Practice Drawing Floor and Ceiling Functions: Step Graphs with Open and Closed Endpoints

Original tasks 1, 2, 3 / complete keys

Task 1

Graph y = floor(x) for x from -2 to 2. Mark all endpoints and state your convention.

Answer: On [-2, -1) the segment is at y = -2; on [-1, 0) at y = -1; on [0, 1) at y = 0; on [1, 2) at y = 1. Each step has a filled dot at its left endpoint and an open circle at its right endpoint. At x = 2 the value is 2, so a filled dot at (2, 2) begins the next step if shown.

Reason: Floor returns the greatest integer not exceeding the input, so each interval [n, n+1) has constant output n. The left endpoint is included because floor(n) = n, and the right endpoint is excluded because floor(n+1) belongs to the next step.

Check: Substitute x = -1.5, -0.5, 0.5, and 1.5 to confirm outputs -2, -1, 0, and 1. Then substitute x = -2, -1, 0, 1, and 2 to confirm the filled endpoints.

Task 2

Graph y = ceil(x) for x from -1 to 2. Mark all endpoints and state your convention.

Answer: On (-1, 0] the segment is at y = 0; on (0, 1] at y = 1; on (1, 2] at y = 2. Each step has an open circle at its left endpoint and a filled dot at its right endpoint. At x = -1 the value is -1, so a filled dot at (-1, -1) ends the previous step if shown.

Reason: Ceiling returns the least integer not less than the input. On an interval (n, n+1] the output is n+1, so the right endpoint is included and the left endpoint is excluded.

Check: Substitute x = -0.5, 0.5, and 1.5 to confirm outputs 0, 1, and 2. Then substitute x = 0, 1, and 2 to confirm the filled right endpoints.

Task 3

Graph y = floor(x) - 1 for x from -1 to 2. Mark all endpoints and state your convention.

Answer: On [-1, 0) the segment is at y = -2; on [0, 1) at y = -1; on [1, 2) at y = 0. Each step has a filled dot at its left endpoint and an open circle at its right endpoint. At x = 2 the value is floor(2) - 1 = 1, so a filled dot at (2, 1) begins the next step if shown.

Reason: The shift subtracts 1 from every floor output, so each step height is one unit lower than the corresponding step of y = floor(x). The boundary locations and endpoint types are unchanged.

Check: Compare with the graph of y = floor(x): every segment should be exactly one unit lower. Substitute x = -0.5, 0.5, and 1.5 to confirm outputs -2, -1, and 0.

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Original tasks 4 / complete keys

Task 4

Graph y = ceil(2x) for x from 0 to 1.5. Mark all endpoints and state your convention.

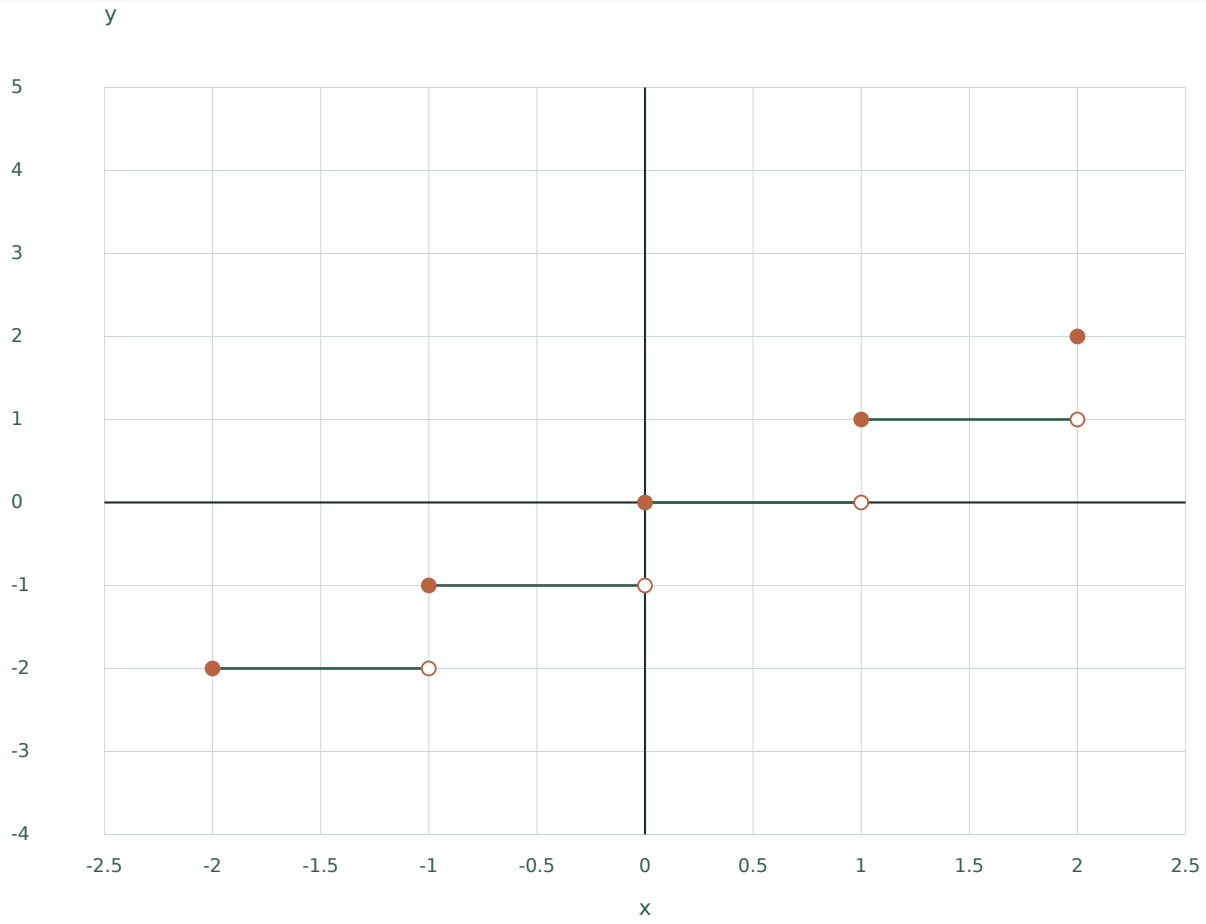
Answer: The inside expression 2x reaches integers at x = 0, 0.5, 1, and 1.5. On (0, 0.5] the segment is at y = 1; on (0.5, 1] at y = 2; on (1, 1.5] at y = 3. Each step has an open circle at its left endpoint and a filled dot at its right endpoint. At x = 0 the value is ceil(0) = 0, so a filled dot at (0, 0) ends the previous step if shown.

Reason: Ceiling of 2x jumps when 2x crosses an integer, which happens at half-integer values of x. The right endpoint of each interval is included because ceil(2x) equals the integer at that boundary.

Check: Substitute x = 0.25, 0.75, and 1.25 to confirm outputs 1, 2, and 3. Then substitute x = 0.5, 1, and 1.5 to confirm the filled right endpoints.

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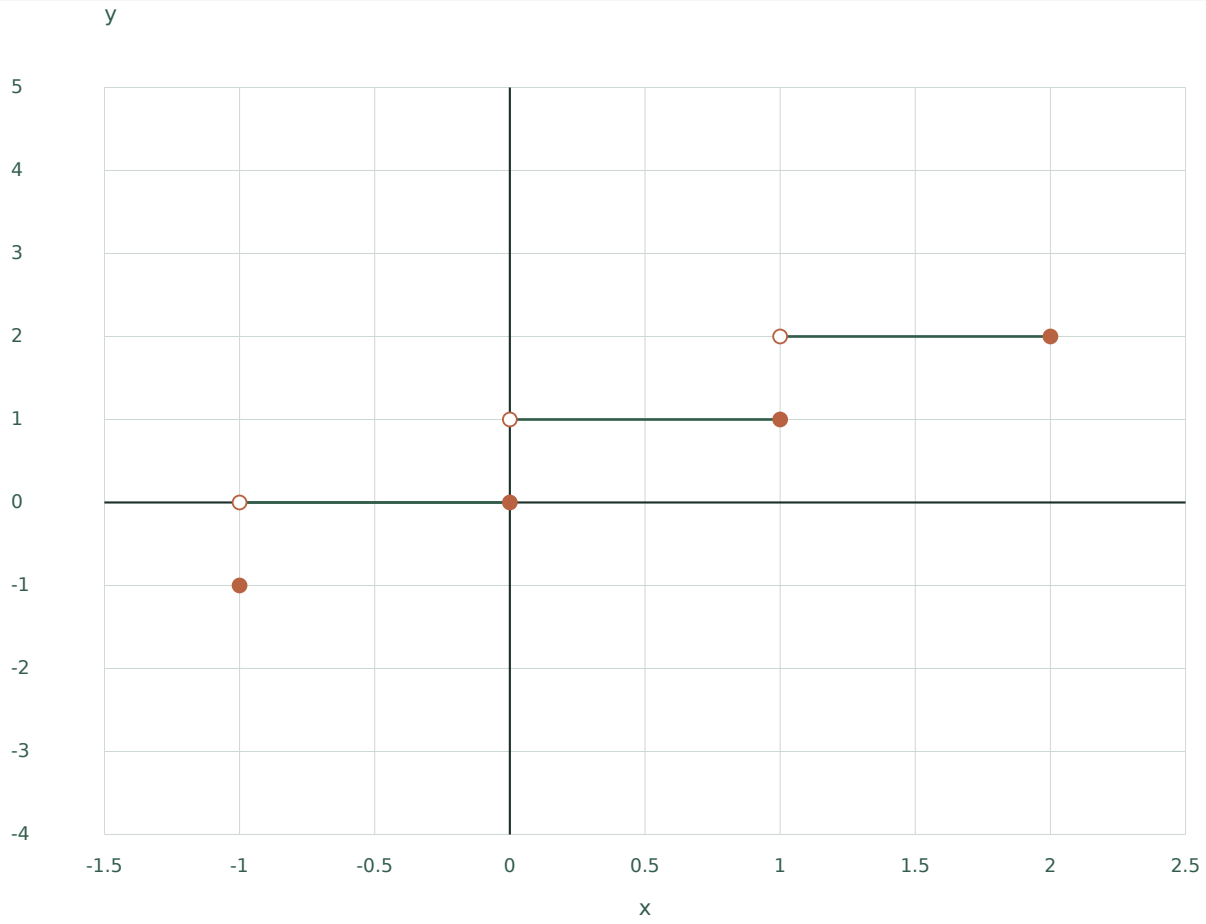
Task 1 / graph key



Filled dots are included; white circles are excluded. The isolated boundary dot is the actual function value at the finite window endpoint.

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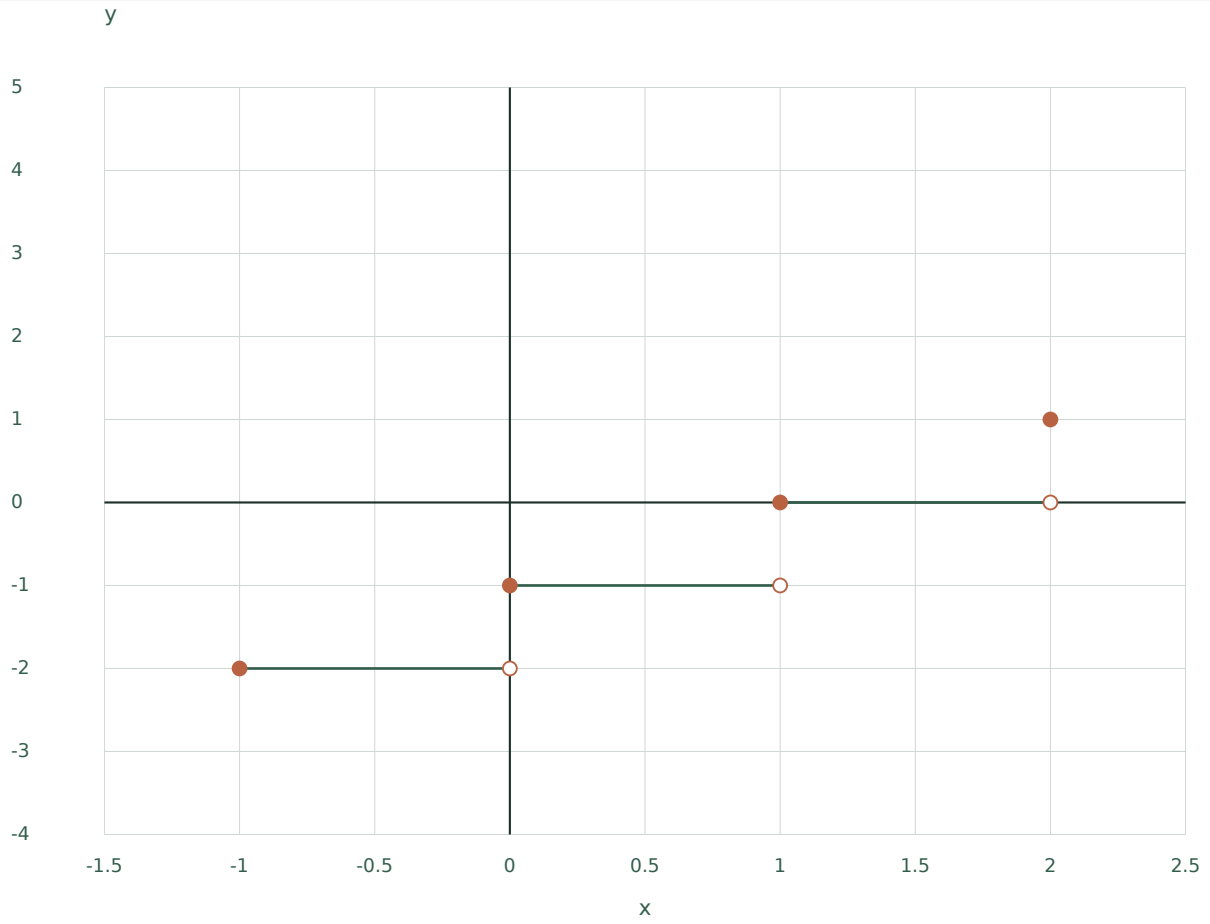
Task 2 / graph key



Filled dots are included; white circles are excluded. The isolated boundary dot is the actual function value at the finite window endpoint.

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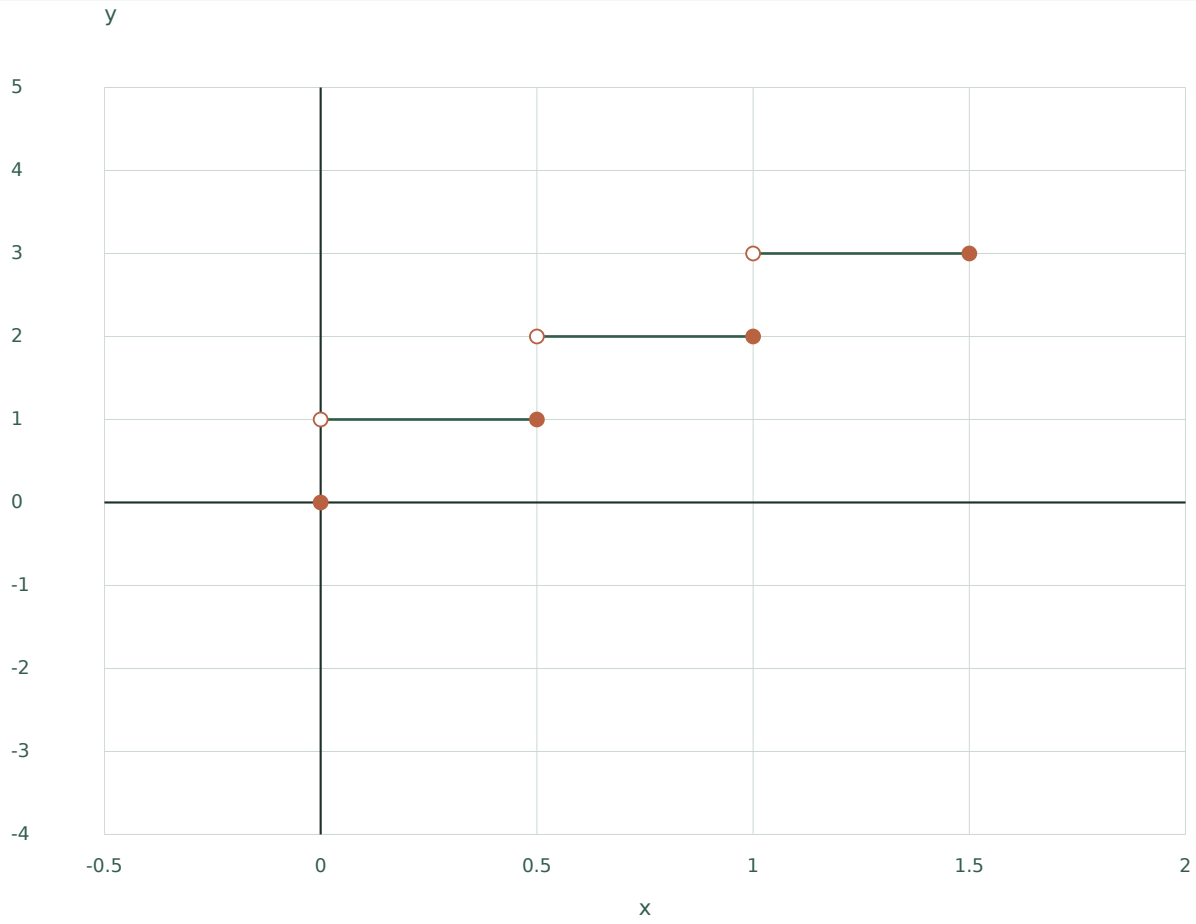
Task 3 / graph key



Filled dots are included; white circles are excluded. The isolated boundary dot is the actual function value at the finite window endpoint.

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Task 4 / graph key



Filled dots are included; white circles are excluded. The isolated boundary dot is the actual function value at the finite window endpoint.

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Source rubric / reflection

- [ ] Correctly identifies the base function as floor or ceiling.
- [ ] Computes at least one test output per interval accurately.
- [ ] Draws horizontal segments only, with no diagonal connectors.
- [ ] Marks included endpoints with filled dots and excluded endpoints with open circles, or states an equally clear alternative convention.
- [ ] Labels axes and states the endpoint convention beside the graph.
- [ ] Checks at least two boundary values by direct substitution.

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