

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 _____

THE BIG IDEA

In $y=a|x-h|+k$, the vertex is (h,k) , and the graph opens up when a is positive and down when a is negative. To solve $|\text{expression}|=d$, set the expression equal to d and to $-d$. In a real situation, use only input values that make sense for the context.

WORKED EXAMPLE

Graph $y=-|x-11|+13$.

1. The $x-11$ shifts the parent graph right 11.
2. The $+13$ shifts the graph up 13, so the vertex is $(11,13)$.
3. The negative sign reflects the graph, so it opens downward.
4. The axis of symmetry is $x=11$.

Answer: Vertex: (11,13); axis of symmetry: $x=11$; opens downward.

PRACTICE 6 problems

1 Solve $|x-7|=5$.

ANSWER _____

2 Solve $|2x+5|=7$.

ANSWER _____

3 For $y=-|x+6|+5$, state the vertex, axis of symmetry, and opening direction.

ANSWER _____

4 Solve $|x-5|<7$.

ANSWER _____

5 For $y=2|x+3|-6$, state the vertex and give two additional points that can be used to graph the function.

ANSWER _____

6 Solve $|x+1|-2=4$.

ANSWER _____

APPLY IT Show your work

- 1** During a school gaming event, a sound-check score is modeled by $N(t)=|t-5|+2$, where t is the number of hours after noon and $0 \leq t \leq 7$. Find the minimum score and all times when $N(t)=4$. Interpret the times in the context.

WORK SPACE

ANSWER _____

- 2** For a wellness challenge, a student's focus score is modeled by $S(x)=12-2|x-4|$, where x is hours of sleep and $0 \leq x \leq 7$. Find the maximum focus score and the hours of sleep that give a score of at least 6.

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

An absolute value graph has vertex $(2,-3)$, passes through $(5,6)$, and opens upward. Write its equation in the form $y=a|x-h|+k$. Then solve for x when $y=3$. Explain how you found a .

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Solve $ x-7 =5$.	$x=2$ or $x=12$
2	Solve $ 2x+5 =7$.	$x=1$ or $x=-6$
3	For $y=- x+6 +5$, state the vertex, axis of symmetry, and opening direction.	Vertex: $(-6,5)$; axis of symmetry: $x=-6$; opens downward.
4	Solve $ x-5 <7$.	$-2<x<12$
5	For $y=2 x+3 -6$, state the vertex and give two additional points that can be used to graph the function.	Vertex: $(-3,-6)$; possible additional points: $(-2,-4)$ and $(-4,-4)$.
6	Solve $ x+1 -2=4$.	$x=5$ or $x=-7$

PART 2 · APPLY IT

- The minimum score is 2 at $t=5$, or 5:00 p.m. The score is at most 4 from $t=3$ to $t=7$, or from 3:00 p.m. through 7:00 p.m.** The vertex is $(5,2)$, so the minimum is 2 when $t=5$. Solving $|t-5|+2\leq 4$ gives $3\leq t\leq 7$, which already fits the time constraint.
- The maximum focus score is 12 at $x=4$ hours. A score of at least 6 occurs when $1\leq x\leq 7$ hours.** The vertex $(4,12)$ gives the maximum score. Solve $12-2|x-4|\geq 6$ to get $|x-4|\leq 3$, so $1\leq x\leq 7$.

CHALLENGE

$y=3|x-2|-3$. When $y=3$, $x=0$ or $x=4$. Since $(5,6)$ is on the graph, $6=3a-3$, so $a=3$.

Accept equivalent solution-set notation, including interval notation for inequalities. For graphing items, accept any correct pair of symmetric points in addition to the vertex.