

V-Shape Decisions

Solve, graph, and interpret absolute value models.

HIGH SCHOOL • MA.912.AR.4.4

MA.912.AR.4.4 "Solve and graph mathematical and real-world problems that are modeled with absolute value functions. Interpret key features and determine constraints in terms of the context."

NAME _____

DATE _____

ABSOLUTE VALUE PATTERNS

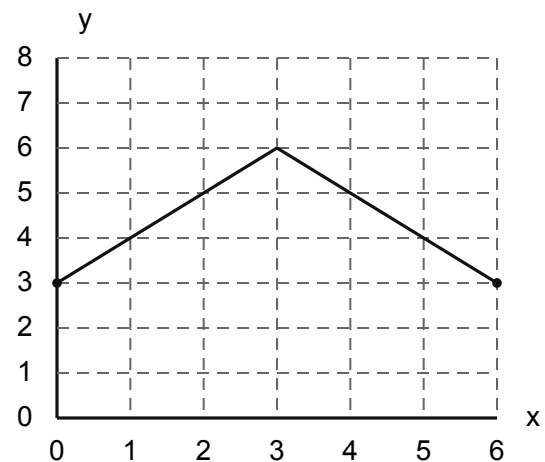
For $y=a|x-h|+k$, plot the vertex (h,k) and two straight branches with a ruler. Restrict the graph to inputs allowed by the context. Solve a requested output by considering both branches, then reject inputs outside the domain. Interpret vertices, intervals and intercepts with units. R means all real numbers.

WORKED EXAMPLE

A roof has height $y=6-|x-3|$ meters for $0 \leq x \leq 6$ meters across the building. Graph it. Find its maximum, range, and positions where $y=4$.

1. The vertex $(3,6)$ is the peak. Draw straight segments to $(0,3)$ and $(6,3)$.
2. $6-|x-3|=4$ gives $|x-3|=2$, so $x=1$ or 5 .
3. Both solutions are in the modeled domain.

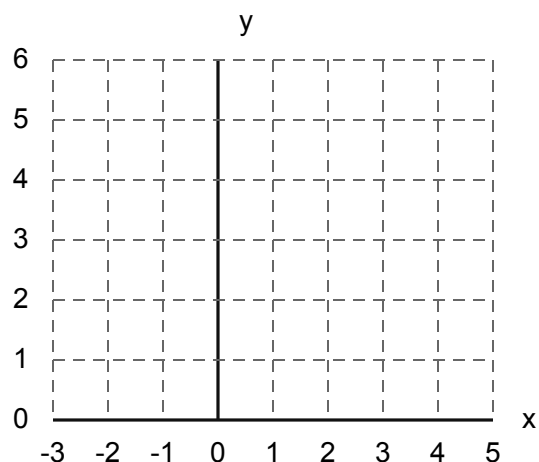
Answer: Maximum 6 m at $x=3$; range $3 \leq y \leq 6$; $y=4$ at $x=1, 5$ m; domain $0 \leq x \leq 6$.



PRACTICE 4 problems

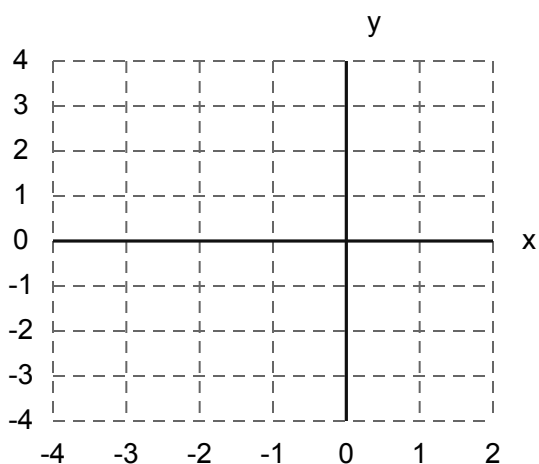
- 1** A drone lane has height $y=|x-1|+1$ meters for $-3 \leq x \leq 5$ meters horizontally. Graph it. Find its minimum, range and positions where $y \leq 3$.

ANSWER _____



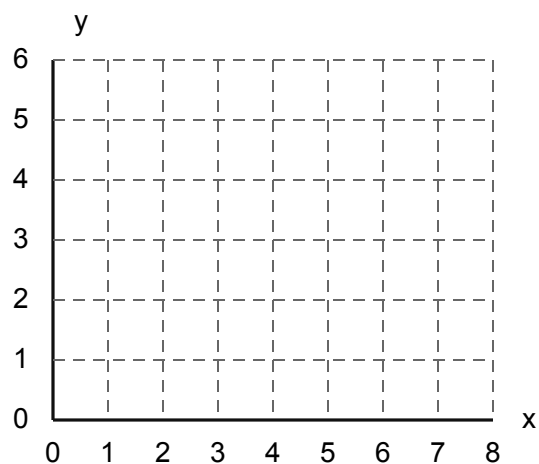
- 2** Graph $y=2|x+1|-3$ for all real x . State the vertex, range and solutions of $y \leq 1$.

ANSWER _____



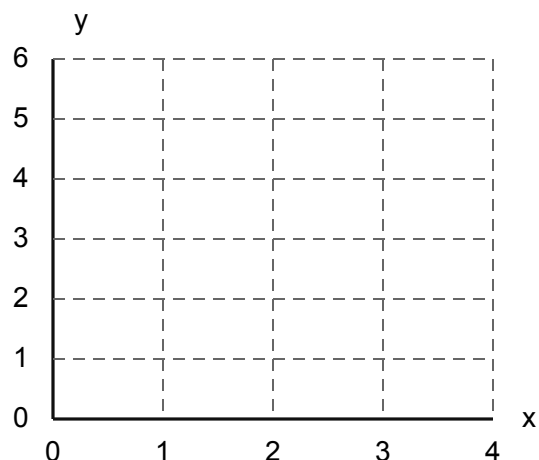
- 3** A sensor deviation is $y=|x-4|$ units, for real input $0 \leq x \leq 8$. Graph it. Which inputs have deviation at most 2? State the symmetry axis and range.

ANSWER _____



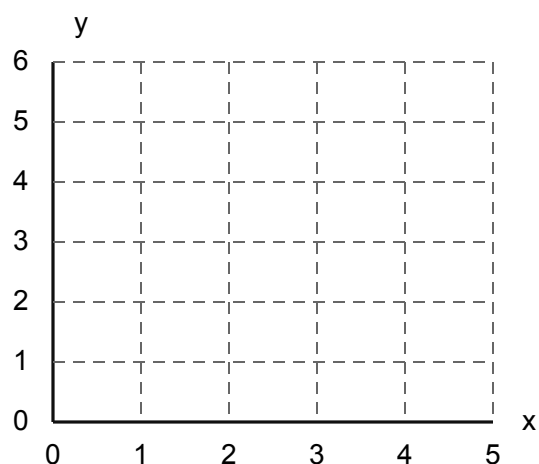
- 4 An inverted-V profile has vertex $(2,5)$, passes through $(0,1)$, and is modeled for $0 \leq x \leq 4$. Write and graph y as a function of x . Where is $y > 3$?

ANSWER _____



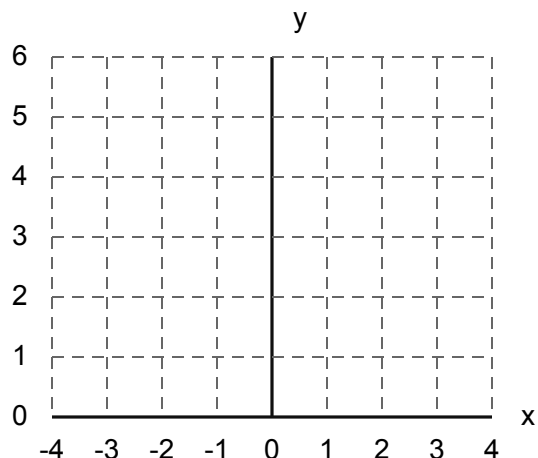
APPLY IT Show your work

- 1 A cyclist is $y = |x - 2| + 1$ kilometers from a station, x hours after noon, for $0 \leq x \leq 5$. Graph the trip. When is the cyclist closest, and when is the distance at most 2 km?



2

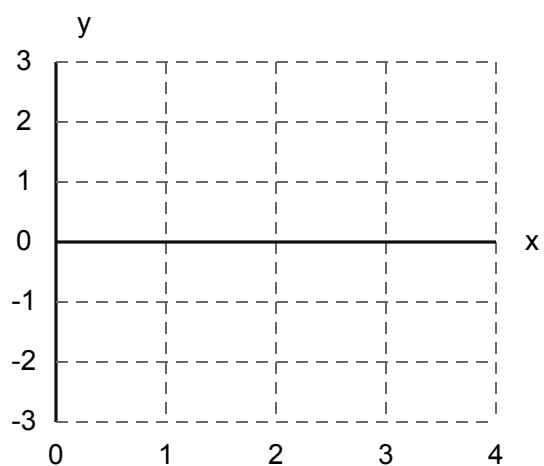
A sign is modeled by height $y=4-|x|$ feet across $-4 \leq x \leq 4$ feet. Graph it. State intercepts, symmetry, and the intervals where the height rises and falls.



CHALLENGE One step up

A simulation uses $y=|x-1|-2$ only for $0 \leq x \leq 4$. Graph it. Give domain/range, intercepts and where y is positive or negative. Explain why one algebraic zero is excluded.

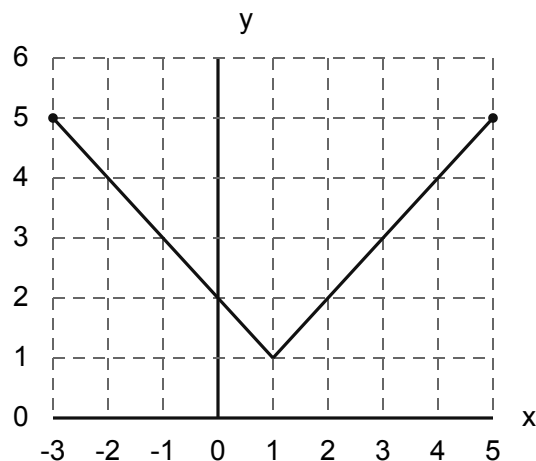
WORK SPACE AND ANSWER



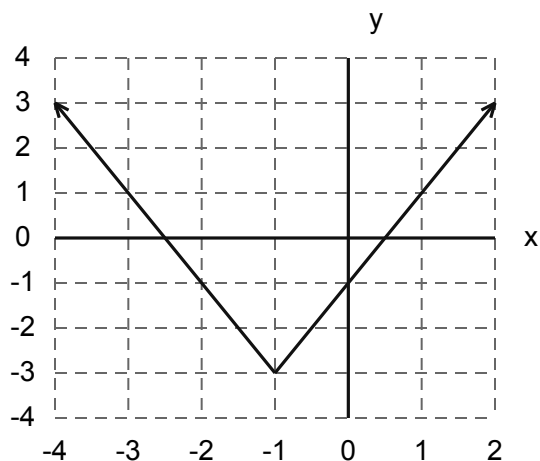
Require actual graphs with sharp vertices and the stated closed domains. Boundary inputs matter: include them in solution intervals when the condition holds there. Unrestricted graphs use arrows; contextual graphs stop at their allowed endpoints. Accept equivalent inequality or set-builder notation.

PRACTICE 1

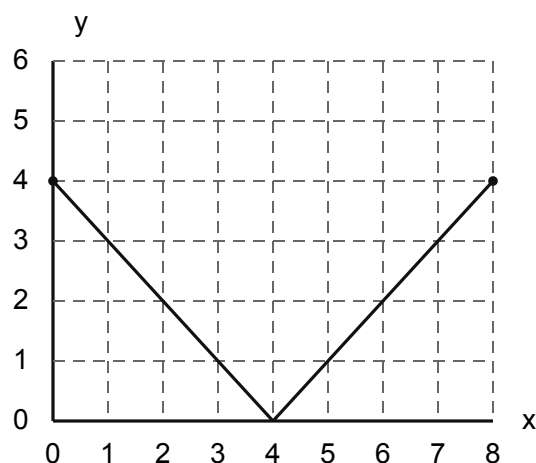
Minimum 1 m at $x=1$; range $1 \leq y \leq 5$; $y \leq 3$ for $-1 \leq x \leq 3$.

**PRACTICE 2**

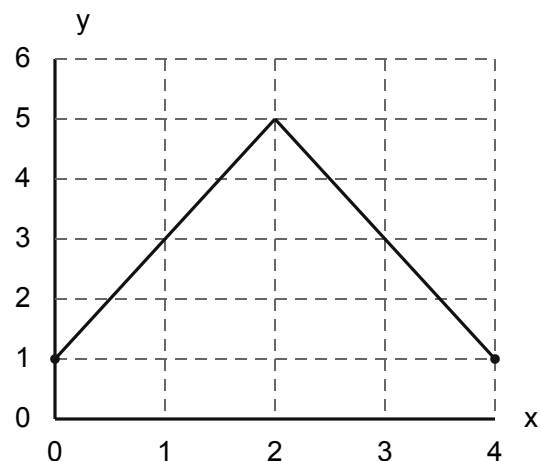
Vertex $(-1, -3)$; range $y \geq -3$; $-3 \leq x \leq 1$. Domain $\mathbb{R}$.

**PRACTICE 3**

Inputs $2 \leq x \leq 6$; symmetry $x=4$; range $0 \leq y \leq 4$.

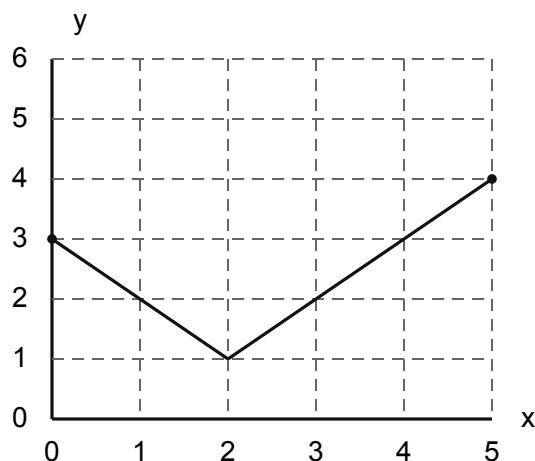
**PRACTICE 4**

$y = -2|x-2|+5$; $y > 3$ for $1 < x < 3$; range $1 \leq y \leq 5$.



APPLY IT 1

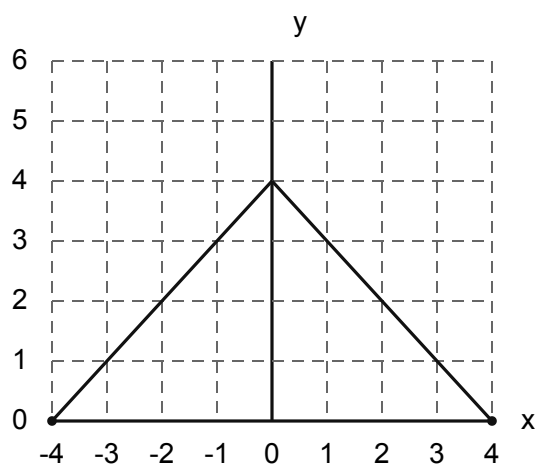
Closest at 2 p.m., 1 km away. At most 2 km for $1 \leq x \leq 3$, from 1 to 3 p.m. Range $1 \leq y \leq 4$. The vertex minimizes distance; solve $|x-2| \leq 1$.



APPLY IT 2

Intercepts $(-4,0)$, $(4,0)$, $(0,4)$; symmetry $x=0$. Rising $-4 < x < 0$, falling $0 < x < 4$. Domain $-4 \leq x \leq 4$; range $0 \leq y \leq 4$.

Use only the physical width; both bases are included.



CHALLENGE

D: $0 \leq x \leq 4$; range $-2 \leq y \leq 1$. Intercepts $(3,0)$, $(0,-1)$.

Positive $3 < x \leq 4$; **negative** $0 \leq x < 3$. Algebraic zero -1 is outside the domain.

