

Answer: The quadrilateral formed by joining the midpoints of a square's sides must be a square.

Short explanation (step-by-step):

1. Start with an easy coordinate picture. Put the square's corners at $A=(0,0)$, $B=(1,0)$, $C=(1,1)$, $D=(0,1)$.
2. Find the midpoints of each side: E (midpoint of AB) = $(0.5, 0)$, F (midpoint of BC) = $(1, 0.5)$, G (midpoint of CD) = $(0.5, 1)$, H (midpoint of DA) = $(0, 0.5)$.
3. Compute the vectors for consecutive sides of $EFGH$: $EF = F-E = (0.5, 0.5)$ and $FG = G-F = (-0.5, 0.5)$.
4. Lengths: $|EF| = \sqrt{0.5^2 + 0.5^2} = \sqrt{0.5}$. Same for $|FG|$, $|GH|$ and $|HE|$ — all four sides are equal.
5. Right angle check: $EF \cdot FG = (0.5)(-0.5) + (0.5)(0.5) = 0$, so EF is perpendicular to FG . Similarly between other consecutive sides.
6. Equal side lengths and right angles means $EFGH$ is a square. (Geometrically, it is a smaller square rotated 45° inside the original.)

Quick theory note: Varignon's theorem says joining midpoints of any quadrilateral gives a parallelogram. For a square the parallelogram has equal adjacent sides and right angles, so it becomes a square.

Evaluation of the student's answer

The student wrote: “a quadrilateral has 4 sides, the only quadrilateral to be made from $wxyz$'s midpoints that is the square.” They named the correct final shape (square) but gave no reasoning. The response repeats a definition (a quadrilateral has four sides) instead of showing why the midpoint-joining process produces a square. Score suggestions below.

Suggested rubric (4-level) — mapped to ACARA v9 style outcomes (geometry, reasoning, and use of coordinates):

- **Excellent (4):** Correct answer; clear step-by-step justification (diagram or coordinates); demonstrates understanding of properties (equal sides, right angles) and links to Varignon or coordinate proof.
- **Good (3):** Correct answer with partial justification (some calculations or diagram), minor gaps in explanation.
- **Satisfactory (2):** Correct answer stated but reasoning weak, incomplete, or mostly verbal without supporting work.
- **Needs Improvement (1):** Incorrect or unsupported answer; no clear reasoning or working shown.

For this student: Correct final claim but insufficient reasoning — overall level: Satisfactory (2/4). To reach Good or Excellent, add a short coordinate computation or a labelled diagram showing equal lengths and right angles.

ACARA v9 alignment: Reasoning about properties of shapes and using coordinates to prove geometric results (appropriate to middle secondary levels).

Teacher comment (Nigella Lawson cadence, 200 words):

Darling, there is something utterly delicious about the simplicity of your thinking—clean, uncluttered, as if you've just sliced through a tart with a warm, sure hand. You arrive at the right place — 'square' — but your plate is missing seasoning. A truly satisfying mathematical explanation savours the why as much

as the what: show the symmetry, the distances, the right angles; let the reader taste the proof. Imagine placing the square on a table: each midpoint is like a jewel placed at the heart of each side, and when you join them the shape that emerges is not merely a quadrilateral but a perfect little square, rotated and smaller, echoing the original. To elevate your answer, add a short diagram or a coordinate argument: pick corners $(0,0)$, $(1,0)$, $(1,1)$, $(0,1)$ and show the midpoints produce vectors of equal length and right angles. Be careful with language—avoid tautologies('a quadrilateral has four sides') and focus on justification. With a pinch more detail and a confident flourish of reasoning, your answer will be as irresistible as a slice of warm chocolate cake. Keep practising this tasty logic — clear steps, diagrams and neat notation will make your mathematics absolutely sumptuous and convincing.