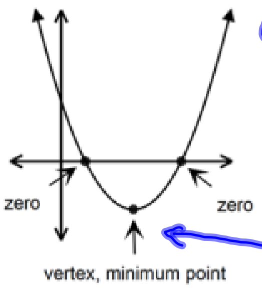
**Section:** 7.3

**Objective:** Find the zeros of quadratic functions and the $x$-intercepts of their graphs

***Zeros of a Function:*** The **values** of $x$ that make $f(x)$ or $y$ equal zero. If the zeros are **real**, they tell you the places where the graph **crosses the** $x$**-axis**, or the ***x-intercepts*** of the graph.

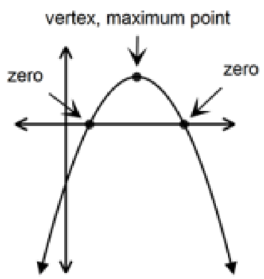
**Other words for zeros:** ***solutions to*** $f(x)=0$, ***roots, x-intercepts.***

$a > 0$




a is positive
opens up
min

$a < 0$

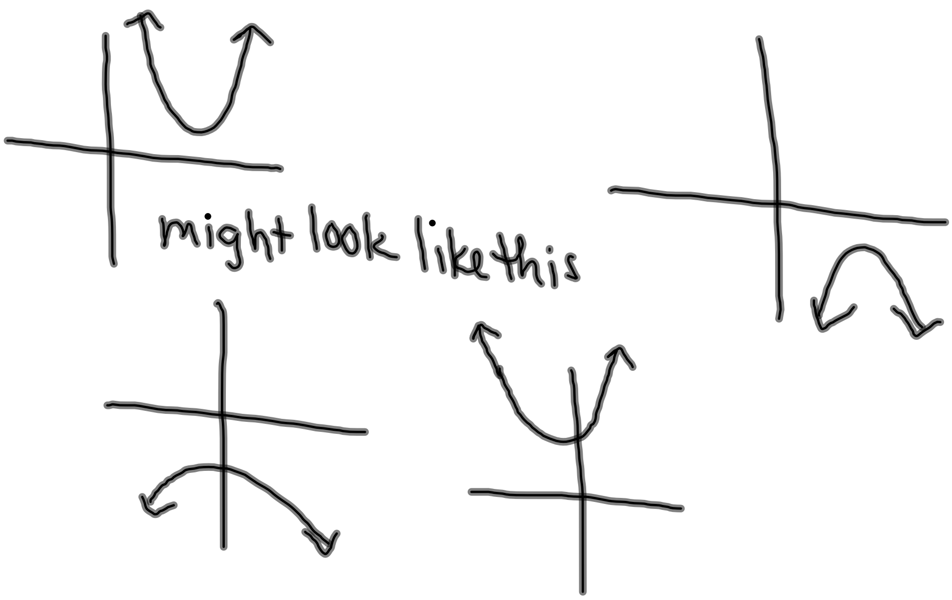



a is negative
opens down
max

**Finding zeros and $x$-intercepts:**

1. Change $y$ or $f(x)$ to 0.
2. Solve for $x$.
   - If the equation is **in factored form**, solving for $x$ is easy – just think "What would $x$ have to be to make each set of parentheses equal to 0?"
   - If the equation is **in standard form**, solve by factoring or by using quadratic formula
   - If the equation is **in vertex form**, get the perfect square by itself, take the square root of both sides (don't forget the $\pm$), then solve for $x$.

★ **If your answers are imaginary** (negative under the square root), **the graph doesn't have $x$-intercepts.**



For each function, do the following: 1) state whether the function is in **standard**, **vertex**, or **factored** form, 2) state whether the parabola opens **up** or **down**, 3) find the **zeros** ($x$-values), 4) state the **$x$-intercepts** as ordered pairs.

A. $f(x)=(x+7)(x-1)$

$a=1$ $p=-7$ $q=1$

1) Form: factored

2) Direction of opening: up

3) Zeros: $-7, 1$

4) $x$-intercepts: $(-7,0)$ $(1,0)$

Show work here:

$0=(x+7)(x-1)$

$x+7=0$ $x-1=0$

$x=-7$ $x=1$

B. $y=-4x^2+2x$

$a=-4$
$b=2$
$c=0$

1) Form: Standard

2) Direction of opening: down

3) Zeros: $0 ; \frac{1}{2}$

4) $x$-intercepts: $(0,0)$ $(\frac{1}{2},0)$

Show work here:

$0=-4x^2+2x$

GCF $0=-2(2x^2-1x)$

$0=-2x(2x-1)$

$0=-2x$ $0=2x-1$

$\frac{0}{-2}=\frac{-2x}{-2}$ $+1$ $+1$

$\boxed{0=x}$ $1=2x$

$\frac{1}{2}=\frac{2x}{2}$

$\boxed{\frac{1}{2}=x}$

C. $y=-3(x+5)^2+27$

a: -3 h: -5 k: 27

1) Form: vertex

2) Direction of opening: down

3) Zeros: -2, -8

4) $x$-intercepts: (-2,0) (-8,0)

Show work here:

$0=-3(x+5)^2+27$

$\frac{-27}{-3}=\frac{\cancel{-3}(x+5)^2}{\cancel{-3}}$ sub 27 $\div -3$

$9=(x+5)^2$

$\pm\sqrt{9}=\sqrt{(x+5)(x+5)}$ take sq root

$\pm 3 = x+5$
$-5 \quad -5$

$3-5=x \quad x=-2$
$-3-5=x \quad x=-8$

D. $f(x)=5x^2-20$

1) Form: Standard or vertex

2) Direction of opening: up

3) Zeros: 2, -2

4) $x$-intercepts: (2,0) (-2,0)

Show work here:

$0=5x^2-20$

GCF $0=5(x^2-4)$

$0=5(x-2)(x+2)$

$x-2=0 \quad x+2=0$
$+2+2 \quad -2-2$

$\boxed{x=2 \quad x=-2}$

E. $y = x^2 - 16x + 48$

$a = 1 \quad b = -16 \quad c = 48$

1) Form: Standard

2) Direction of opening: up

3) Zeros: 4, 12

4) $x$-intercepts: (4,0) (12,0)

Show work here:

$$0 = x^2 - 16x + 48$$

-·- Add

| 48 | -16 |
|---|---|
| -1·-48 | |
| -2·-24 | |
| -3·-16 | |
| -4·-12 | |
| -6·-8 | |

| | $x$ | $-4$ |
|---|---|---|
| $x$ | $x^2$ | $-4x$ |
| $-12$ | $-12x$ | $48$ |

$$(x-4)(x-12) = 0$$

$$x - 4 = 0 \qquad x - 12 = 0$$

$$+4 \ +4 \qquad +12 \ +12$$

$$\boxed{x = 4} \qquad \boxed{x = 12}$$

F. $f(x) = 2(x-2)^2 + 8$

$a = 2 \quad h = 2 \quad k = 8$

1) Form: vertex

2) Direction of opening: up

3) Zeros: $2 + 2i$ ; $2 - 2i$ or $2 \pm 2i$

4) $x$-intercepts: none

Show work here:

$$0 = 2(x-2)^2 + 8$$

$$-8 \qquad\qquad -8$$

$$\frac{-8}{2} = \frac{\cancel{2}(x-2)^2}{\cancel{2}}$$

$$-4 = (x-2)^2$$

$$\sqrt{-4} = \sqrt{(x-2)(x-2)}$$

$$i\sqrt{4} = x - 2$$

$$\pm 2i = x - 2$$

$$\boxed{2 \pm 2i = x}$$

G. $f(x) = -(x+3)^2 + 50$

$a=-1 \quad h=-3 \quad k=50$

1) Form: vertex

2) Direction of opening: down

3) Zeros: $-3 \pm 5\sqrt{2}$

4) $x$-intercepts: $(-3+5\sqrt{2}, 0)$ $(-3-5\sqrt{2}, 0)$

Show work here:

$0 = -(x+3)^2 + \cancel{50}$
$-50 \qquad\qquad \cancel{-50}$

$\frac{-50}{-1} = \frac{\cancel{-1}(x+3)^2}{\cancel{-1}}$

$50 = (x+3)^2$

$\pm\sqrt{50} = \sqrt{(x+3)(x+3)}$

$\pm\sqrt{10\cdot 5} = x+3$

$\pm\sqrt{2\cdot(5\cdot 5)}$

$\pm 5\sqrt{2} = x+3$
$\qquad\qquad -3$

$\boxed{-3 \pm 5\sqrt{2} = x}$

H. $y = -2x^2 + 4x - 10$

$a=-2 \quad b=4 \quad c=-10$

1) Form: Standard

2) Direction of opening: down

3) Zeros: $1 \pm 2i$

4) $x$-intercepts: none

Show work here:

$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$

$\frac{-4 \pm \sqrt{(4)^2-4(-2)(-10)}}{2(-2)}$

$\frac{-4 \pm \sqrt{-64}}{-4}$

$\frac{-4 \pm 8i}{-4}$

$\frac{\cancel{-4}(1 \pm 2i)}{\cancel{-4}}$

$\boxed{1 \pm 2i}$