Realistic Star Drawing: Point Geometry and Glow Shading

Original tasks 1, 2 / complete keys

Task 1

A six-point star is drawn on a circle of radius 25 mm. Calculate the chord length for 60-degree spacing and state how many points you mark. Describe the glow zones using a value scale of 1 to 5.

Answer: Chord = 2 × 25 × sin(30°) = 25 mm. Mark six points at 60-degree intervals. Glow zones: background 2, outer falloff 3, core 5.

Reason: The chord formula 2r sin(theta/2) with theta = 60° gives 2 × 25 × 0.5 = 25 mm. Six points are needed for a six-point star. The glow zones follow the radial gradient convention.

Check: Verify that six chord steps of 25 mm return to the starting point, forming a regular hexagon inscribed in the circle (perimeter 6 × 25 = 150 mm; the arc length between adjacent points is 2π × 25 / 6 ≈ 26.2 mm, so the chord is shorter than the arc—this is expected, not an error). Check that all six points lie on the circle and are 60° apart.

Task 2

A five-point star has radius 40 mm. Calculate the chord length for 72-degree spacing. If the light direction is from the left, describe where facet highlights go and give one check for consistency.

Answer: Chord = 2 × 40 × sin(36°) ≈ 47.0 mm. Highlights go on the left edge of each facet; shadows on the right edge. Check that all highlights are on the left side relative to the light direction.

Reason: The chord formula gives 2 × 40 × 0.5878 ≈ 47.0 mm. Facet highlights follow the light direction: left-facing edges catch light from the left.

Check: Measure the chord with a compass and step around the circle; all five points should align. For facets, verify that no highlight appears on the right edge of any facet.

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Original tasks 3, 4 / complete keys

Task 3

Describe how to apply a radial glow to a star with radius 20 mm, including the falloff distance beyond the outline. Use a hypothetical falloff of 0.3r and state the value at the core and background on a 1-to-5 scale.

Answer: Falloff distance = 0.3 × 20 = 6 mm beyond the outline. Core value 5, background value 2, with a mid-glow value 3 at the outline. Blend smoothly from core to background.

Reason: The falloff distance is a fraction of the radius, here 0.3r = 6 mm. The value scale decreases monotonically from core to background.

Check: Measure 6 mm beyond the star points and confirm the glow fades to background value 2. Check that the value at the outline is approximately 3 and that no hard edges appear.

Task 4

A student draws a five-point star but the points are uneven. List two checkable steps to diagnose and fix the spacing, including a numerical example with r = 35 mm.

Answer: First, recalculate the chord: 2 × 35 × sin(36°) ≈ 41.1 mm. Second, step the compass around the circle and verify that five steps return to the start. If not, adjust the compass and repeat.

Reason: Uneven spacing usually comes from an incorrect chord setting or slipping compass. Recalculating and re-stepping provides a checkable fix.

Check: After re-stepping, measure the angle between adjacent radii with a protractor; each should be 72° ± 2°. Confirm all points lie on the circle.

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Source rubric / reflection

- [ ] All outer points lie on the construction circle and are equally spaced (72° or 60°).
- [ ] The star outline connects every second point correctly for the chosen number of points.
- [ ] Glow shows a smooth radial gradient with at least three distinct value zones from core to background.
- [ ] Glow extends slightly beyond the star outline and blends softly.
- [ ] Facet highlights are consistent with a single stated light direction.
- [ ] At least two distinct facet values are visible, with highlights on the light-facing edge.
- [ ] The final drawing reads as a luminous, three-dimensional star from a distance.
- [ ] Valid alternatives (e.g., stippling, erasing, colored pencil layering) are accepted if the gradient and facet conventions are followed.

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