

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

Find the initial value of a parabola with vertex  $V(3, 5)$  that passes through the point  $P(7, 1)$ .

$$\textcircled{1} \quad y = a(x-3)^2 + 5$$

$$-4 = 16a$$

$$-\frac{1}{4} = a$$

$$\textcircled{2} \quad f(x) = -\frac{1}{4}(x-3)^2 + 5$$

$$= -\frac{1}{4}(0-3)^2 + 5$$

$$y = 2.75$$

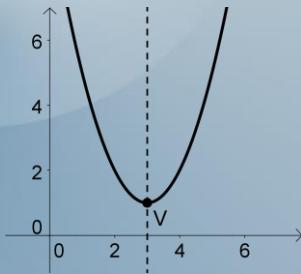
## Lesson 18

### Quadratic Functions – General Form

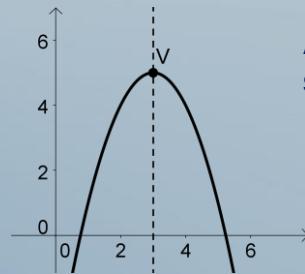
## Quadratic Function – General Form

**General Form:**  $f(x) = ax^2 + bx + c$

**Vertex:**  $V(h, k)$  from  $f(x) = a(x - h)^2 + k$



$$a > 0$$



**Axis of symmetry:**  
 $x = h$

## Quadratic Function – General Form

**General Form:**  $f(x) = ax^2 + bx + c$

**Vertex:**  $V(h, k)$  from  $f(x) = a(x - h)^2 + k$

We deduce the vertex:

$$h = -\frac{b}{2a} \quad k = \frac{4ac - b^2}{4a} \quad \therefore V\left(-\frac{b}{2a}, \frac{4ac - b^2}{4a}\right)$$

$$\text{Axis of symmetry: } x = -\frac{b}{2a}$$

## Quadratic Function – General Form

**Ex 1:** Find the coordinates of the vertex and the equation of the axis of symmetry of the following parabola:  $f(x) = -x^2 + 4x - 3$

$$a = -1 \quad b = 4 \quad c = -3$$

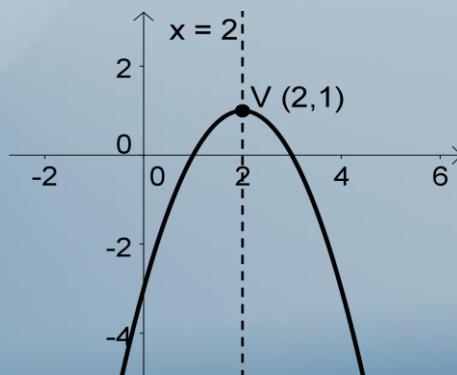
$$h = -\frac{b}{2a} = -\frac{4}{2(-1)} = -\frac{4}{-2} = 2$$

$$k = \frac{4ac - b^2}{4a} = \frac{4(-1)(-3) - (4)^2}{4(-1)} = \frac{12 - 16}{-4} = \frac{-4}{-4} = 1$$

$$\therefore V(2,1) \text{ and } x = 2$$

## Quadratic Function – General Form

**Ex 1:** Find the coordinates of the vertex and the equation of the axis of symmetry of the following parabola:  $f(x) = -x^2 + 4x - 3$



## Quadratic Function – General Form

Finding the zero(s) of the Quadratic functions:

Starting with  $f(x) = ax^2 + bx + c$

- 1) By factoring:

**Ex 1:** Find the zeros of:  $f(x) = -x^2 + 4x - 3$

$$\begin{aligned} -x^2 + 4x - 3 &= 0 \Rightarrow x^2 - 4x + 3 = 0 \\ (x^2 - x) + (3x + 3) &= 0 \\ x(x - 1) + 3(x - 1) &= 0 \\ (x - 1)(x - 3) &= 0 \end{aligned}$$

## Quadratic Function – General Form

Finding the zero(s) of the Quadratic functions:

Starting with  $f(x) = ax^2 + bx + c$

- 1) By factoring:

**Ex 1:** Find the zeros of:  $f(x) = -x^2 + 4x - 3$

**Case 1:**

$$x - 1 = 0$$

$$\therefore x = 1$$

**Case 2:**

$$x - 3 = 0$$

$$\therefore x = 3$$

$\therefore$  the zeros are: 1 and 3 or (1,0) and (3,0) or {1,3}

## Quadratic Function – General Form

Finding the zero(s) of the Quadratic functions:

Starting with  $f(x) = ax^2 + bx + c$

2) By using the formula:  $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

**Ex 1:** Find the zeros of:  $f(x) = -x^2 + 4x - 3$

$$a = -1 \quad b = 4 \quad c = -3$$

$$x_1 = \frac{-b + \sqrt{b^2 - 4ac}}{2a} = \frac{-4 + \sqrt{4^2 - 4(-1)(-3)}}{2(-1)} = \frac{-4 + \sqrt{4}}{-2} = 1$$

$$x_2 = \frac{-b - \sqrt{b^2 - 4ac}}{2a} = \frac{-4 - \sqrt{4^2 - 4(-1)(-3)}}{2(-1)} = \frac{-4 - \sqrt{4}}{-2} = 3$$

## Quadratic Function – General Form

Finding the zero(s) of the Quadratic functions:

**Case 1:** if  $b^2 - 4ac > 0$  - there are two zeros

**Ex**  $f(x) = x^2 - 6x + 8$

$$\begin{aligned} b^2 - 4ac \\ = (-6)^2 - 4(1)(8) \\ = 36 - 32 = 4 > 0 \end{aligned}$$



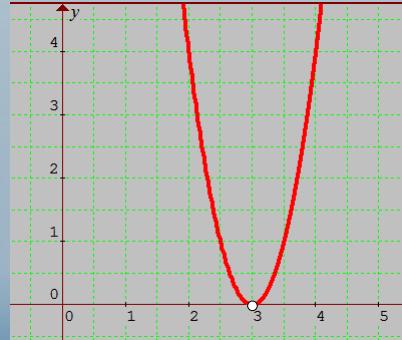
## Quadratic Function – General Form

Finding the zero(s) of the Quadratic functions:

Case 2: if  $b^2 - 4ac = 0$  - there is one zero

**Ex**  $f(x) = x^2 - 6x + 9$

$$\begin{aligned} b^2 - 4ac \\ &= (-6)^2 - 4(1)(9) \\ &= 36 - 36 = 0 \end{aligned}$$



## Quadratic Function – General Form

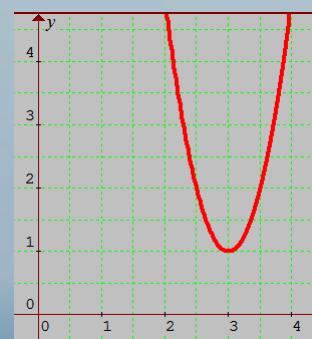
Finding the zero(s) of the Quadratic functions:

Case 3: if  $b^2 - 4ac < 0$  - there are no zeros

**Ex**  $f(x) = x^2 - 6x + 10$

$$\begin{aligned} b^2 - 4ac \\ &= (-6)^2 - 4(1)(10) \\ &= 36 - 40 = -4 < 0 \end{aligned}$$

Since we cannot square root a negative!



# Homework

## Workbook

P. 101 #1

P. 102 #2

P. 103 #3

P. 104 #4-13