Draw a Paper Wasp Nest: Hexagonal Comb Layout

Original tasks 1, 2, 3 / complete keys

Task 1

Plan a flat-top comb with s = 6 mm, 6 cells in a row, and 5 rows. Calculate the horizontal span between first and last centers in a row and the vertical span between first and last row centers. Describe the center layout in words.

Answer: Horizontal span = (6 − 1) × 1.5 × 6 mm = 5 × 9 mm = 45 mm. Vertical span = (5 − 1) × 0.866 × 6 mm ≈ 4 × 5.20 mm ≈ 20.8 mm. Layout: first row centers spaced 9 mm apart; each next row offset by 4.5 mm horizontally and 5.20 mm vertically.

Reason: Use the flat-top spacing rules: horizontal center spacing is 1.5s and vertical row spacing is 0.866s. Multiply by the number of intervals, which is one less than the number of cells or rows.

Check: Measure the drawn first-to-last center spans and compare with 45 mm and about 20.8 mm; confirm every interior vertex has three edges.

Task 2

A drawing has 8 cells in a row with s = 5 mm. The measured distance between the first and last centers is 52 mm. Is this consistent with the planned spacing? Show the arithmetic.

Answer: Expected span = (8 − 1) × 1.5 × 5 mm = 7 × 7.5 mm = 52.5 mm. The measured 52 mm is within 0.5 mm of expected, so it is consistent for hand drawing.

Reason: Compare the measured span with the planned span using the same formula. A small difference is acceptable in hand drawing; a large difference indicates inconsistent spacing.

Check: Re-measure with a ruler along the row of centers and confirm the difference is small relative to s.

Task 3

You want a comb with 4 rows and vertical span between first and last row centers of about 26 mm. Using s = 10 mm, does 4 rows fit? Show the arithmetic and state whether you would adjust the row count.

Answer: Expected vertical span = (4 − 1) × 0.866 × 10 mm ≈ 3 × 8.66 mm ≈ 26.0 mm. Yes, 4 rows fit the target. No row-count adjustment is needed if the measured span is close to 26 mm.

Reason: Rearrange the vertical spacing rule to test the plan: span = (rows − 1) × 0.866s. Substitute the planned values and compare with the target.

Check: Measure the drawn vertical span and compare with 26 mm; also check that each interior vertex has three edges.

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Original tasks 4 / complete keys

Task 4

After tiling a rectangular block, you erase two outer cells to round the comb boundary. Describe how to redraw the broken edges and state one vertex check for the new boundary.

Answer: Erase the removed cells completely, then redraw the remaining shared edges so each surviving cell is closed by single lines. At the new outer boundary, each boundary vertex should have exactly two edges; interior vertices should still have three.

Reason: Removing cells exposes new boundary vertices. Redrawing shared edges once prevents doubled lines, and the vertex count distinguishes interior from boundary points.

Check: Trace each new boundary vertex and count the edges meeting there; confirm two at the boundary and three in the interior.

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Source rubric / reflection

- [ ] Hexagon orientation is consistent across the comb.
- [ ] Cell centers follow the chosen spacing within a few millimetres of the planned values.
- [ ] Shared edges are drawn once; interior vertices show three edges.
- [ ] Comb boundary is shaped deliberately, not left as an unmodified rectangle.
- [ ] Envelope is present and leaves at least a few complete hex cells visible.
- [ ] Margin note records s and row count for verification.
- [ ] Valid alternatives such as point-top orientation or a different cell count are accepted if the spacing arithmetic and vertex check hold.

Reflection: What did you check, what did you change, and what will you try next?