

Parabola Feature Hunt

Graph quadratics from equations, tables, and descriptions.

HIGH SCHOOL • MA.912.AR.3.7

MA.912.AR.3.7 "Given a table, equation or written description of a quadratic function, graph that function, and determine and interpret its key features."

NAME _____

DATE _____

GRAPHING FROM FEATURES

In $y = a(x - h)^2 + k$, the vertex is (h, k) , the axis of symmetry is $x = h$, and a tells whether the graph opens up or down. Plot the vertex and matching points on both sides of the axis, then use the graph to identify key features.

WORKED EXAMPLE

Graph $y = (x - 4)^2 - 3$. State the vertex, axis, opening, and intercepts.

1. The vertex is $(4, -3)$, so the axis is $x = 4$.
2. Because $a = 1$, the parabola opens up.
3. Plot $(3, -2)$, $(5, -2)$, $(2, 1)$, and $(6, 1)$.
4. Set $y = 0$: $(x - 4)^2 = 3$, so $x = 4 \pm \sqrt{3}$.

Answer: Vertex: $(4, -3)$. Axis: $x = 4$. Opens up. y-intercept: $(0, 13)$. x-intercepts: $(4 - \sqrt{3}, 0)$ and $(4 + \sqrt{3}, 0)$. Range: $y \geq -3$.

PRACTICE 5 problems

- 1** Graph $y = (x + 7)^2 + 8$. State the vertex, axis, opening, and range.

ANSWER _____

- 2** Graph $y = -(x - 9)^2 + 10$. State the vertex, axis, opening, and range.

ANSWER _____

- 3** Graph $y = x^2 - 22x + 109$. State the vertex, axis, opening, and range.

ANSWER _____

- 4** Graph the quadratic shown in the table. State its vertex, axis, and opening. x: -10 -9 -8 -7 -6 y: -11 -14 -15 -14 -11

ANSWER _____

- 5** A parabola has vertex $(13, 14)$, opens down, and passes through $(12, 12)$ and $(14, 12)$. Graph it. State its axis and range.

ANSWER _____

APPLY IT Show your work

- 1** A basketball's height h , in feet, after t seconds is $h = -t^2 + 16t + 17$. Graph the model for $t \geq 0$. What is the maximum height, when does it occur, and when does the ball hit the ground?

WORK SPACE

ANSWER _____

- 2** For a school concert, profit P in hundreds of dollars is modeled by $P = -x^2 + 18x - 32$, where x is the ticket price in dollars. Graph the model. What ticket price gives the greatest profit, and what prices break even?

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

A quadratic has axis of symmetry $x = 5$ and this table. x : 5 6 7 y : 17 15 9 Write its equation in vertex form. Explain how the table supports your equation, then state the intercepts and range.

PART 1 • PRACTICE

#	PROBLEM	ANSWER
1	Graph $y = (x + 7)^2 + 8$. State the vertex, axis, opening, and range.	Vertex: $(-7, 8)$. Axis: $x = -7$. Opens up. Range: $y \geq 8$.
2	Graph $y = -(x - 9)^2 + 10$. State the vertex, axis, opening, and range.	Vertex: $(9, 10)$. Axis: $x = 9$. Opens down. Range: $y \leq 10$.
3	Graph $y = x^2 - 22x + 109$. State the vertex, axis, opening, and range.	Vertex: $(11, -12)$. Axis: $x = 11$. Opens up. Range: $y \geq -12$.
4	Graph the quadratic shown in the table. State its vertex, axis, and opening. x: -10 -9 -8 -7 -6 y: -11 -14 -15 -14 -11	Vertex: $(-8, -15)$. Axis: $x = -8$. Opens up.
5	A parabola has vertex $(13, 14)$, opens down, and passes through $(12, 12)$ and $(14, 12)$. Graph it. State its axis and range.	Axis: $x = 13$. Range: $y \leq 14$. The graph opens down through $(12, 12)$ and $(14, 12)$.

PART 2 • APPLY IT

- Vertex: $(8, 81)$, so the maximum height is 81 feet at 8 seconds. The graph opens down, has axis $t = 8$, starts at $(0, 17)$, and hits the ground at $(17, 0)$.** Find the vertex using $t = -b/(2a) = 8$. Solving $-t^2 + 16t + 17 = 0$ gives $t = -1$ and $t = 17$, so only 17 seconds is physical.
- Vertex: $(9, 49)$, so a \$9 ticket price gives the greatest profit of \$4,900. The break-even prices are \$2 and \$16. The graph opens down and has axis $x = 9$.** The vertex occurs at $x = -18/(2(-1)) = 9$, and $P(9) = 49$. Factor $P = -(x - 2)(x - 16)$ to find the break-even prices.

CHALLENGE

$y = -2(x - 5)^2 + 17$. The point $(5, 17)$ is the vertex, and moving 1 unit to $x = 6$ changes y by -2 , so $a = -2$. y-intercept: $(0, -33)$. x-intercepts: $(5 - \sqrt{17/2}, 0)$ and $(5 + \sqrt{17/2}, 0)$. Range: $y \leq 17$.

Accept equivalent vertex forms and equivalent radical forms for the challenge x-intercepts, such as $5 \pm \sqrt{34}/2$. For graphs, accept accurate symmetric sketches with the stated vertex, axis, and opening.