How to Draw a Starfish with Five-Fold Radial Symmetry

Original tasks 1, 2 / complete keys

Task 1

A starfish drawing has five radial lines. The angle between the first and second line is 70 degrees, between the second and third is 74 degrees, and the remaining three angles are 72 degrees each. Does this arrangement have equal five-fold spacing? Explain.

Answer: No. The angles are not all equal; two angles are 70 and 74 degrees instead of 72 degrees. Equal five-fold spacing requires all five angles to be equal.

Reason: Five-fold radial symmetry means the arms are spaced equally around the center. Equal spacing corresponds to equal angles of 360 divided by 5, which is 72 degrees. Any deviation means the spacing is not equal.

Check: Add the five angles: 70 + 74 + 72 + 72 + 72 = 360 degrees. Although they sum to 360, they are not equal, so the spacing is uneven.

Task 2

You are drawing a starfish with a hypothetical arm length of 7 cm and a central disk radius of 1 cm. You mark tip points at 7 cm from the center along each radial line. What is the distance from the center to the base of each arm if the base is at the edge of the central disk?

Answer: The distance from the center to the base of each arm is 1 cm, the radius of the central disk.

Reason: The central disk has radius 1 cm, so its edge is 1 cm from the center. The arms begin at the edge of the disk, so the base distance is 1 cm.

Check: Measure the central disk radius on your drawing and confirm that the arm bases start at that distance from the center.

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Original tasks 3, 4 / complete keys

Task 3

A student draws a starfish with five arms, but one arm is 9 cm long while the other four are 7 cm long. The angles between arms are all 72 degrees. Is the drawing pentaradially symmetric? Explain.

Answer: No. Although the angular spacing is equal, the arm lengths are not equal, so the drawing does not have full five-fold radial symmetry.

Reason: Five-fold radial symmetry requires that rotating the drawing by 72 degrees maps it onto itself. If one arm is longer, rotation will not map that arm onto the shorter arms, so symmetry is broken.

Check: Measure each arm length from the center to the tip. All five should be approximately equal for full symmetry.

Task 4

You have a symmetry-check overlay with five radial lines at 72-degree intervals. When you place it over your drawing, four arms align well but one arm is offset by about 5 degrees. What is a reasonable adjustment, and how would you check it?

Answer: Adjust the offset arm by rotating its centerline about 5 degrees toward the nearest overlay line, then redraw the arm outline. Check by placing the overlay again and confirming that all five arms align within a small tolerance.

Reason: The overlay reveals that one arm's centerline is not at the correct angle. Rotating that arm's centerline to match the overlay restores equal spacing. The check confirms alignment.

Check: After adjustment, measure the angle between the adjusted arm and its neighbors; both should be approximately 72 degrees. Use the overlay to confirm visual alignment.

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Source rubric / reflection

- [ ] Five arm centerlines are spaced at equal angles (approximately 72 degrees).
- [ ] All five arm tips are at approximately equal distances from the center.
- [ ] The central disk is centered on the intersection of the radial lines.
- [ ] Arms taper from base to tip and have similar shapes.
- [ ] The overall drawing looks balanced when rotated by 72 degrees.
- [ ] Valid alternatives: arm length, arm width, taper style, and surface details may vary as long as five-fold symmetry is preserved.

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