equilateral triangle also has at least two equal sides.

Therefore the all-three-equal condition must be tested before the broader at-least-two condition.

Answer: First test all three sides equal: Equilateral. Otherwise test at least two equal sides: Isosceles. Otherwise: Scalene.

6. A four-sided shape has no right angles and not all sides equal. The table outputs Other quadrilateral. Does this prove it has no parallel sides? Explain. [2 marks]

Other quadrilateral means only that earlier categories were not selected.

For example, a non-rectangular parallelogram with unequal adjacent sides reaches that output.

Answer: No. The table has not tested parallel sides.