

Quadratic Relationship Lab

Build function rules from key information.

HIGH SCHOOL • MA.912.AR.3.4

MA.912.AR.3.4 "Write a quadratic function to represent the relationship between two quantities from a graph, a written description or a table of values within a mathematical or real-world context."

NAME _____

DATE _____

BUILD THE RULE

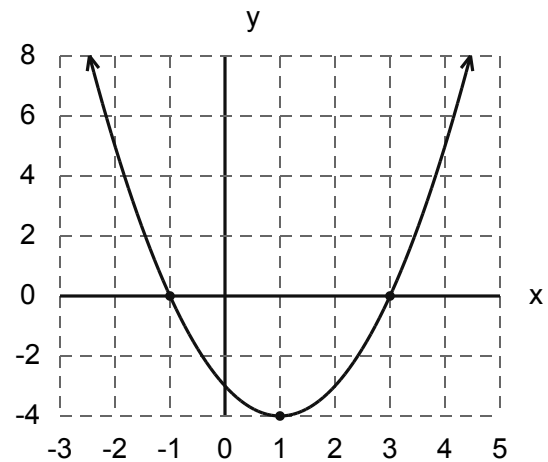
A quadratic can be written as $f(x)=a(x-h)^2+k$ using its vertex (h,k) , or as $a(x-r)(x-s)$ using its zeros r,s . Substitute another point to find a ; do not assume $a=1$. Expand to obtain standard form. Check your rule against all supplied points. Symmetric points have equal outputs and are equally far from the vertex.

WORKED EXAMPLE

The graph has vertex $(1,-4)$ and zeros $(-1,0)$ and $(3,0)$. Write the function in vertex, factored and standard form.

1. Start $f(x)=a(x-1)^2-4$. Use $(3,0)$: $0=4a-4$, so $a=1$.
2. The zeros give factors $(x+1)$ and $(x-3)$.
3. Expanding gives x^2-2x-3 . Check the vertex and both zeros.

Answer: $f(x)=(x-1)^2-4=(x+1)(x-3)=x^2-2x-3$.



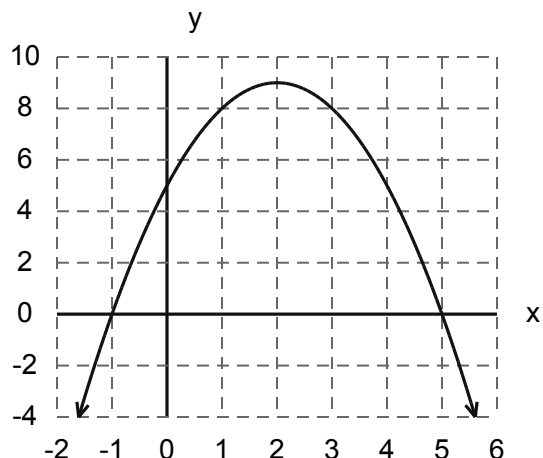
PRACTICE 4 problems

- 1** A quadratic has vertex $(0,-3)$ and passes through $(-3,6)$ and $(3,6)$. Write vertex and standard forms.

ANSWER _____

- 2** The shown parabola has vertex $(2,9)$ and zeros $(-1,0)$, $(5,0)$. Write vertex, factored and standard forms.

ANSWER _____



- 3** This table comes from a quadratic. Identify the vertex and use another row to write its function.

ANSWER _____

QUADRATIC VALUES

x	y
-1	8
0	2
1	0
2	2
3	8

- 4** A parabola has vertex $(2,-4)$ and passes through $(0,0)$ and $(4,0)$. Write factored and standard forms.

ANSWER _____

APPLY IT Show your work

1

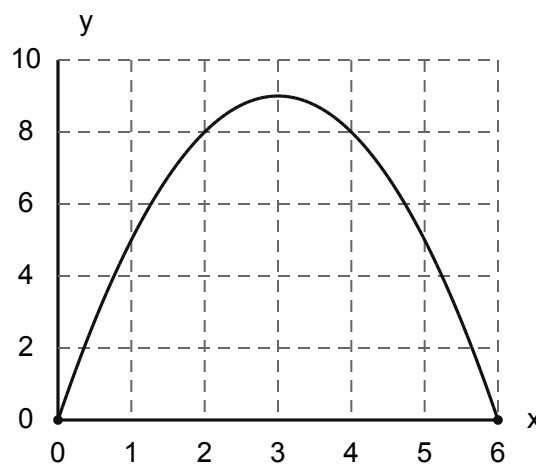
The table describes the height y of a parabolic arch, in feet, at horizontal distance x feet from its left base. Write a quadratic model and state the modeled x -domain.

ARCH PROFILE

x (ft)	y (ft)
0	0
3	15
4	16
5	15
8	0

2

A fountain designer models an arch of water. The graph shows horizontal distance x and height y , both in feet. Its vertex is $(3,9)$; it meets the water surface at $(0,0)$, $(6,0)$. Write standard form and state the physical domain.



CHALLENGE One step up

A quadratic has vertex $(1, 18)$ and zeros $(-2, 0), (4, 0)$. Write all three forms. Explain why the leading coefficient is negative.

WORK SPACE AND ANSWER

Require substitution to determine a and checks against the supplied points. All point sets include a vertex and a symmetric pair. Accept equivalent forms when the requested form is also shown. Arch and fountain domains describe the physical spans. Function expressions use 2 to mean squared.

PRACTICE 1

$$f(x)=(x-0)^2-3=x^2-3; a=1.$$

PRACTICE 2

$$f(x)=-(x-2)^2+9=-(x+1)(x-5)=-x^2+4x+5.$$

PRACTICE 3

$$\text{Vertex } (1,0); f(x)=2(x-1)^2=2x^2-4x+2.$$

PRACTICE 4

$$f(x)=x(x-4)=x^2-4x; a=1.$$

APPLY IT 1

$$y=-(x-4)^2+16=-x^2+8x; 0 \leq x \leq 8.$$

Vertex (4,16); use (3,15) to get $a=-1$.

APPLY IT 2

$$y=-x^2+6x, \text{ for } 0 \leq x \leq 6.$$
$$y=a \cdot x \cdot (x-6). \text{ At } (3,9), 9=-9a, \text{ so } a=-1.$$

CHALLENGE

$$f(x)=-2(x-1)^2+18=-2(x+2)(x-4)=-2x^2+4x+16. \text{ The vertex is a maximum, so } a<0.$$