Drawing Piecewise Functions: Breakpoints and Endpoint Notation

Rubric Key

Hypothetical example values; one grid square = one unit on both axes.

Rubric: (1) each segment plotted only over its stated interval; (2) breakpoints marked with open or closed dots matching interval conditions; (3) at least two interior sample points per segment correct; (4) axis scale and units stated and consistent; (5) no stray lines extend beyond segment intervals; (6) endpoint notation unambiguous and matches the written interval table.

Drawing Piecewise Functions: Breakpoints and Endpoint Notation

Complete worked example / separate answer key

Graph f(x) = 2x + 1 for x < 1, and f(x) = 4 - x for x >= 1. Mark the breakpoint at x = 1 with correct endpoint notation.

Answer: For x < 1, plot the line y = 2x + 1 using interior points (0, 1) and (0.5, 2), ending with an open dot at (1, 3). For x >= 1, plot y = 4 - x using interior points (2, 2) and (3, 1), starting with a closed dot at (1, 3). The two segments meet at (1, 3), so the graph is continuous there, but the dot at (1, 3) is closed because the second interval includes x = 1.

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Original tasks 1, 2, 3 / complete keys

Task 1

Graph g(x) = x + 2 for x <= 0, and g(x) = 3 for x > 0. Mark the breakpoint at x = 0.

Answer: Left segment: line y = x + 2 over x <= 0, with interior points (-2, 0) and (-1, 1), ending in a closed dot at (0, 2). Right segment: horizontal line y = 3 over x > 0, starting with an open dot at (0, 3) and passing through (1, 3) and (2, 3).

Reason: The first interval includes x = 0, so (0, 2) is closed. The second interval excludes x = 0, so (0, 3) is open. The function jumps from 2 to 3 at the breakpoint.

Check: Substitute x = 0 into both formulas: left gives 2, right gives 3. Confirm the closed dot is at (0, 2) and the open dot at (0, 3), and that no horizontal line is drawn for x <= 0.

Task 2

Graph h(x) = -x + 4 for x < 2, and h(x) = x - 1 for x >= 2. Mark the breakpoint at x = 2.

Answer: Left segment: line y = -x + 4 over x < 2, with interior points (0, 4) and (1, 3), ending in an open dot at (2, 2). Right segment: line y = x - 1 over x >= 2, starting with a closed dot at (2, 1) and passing through (3, 2) and (4, 3).

Reason: At x = 2 the left formula gives 2 but is excluded, so the dot at (2, 2) is open. The right formula gives 1 and is included, so (2, 1) is closed. The graph jumps downward at the breakpoint.

Check: Evaluate both formulas at x = 2: left yields 2, right yields 1. Verify the open dot sits at (2, 2) and the closed dot at (2, 1), and that each line stops at x = 2.

Task 3

Graph k(x) = 1 for x < -1, k(x) = x + 1 for -1 <= x <= 2, and k(x) = 5 for x > 2. Mark both breakpoints.

Answer: First segment: horizontal line y = 1 over x < -1, ending in an open dot at (-1, 1). Middle segment: line y = x + 1 over -1 <= x <= 2, starting with a closed dot at (-1, 0), passing through (0, 1) and (1, 2), ending with a closed dot at (2, 3). Third segment: horizontal line y = 5 over x > 2, starting with an open dot at (2, 5).

Reason: The middle interval includes both endpoints, so both its dots are closed. The outer intervals exclude their shared breakpoints, so their dots are open. The graph jumps at x = -1 and again at x = 2.

Check: Check x = -1: first formula gives 1 (open), middle gives 0 (closed). Check x = 2: middle gives 3 (closed), third gives 5 (open). Confirm no horizontal line crosses into the middle interval.

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Original tasks 4 / complete keys

Task 4

Graph m(x) = 2x for x < 1, m(x) = 3 for x = 1, and m(x) = x + 1 for x > 1. Mark the breakpoint at x = 1 with all three pieces.

Answer: Left segment: line y = 2x over x < 1, with interior points (0, 0) and (0.5, 1), ending in an open dot at (1, 2). Single point: closed dot at (1, 3). Right segment: line y = x + 1 over x > 1, starting with an open dot at (1, 2) and passing through (2, 3) and (3, 4).

Reason: The left and right formulas both approach 2 at x = 1 but neither interval includes x = 1, so both dots at (1, 2) are open. The definition assigns the single value 3 at x = 1, so a closed dot is placed at (1, 3).

Check: Substitute x = 1 into each formula: left gives 2, right gives 2, and the single-value rule gives 3. Confirm two open dots at (1, 2) and one closed dot at (1, 3), with no line connecting them.

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Task 1, Task 2, Task 3, Task 4 / Separate Answer Key: Reasoning and Check Methods

Hypothetical example values; one grid square = one unit on both axes.

Task 1 answer: Left segment line y = x + 2 over x <= 0, interior points (-2, 0) and (-1, 1), closed dot at (0, 2). Right segment horizontal line y = 3 over x > 0, open dot at (0, 3), passing through (1, 3) and (2, 3). Reasoning: first interval includes x = 0 so (0, 2) is closed; second excludes x = 0 so (0, 3) is open; function jumps from 2 to 3. Check: substitute x = 0 into both formulas; left gives 2, right gives 3; confirm closed dot at (0, 2), open dot at (0, 3), and no y

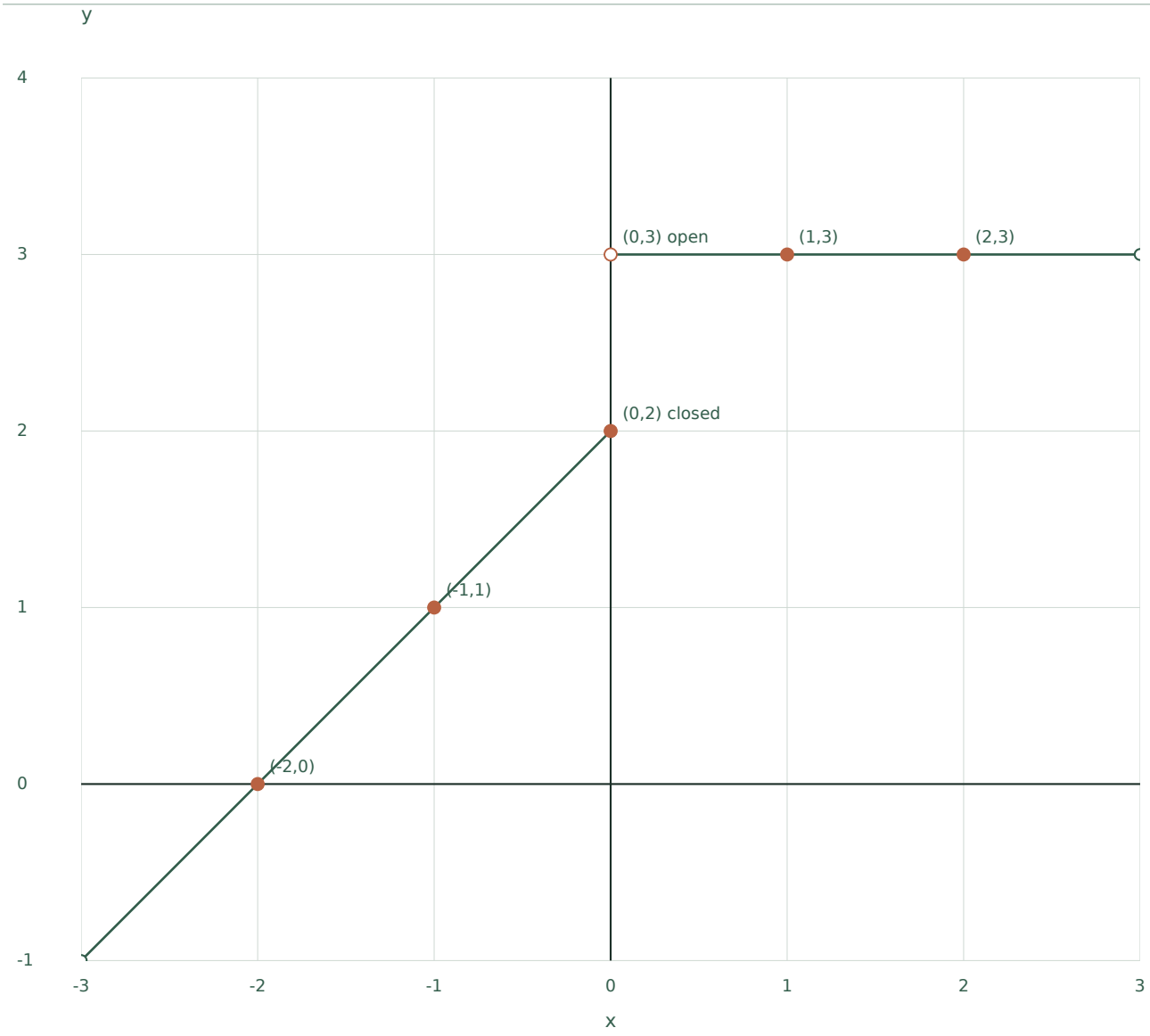
Task 2 answer: Left segment line y = -x + 4 over x < 2, interior points (0, 4) and (1, 3), open dot at (2, 2). Right segment line y = x - 1 over x >= 2, closed dot at (2, 1), passing through (3, 2) and (4, 3). Reasoning: at x = 2 left formula gives 2 but is excluded so (2, 2) is open; right formula gives 1 and is included so (2, 1) is closed; graph jumps downward. Check: evaluate both formulas at x = 2; left yields 2, right yields 1; verify open dot at (2, 2), closed dot at (

Task 3 answer: First segment horizontal line y = 1 over x < -1, open dot at (-1, 1). Middle segment line y = x + 1 over -1 <= x <= 2, closed dot at (-1, 0), passing through (0, 1) and (1, 2), closed dot at (2, 3). Third segment horizontal line y = 5 over x > 2, open dot at (2, 5). Reasoning: middle interval includes both endpoints so both its dots are closed; outer intervals exclude their shared breakpoints so their dots are open; graph jumps at x = -1 and again at x = 2.

Task 4 answer: Left segment line y = 2x over x < 1, interior points (0, 0) and (0.5, 1), open dot at (1, 2). Single point closed dot at (1, 3). Right segment line y = x + 1 over x > 1, open dot at (1, 2), passing through (2, 3) and (3, 4). Reasoning: left and right formulas both approach 2 at x = 1 but neither interval includes x = 1 so both dots at (1, 2) are open; definition assigns single value 3 at x = 1 so closed dot at (1, 3). Check: substitute x = 1 into each formula;

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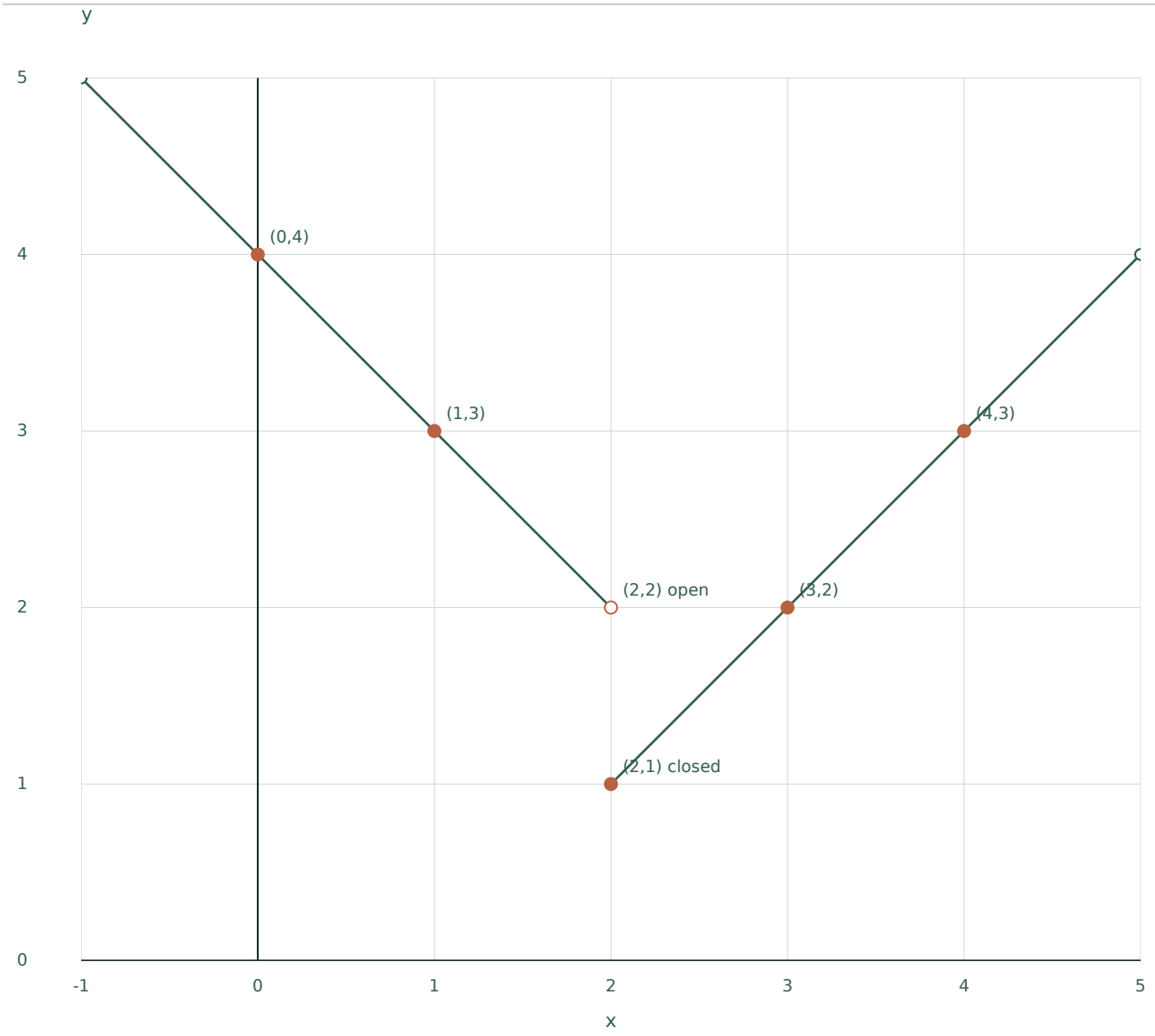
Task 1 / Exercise 1 Reference: g(x) = x + 2 for x <= 0; g(x) = 3 for x > 0



Closed dot at (0,2); open dot at (0,3).

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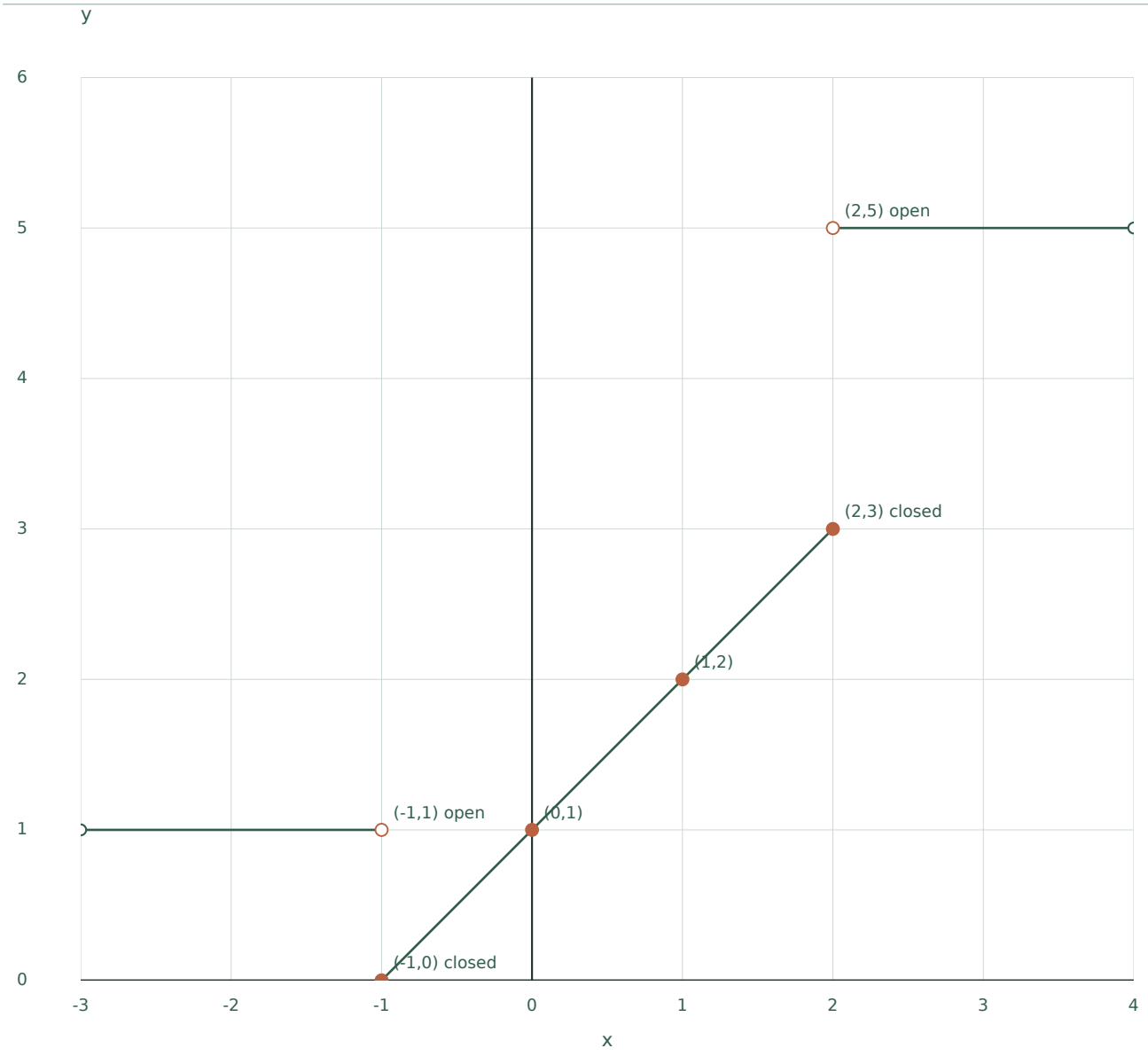
Task 2 / Exercise 2 Reference: h(x) = -x + 4 for x < 2; h(x) = x - 1 for x >= 2



Open dot at (2,2); closed dot at (2,1).

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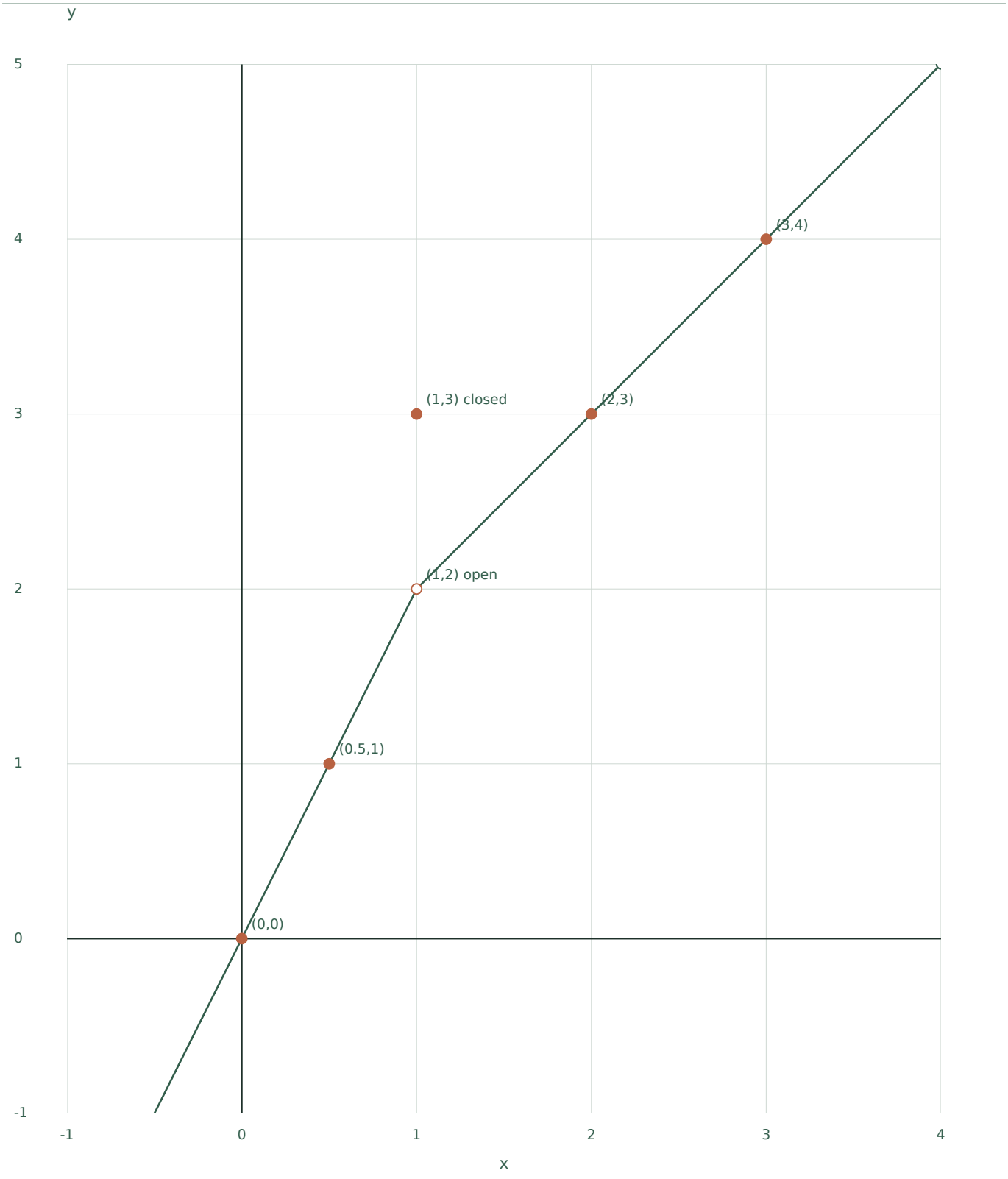
Task 3 / Exercise 3 Reference: k(x) = 1 for x < -1; k(x) = x + 1 for -1 <= x <= 2; k(x) = 5 for x > 2



Open at (-1,1) and (2,5); closed at (-1,0) and (2,3).

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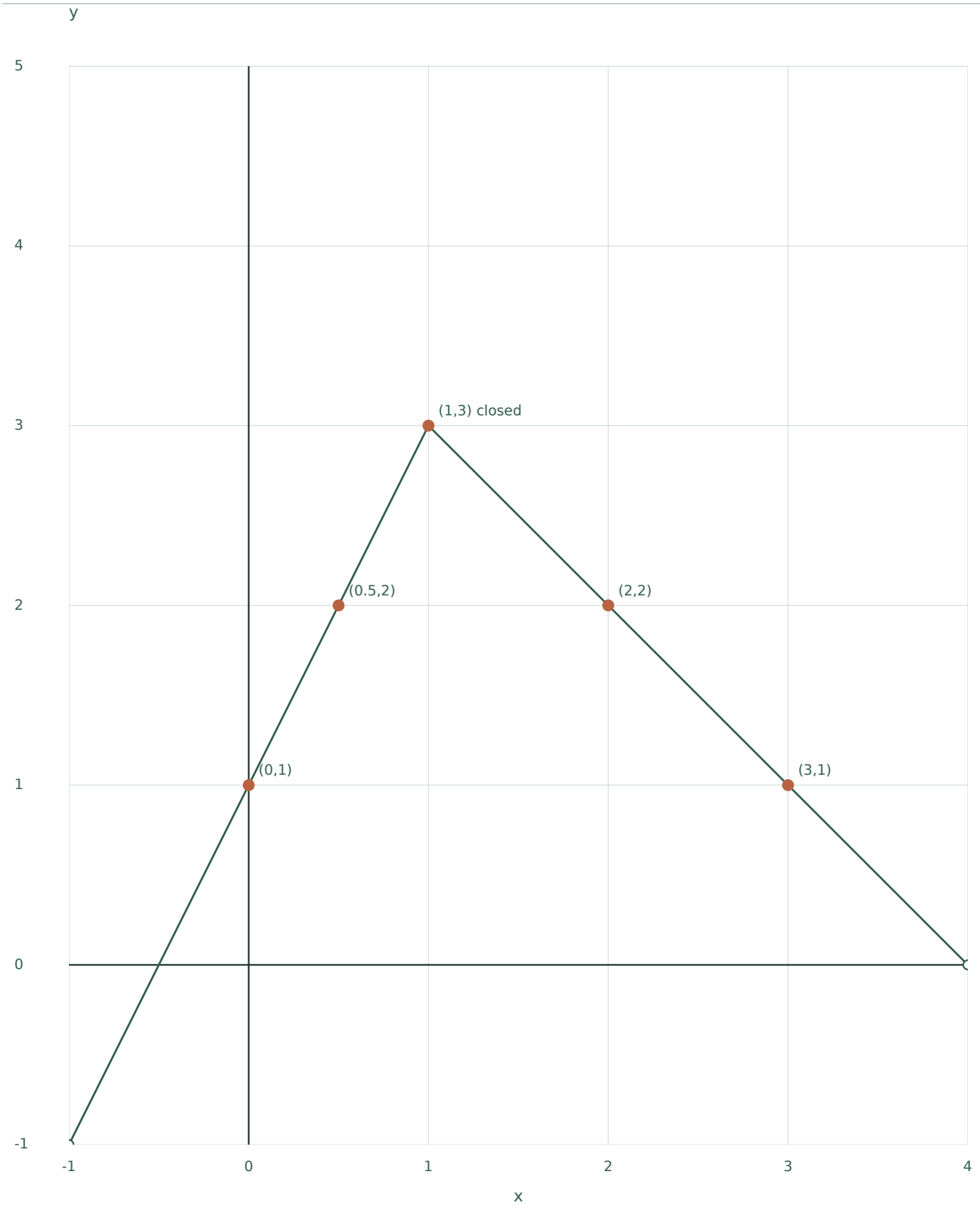
Task 4 / Exercise 4 Reference: m(x) = 2x for x < 1; m(x) = 3 for x = 1; m(x) = x + 1 for x > 1



Two open dots at (1,2) (left and right segments); one closed dot at (1,3).

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Worked example / Worked Example: f(x) = 2x + 1 for x < 1; f(x) = 4 - x for x >= 1



Open dot at (1,3) on the left segment is superseded by the closed dot at (1,3) from the right segment; the closed dot is shown.

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Source rubric / reflection

- [ ] Each segment is plotted only over its stated interval.
- [ ] Breakpoints are marked with open or closed dots matching the interval conditions.
- [ ] At least two interior sample points per segment are correct.
- [ ] Axis scale and units are stated and consistent.
- [ ] No stray lines extend beyond segment intervals.
- [ ] Endpoint notation is unambiguous and matches the written interval table.

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