

Parabola Flight Paths

Graph quadratic models and interpret their key features.

HIGH SCHOOL • MA.912.GR.7.5

MA.912.GR.7.5 "Graph and solve mathematical and real-world problems that are modeled with an equation of a parabola. Determine and interpret key features in terms of the context."

NAME _____

DATE _____

READ THE VERTEX FORM

In $y=a(x-h)^2+k$, the vertex is (h,k) , and the axis of symmetry is $x=h$. If a is positive, the parabola opens up and has a minimum. If a is negative, it opens down and has a maximum.

WORKED EXAMPLE

Graph $y=6(x+8)^2+10$. State the vertex, axis of symmetry, and minimum.

1. Match $x+8$ to $x-(-8)$, so $h=-8$ and $k=10$.
2. The vertex is $(-8,10)$, and the axis of symmetry is $x=-8$.
3. Because $a=6$ is positive, the parabola opens up.
4. The minimum y -value is 10.

Answer: Vertex: $(-8,10)$; axis of symmetry: $x=-8$; minimum: 10.

PRACTICE 6 problems

- 1** Graph $y=-3(x-1)^2+4$. State the vertex, axis of symmetry, opening direction, and maximum or minimum.

ANSWER _____

- 2** For $y=x^2-4x+3$, rewrite the equation in vertex form. Then graph it and state the vertex and x -intercepts.

ANSWER _____

- 3** Graph $y=(x+5)(x-3)$. State the x -intercepts, axis of symmetry, and vertex.

ANSWER _____

- 4** Graph $y=-x^2+5x$. State the x -intercepts, axis of symmetry, and maximum value.

ANSWER _____

- 5** A parabola has vertex $(3,-4)$ and passes through $(1,4)$. Write its equation in vertex form. List three points you can use to graph it.

ANSWER _____

- 6** Graph $y=3(x+1)^2-12$. Solve $y=0$ and state the vertex.

ANSWER _____

APPLY IT Show your work

- 1** In a basketball video game, a shot's height is modeled by $h = -3t^2 + 12t + 15$, where h is height in feet and t is time in seconds. Graph the model. What is the greatest height, and when does the ball hit the ground?

WORK SPACE

ANSWER _____

- 2** A school festival entrance arch is modeled by $y = -4(x-3)^2 + 16$, where x is the horizontal distance in feet and y is the height in feet. Graph the arch. State its greatest height and the width of its opening on the ground.

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

A parabola crosses the x -axis at $x = -1$ and $x = 5$ and passes through $(0, 15)$. Write an equation for the parabola. Then find its vertex and explain how the x -intercepts help locate the axis of symmetry.

PART 1 • PRACTICE

#	PROBLEM	ANSWER
1	Graph $y = -3(x-1)^2 + 4$. State the vertex, axis of symmetry, opening direction, and maximum or minimum.	Vertex: (1,4); axis of symmetry: $x=1$; opens down; maximum: 4.
2	For $y = x^2 - 4x + 3$, rewrite the equation in vertex form. Then graph it and state the vertex and x-intercepts.	$y = (x-2)^2 - 1$; vertex: (2,-1); x-intercepts: (1,0) and (3,0).
3	Graph $y = (x+5)(x-3)$. State the x-intercepts, axis of symmetry, and vertex.	x-intercepts: (-5,0) and (3,0); axis of symmetry: $x=-1$; vertex: (-1,-16).
4	Graph $y = -x^2 + 5x$. State the x-intercepts, axis of symmetry, and maximum value.	x-intercepts: (0,0) and (5,0); axis of symmetry: $x=5/2$; maximum value: $25/4$ at $(5/2, 25/4)$.
5	A parabola has vertex (3,-4) and passes through (1,4). Write its equation in vertex form. List three points you can use to graph it.	$y = 2(x-3)^2 - 4$; possible graph points: (3,-4), (1,4), and (5,4).
6	Graph $y = 3(x+1)^2 - 12$. Solve $y=0$ and state the vertex.	$x=-3$ or $x=1$, so the x-intercepts are (-3,0) and (1,0); vertex: (-1,-12).

PART 2 • APPLY IT

- The greatest height is 27 feet at $t=2$ seconds. The ball hits the ground at $t=5$ seconds.** The vertex occurs at $t=2$, and $h=27$. Solve $-3t^2 + 12t + 15 = 0$ to get $t=-1$ and $t=5$, then use the positive time.
- The greatest height is 16 feet at $x=3$. The opening is 4 feet wide, from $x=1$ to $x=5$.** The vertex (3,16) gives the greatest height. Setting $y=0$ gives $x=1$ and $x=5$, so the horizontal width is $5-1=4$ feet.

CHALLENGE

$y = -3(x+1)(x-5)$, or $y = -3(x-2)^2 + 27$. The vertex is (2,27), which is a maximum. The axis of symmetry is $x=2$ because 2 is halfway between -1 and 5.

Accept equivalent equations, including expanded, factored, or vertex forms when they represent the same parabola. Accept correctly labeled graphs that show the stated vertex, axis of symmetry, intercepts, and opening direction.