

*Do the first few activities
before you turn on the video*

Families of Quadratic Functions

Learning Goals

- Identify properties of families of quadratic functions
- Determine equations of quadratic functions using given information

Family ...

What do they have in common?

height

nose



eyes

hair

ears

Quadratic families also have common characteristics.

Graph the following functions using technology

$$f(x) = x^2 - 3x - 10$$

$$g(x) = -2x^2 + 6x + 20$$

$$h(x) = 4x^2 - 12x - 40$$

What do you notice?

Change each equation into factored form.

What do you notice?

Graph the following functions using technology

$$f(x) = 0.5x^2 - 1x + 3.5$$

$$g(x) = -2x^2 + 4x + 1$$

$$h(x) = -6x^2 + 12x - 3$$

What do you notice?

Change each equation into vertex form.

What do you notice?

Graph the following functions using technology

$$f(x) = 2x^2 + 1x - 2$$

$$g(x) = -3x^2 + 5x - 2$$

$$h(x) = -6x^2 + 12x - 2$$

What do you notice?

What do you notice?

Print the Handout if possible

Turn on the video

Graph the following functions using technology

$$f(x) = x^2 - 3x - 10$$

$$g(x) = -2x^2 + 6x + 20$$

$$h(x) = 4x^2 - 12x - 40$$

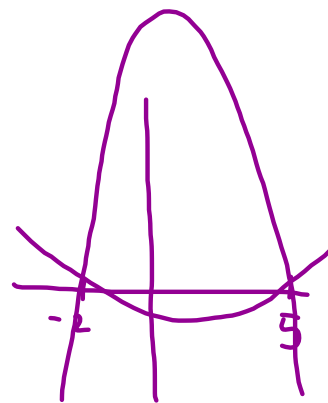
What do you notice? **same zeros**

Change each equation into factored form.

$$f(x) = (x - 5)(x + 2)$$

$$g(x) = -2(x - 5)(x + 2)$$

$$h(x) = 4(x - 5)(x + 2)$$



Graph the following functions using technology

$$f(x) = 0.5x^2 - 1x + 3.5$$

$$g(x) = -2x^2 + 4x + 1$$

$$h(x) = -6x^2 + 12x - 3$$

What do you notice? **same vertex**

Change each equation into vertex form.

$$f(x) = 0.5(x-1)^2 + 3$$

$$g(x) = -2(x-1)^2 + 3$$

$$h(x) = -6(x-1)^2 + 3$$

Graph the following functions using technology

$$f(x) = 2x^2 + 1x - 2$$

$$g(x) = -3x^2 + 5x - 2$$

$$h(x) = -6x^2 + 12x - 2$$

What do you notice?

y-int is the same

Summary

x-int $f(x) = a(x-s)(x-t)$

different \uparrow same

vertex $f(x) = a(x-h)+k$

$\uparrow \uparrow$
same

y-int $f(x) = ax^2+bx+c$

\uparrow
same

print the pdf if you have a printer.

1. Determine the equation of the quadratic function that has a Vertex at (-3,34), and passes through the point (1,2)

$f(x) = a(x-h)^2 + k$

"The Family" $f(x) = a(x+3)^2 + 34$

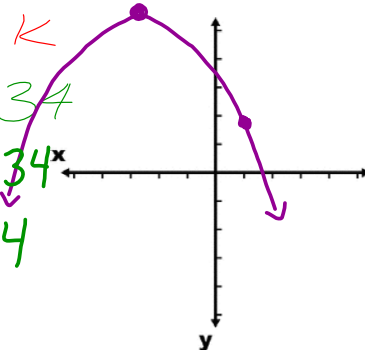
$2 = a(1+3)^2 + 34$

$2 = a(4)^2 + 34$

$-32 = a(16)$

$-2 = a$

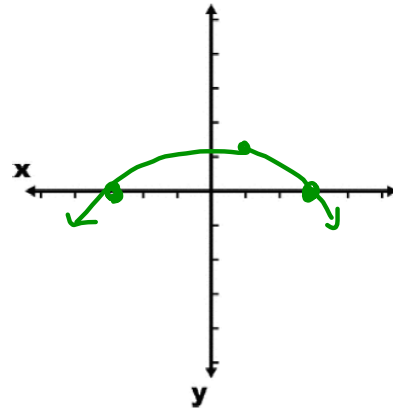
$f(x) = -2(x+3)^2 + 34$



in my lessons - I ask them to the sketch the graph 1st! - see next page - and then delete it!

2. Determine the equation of the quadratic function that passes through (1,1), if its zeros are $\sqrt{6}$ and $-\sqrt{6}$.

$$\begin{aligned}
 f(x) &= a(x-s)(x-t) \\
 1 &= a(1-\sqrt{6})(1-\sqrt{6}) \\
 1 &= a(1-\sqrt{6})(1+\sqrt{6}) \\
 1 &= a(1-6) \\
 1 &= a(-5) \\
 -\frac{1}{5} &= a
 \end{aligned}$$



$$f(x) = -\frac{1}{5}(x+\sqrt{6})(x-\sqrt{6})$$

3. Find a parabola with the same y-int as

$$f(x) = -3x^2 + 5x - 2$$

anything

$$= 5x^2 + 3x - 2$$

4. Construction Engineer

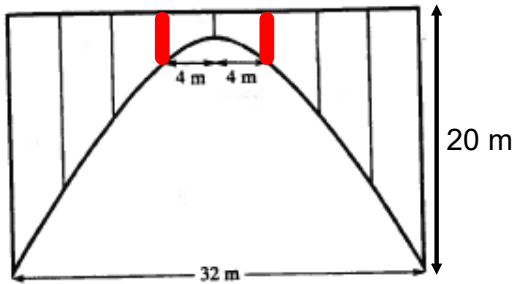
Anne Marie is a construction engineer.

A bridge over a river has an arch in the form of a parabola.

Anne Marie needs to reinforce the bridge by placing 2 additional vertical supports 4 m from the centre of the bridge. She knows the following about the structure of the bridge.

- The width of the arch at water level is 32 m.
- The height of the bridge is 20 m.
- The roadway is 2 m above the highest point of the arch.

How long do they need to be?



Try this on your own...

Hint:

Draw a diagram

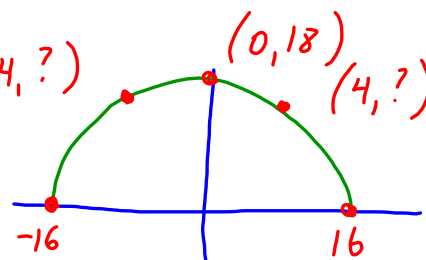
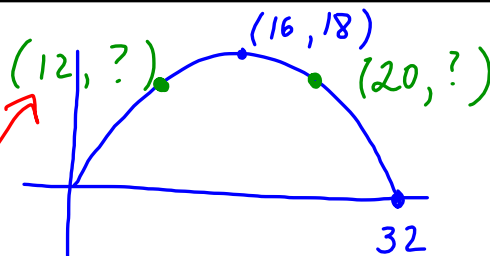
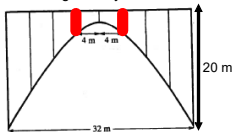
4. Construction Engineer

Anne Marie is a construction engineer. A bridge over a river has an arch in the form of a parabola.

Anne Marie needs to reinforce the bridge by placing 2 additional vertical supports 4 m from the centre of the bridge. She knows the following about the structure of the bridge.

- The width of the arch at water level is 32 m.
- The height of the bridge is 20 m.
- The roadway is 2 m above the highest point of the arch.

How long do they need to be?



$$a = \frac{-9}{128}$$

$$y = \frac{135}{8}$$

$$\text{length} = 20 - \frac{135}{8} = 3.125 \text{ m}$$

Try On Your Own #1

MCR3U - 3.7 Family of Quadratics

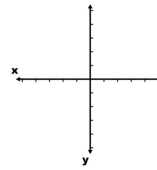
Name _____

Try On Your Own

1. Given $x = \sqrt{5}$ and $x = -3\sqrt{5}$ are the roots of a quadratic function and the graph passes through the point $(-5\sqrt{5}, 180)$.

a. determine the equation of the quadratic function

b. write the equation in standard form.



Try On Your Own #1 - Solution

Given $x = \sqrt{5}$ and $x = -3\sqrt{5}$ are the roots of a quadratic function and the graph passes through the point $(-5\sqrt{5}, 180)$.

a. determine the equation of the quadratic function

b. write the equation in standard form.

$$f(x) = a(x-r)(x-s)$$

$$f(x) = a(x - \sqrt{5})(x + 3\sqrt{5})$$

$$180 = a(-5\sqrt{5} - \sqrt{5})(-5\sqrt{5} + 3\sqrt{5})$$

$$180 = a(-6\sqrt{5})(-2\sqrt{5})$$

$$180 = a(12 \cdot 5)$$

$$180 = a(60)$$

b. write the equation in standard form.

$$3 = a$$

b. write the equation in standard form.

$$f(x) = 3[(x - \sqrt{5})(x + 3\sqrt{5})]$$

$$f(x) = 3[x^2 + 3\sqrt{5}x - \sqrt{5}x - 3 \cdot 5]$$

$$f(x) = 3[x^2 + 2\sqrt{5}x - 15]$$

$$f(x) = 3x^2 + 6\sqrt{5}x - 45$$

Try On Your Own #2

pg 192 # 4ac, 5ac, 6, 10, 14,

4. Determine the equation of the parabola with x -intercepts
 - a) -4 and 3 , and that passes through $(2, 7)$
 - b) 0 and 8 , and that passes through $(-3, -6)$
 - c) $\sqrt{7}$ and $-\sqrt{7}$, and that passes through $(-5, 3)$
 - d) $1 - \sqrt{2}$ and $1 + \sqrt{2}$, and that passes through $(2, 4)$
5. Determine the equation of the parabola with vertex
 - a) $(-2, 5)$ and that passes through $(4, -8)$
 - b) $(1, 6)$ and that passes through $(0, -7)$
 - c) $(4, -5)$ and that passes through $(-1, -3)$
 - d) $(4, 0)$ and that passes through $(11, 8)$
6. Determine the equation of the quadratic function
 $f(x) = ax^2 - 6x - 7$ if $f(2) = 3$.
10. A tunnel with a parabolic arch is 12 m wide. If the height of the arch 4 m from the left edge is 6 m, can a truck that is 5 m tall and 3.5 m wide pass through the tunnel? Justify your decision.
14. What is the equation of the parabola at the right if the point $(-4, -9)$ is on the graph?

Try On Your Own #2 - Answers

4. a) $f(x) = -\frac{7}{6}(x+4)(x-3)$ c) $f(x) = \frac{1}{6}(x^2 - 7)$
 b) $f(x) = -\frac{6}{33}x(x-8)$ d) $f(x) = -4(x^2 - 2x - 1)$
5. a) $f(x) = -\frac{13}{36}(x+2)^2 + 5$ c) $f(x) = \frac{2}{25}(x-4)^2 - 5$
 b) $f(x) = -13(x-1)^2 + 6$ d) $f(x) = \frac{8}{49}(x-4)^2$
6. $f(x) = 5.5x^2 - 6x - 7$
10. $f(x) = -\frac{3}{16}x(x-12)$ Yes, because at a height of 5 m the bridge is 6.11 m wide.
14. $f(x) = -3(x+3)(x+1)$ or $f(x) = -3x^2 - 12x - 9$