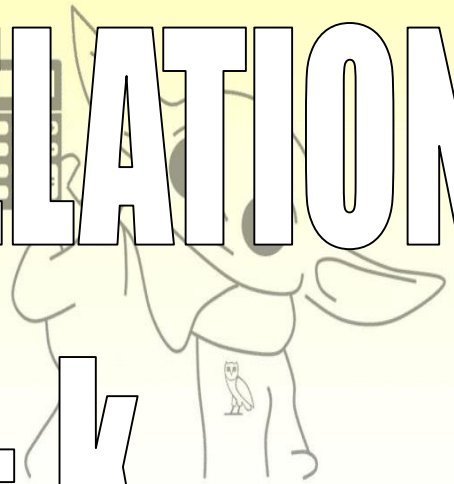
# ST. JEAN DE BREBEUF MATHEMATICS

# CHAPTER 4.4 (PART 2)

# THE QUADRATIC RELATION

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



# CHAPTER 4.4 (PART 2) THE QUADRATIC RELATION $y = a(x - h)^2 + k$

## *KEY CONCEPTS*

To determine the *equation* for a quadratic relation from a graph, use the **vertex** and **another point** to **solve for *a***. Then, write the relation using the **vertex** and the **value of *a***.

# CHAPTER 4.4 (PART 2) THE QUADRATIC RELATION $y = a(x - h)^2 + k$

***EXAMPLE 1***

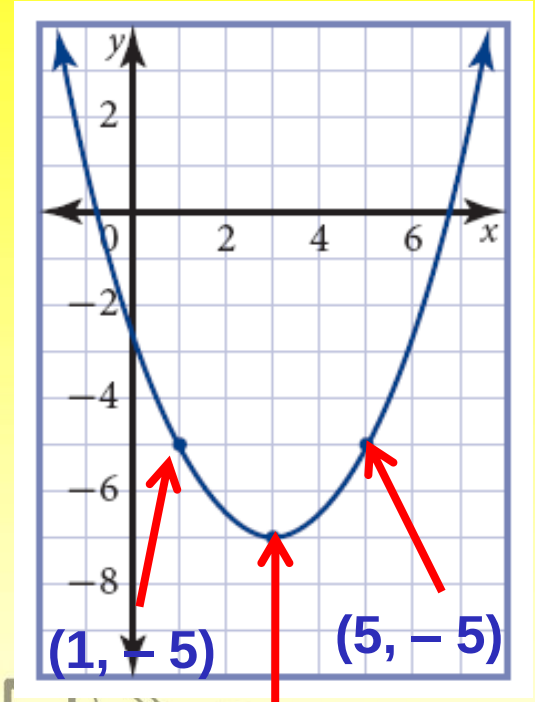
Consider the parabola pictured.

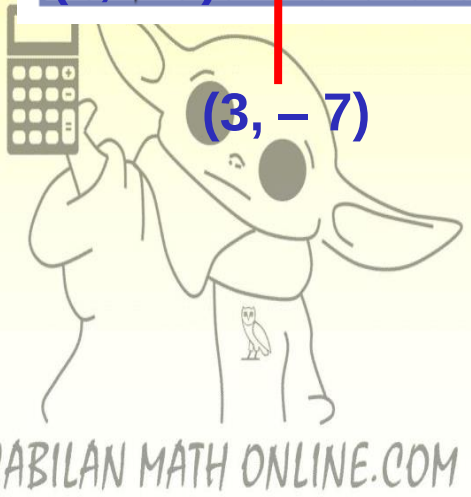
(a) Find the co-ordinates of the **vertex (h, k)**

( **3** , **– 7** )
h k

(b) Determine the co-ordinates of the other two points

( **1** , **– 5** ) and ( **5** , **– 5** )



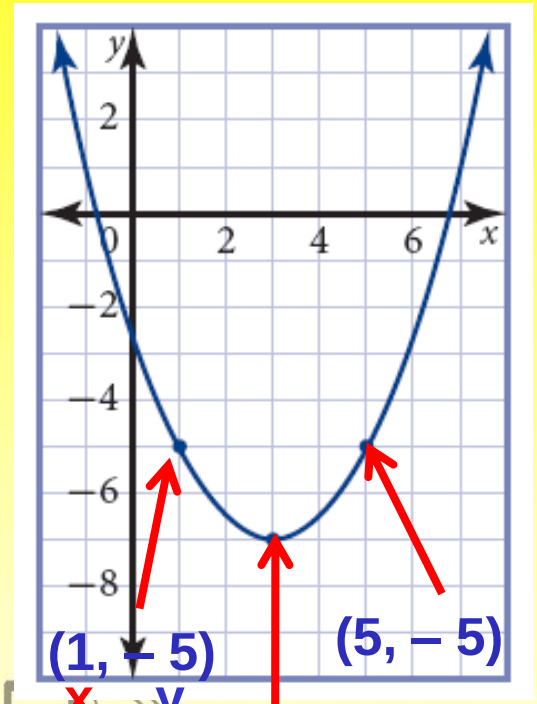



# CHAPTER 4.4 (PART 2) THE QUADRATIC RELATION $y = a(x-h)^2 + k$

***EXAMPLE 1***

Consider the parabola pictured.

(c) Write the **equation** of the parabola (see steps)




**STEPS**

1. Write down the equation **y = a(x – h)² + k**
2. Substitute the co-ordinates of the vertex for **h** and **k**
3. Substitute the co-ordinates of *any other point* on the parabola
4. Solve for **a**
5. Substitute **a** into the equation. This is the equation of the parabola.

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

$$y = a(x-3)^2 + (-7)$$

$$y = a(x-3)^2 - 7$$

$$-5 = a(1-3)^2 - 7$$

$$-5 = a(-2)^2 - 7$$

$$-5 = 4a - 7$$

$$-5 + 7 = 4a$$

$$\frac{2}{4} = \frac{4a}{4}$$

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

The equation is

$$y = \frac{1}{2}(x-3)^2 - 7$$

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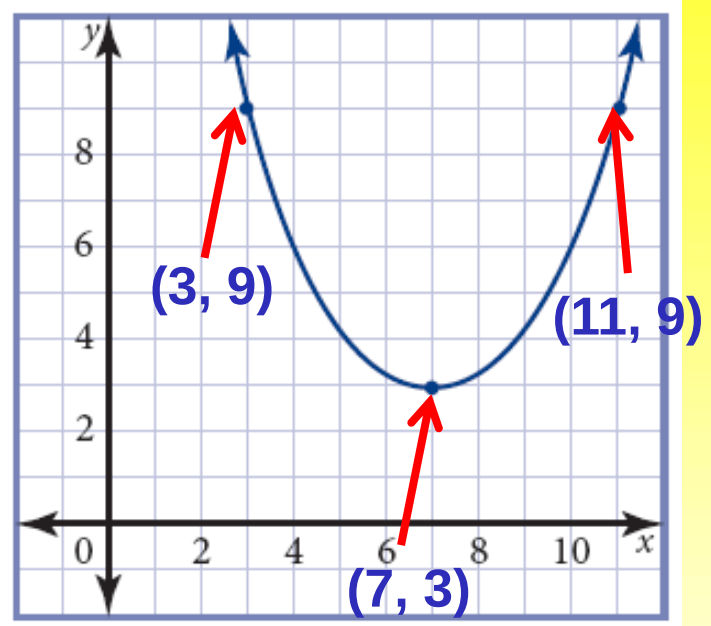
# CHAPTER 4.4 (PART 2) THE QUADRATIC RELATION $y = a(x - h)^2 + k$

***EXAMPLE 2 (page 13 #4b)***




Consider the parabola pictured.

(a) Find the co-ordinates of the **vertex (h, k)**

( **7** , **3** )
h k

(b) Determine the co-ordinates of the other two points

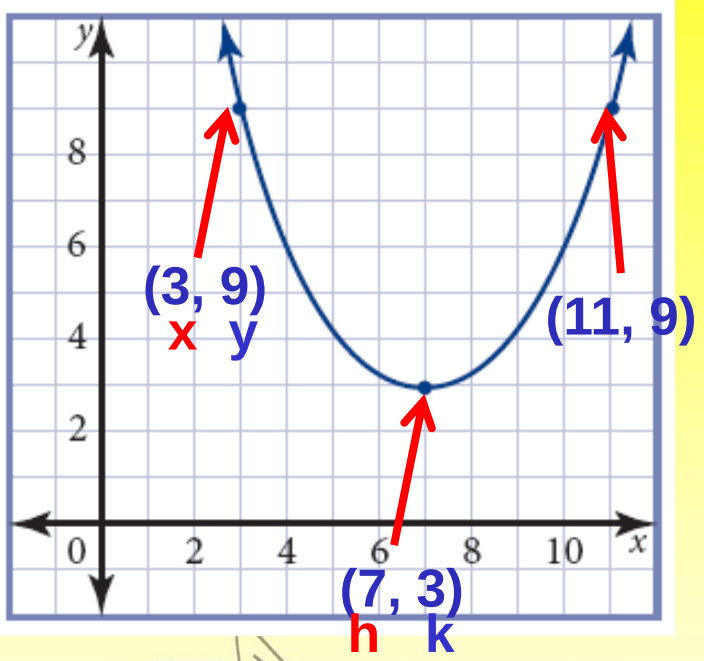
( **3** , **9** ) and ( **11** , **9** )

# CHAPTER 4.4 (PART 2) THE QUADRATIC RELATION $y = a(x-h)^2 + k$

***EXAMPLE 2 (page 13 #4b)***

Consider the parabola pictured.

(c) Write the **equation** of the parabola (see steps)




**STEPS**

1. Write down the equation **y = a(x – h)² + k**
2. Substitute the co-ordinates of the vertex for **h** and **k**
3. Substitute the co-ordinates of *any other point* on the parabola
4. Solve for **a**
5. Substitute **a** into the equation. This is the equation of the parabola.

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

$$y = a(x-7)^2 + 3$$

$$9 = a(3-7)^2 + 3$$

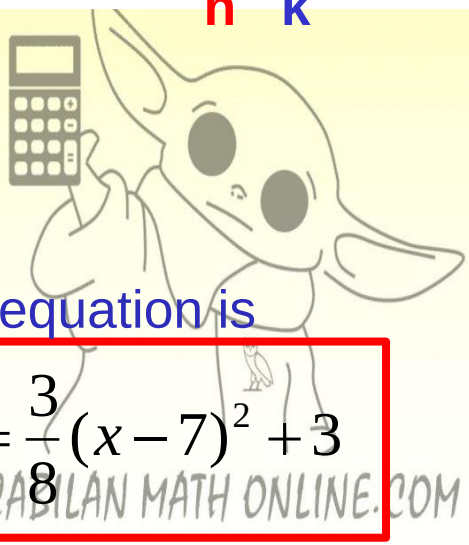
$$9 = a(-4)^2 + 3$$

$$9 = 16a + 3$$

$$9 - 3 = 16a$$

$$\frac{6}{16} = \frac{16a}{16}$$

$$\frac{3}{8} = a$$



The equation is

$$y = \frac{3}{8}(x-7)^2 + 3$$

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# CHAPTER 4.4 (PART 2) THE QUADRATIC RELATION $y = a(x - h)^2 + k$

***EXAMPLE 3*** *Application*

A ninja star was thrown on top of a building and its path can be modelled by the relation $\mathbf{h = -0.5(t - 9)^2 + 50}$, where **h** represents the height of the ninja star in *metres* and **t** represents the time travelled, in *seconds*.

(a) What is the **vertex** of this parabola? What does it represent?

The vertex is **(9, 50)**

→ Represents that the ninja star will reach a maximum height of **50 metres** after **9 seconds**

# CHAPTER 4.4 (PART 2) THE QUADRATIC RELATION $y = a(x - h)^2 + k$

***EXAMPLE 3*** *Application*

A ninja star was thrown on top of a building and its path can be modelled by the relation **$h = -0.5(t - 9)^2 + 50$**, where **h** represents the height of the ninja star in *metres* and **t** represents the time travelled, in *seconds*.

(b) What is the **height** of the ninja star *before* it was thrown?

We need to find the height of the ninja star at **t =** **0**

→Substitute into the relation

$$h = -0.5(t - 9)^2 + 50$$
$$= -0.5(0 - 9)^2 + 50$$
$$= -0.5(-9)^2 + 50$$
$$= \mathbf{9.5}$$

The ninja star was at a height of **9.5 metres** before it was thrown

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# CHAPTER 4.4 (PART 2) THE QUADRATIC RELATION $y = a(x - h)^2 + k$

***EXAMPLE 3*** *Application*

A ninja star was thrown on top of a building and its path can be modelled by the relation **$h = -0.5(t - 9)^2 + 50$**, where **h** represents the height of the ninja star in *metres* and **t** represents the time travelled, in *seconds*.

* (c) **How many seconds** does it take for the ninja star to hit the ground?

To find out how many seconds it takes for the ninja star to touch the ground, we let **h =** **0**

→Substitute into the relation

$$h = -0.5(t-9)^2 + 50$$

$$0 = -0.5(t-9)^2 + 50$$

$$\frac{-50}{-0.5} = \frac{-0.5(t-9)^2}{-0.5}$$

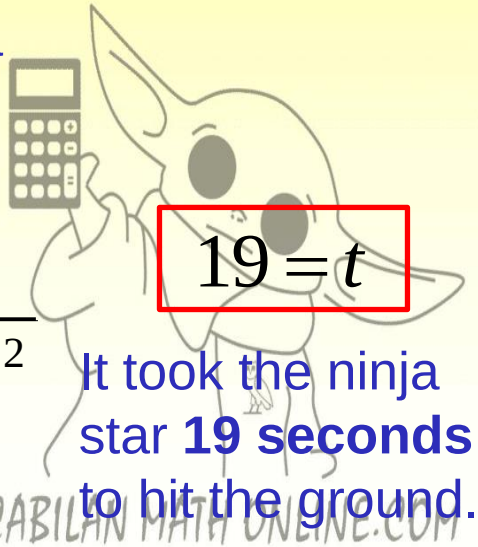
$$100 = (t-9)^2$$

$$\sqrt{100} = \sqrt{(t-9)^2}$$

$$10 = t - 9$$

$$10 + 9 = t$$

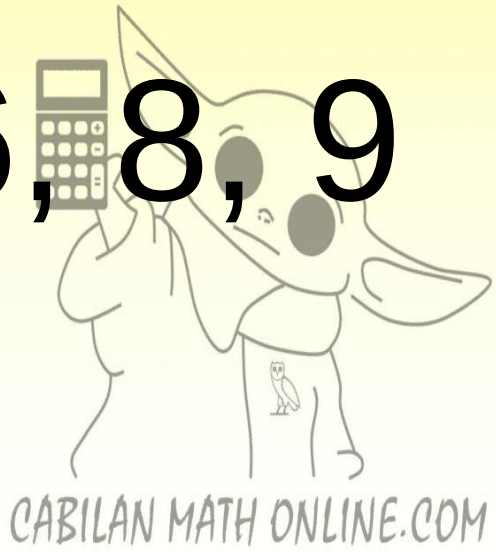
$$19 = t$$




It took the ninja star **19 seconds** to hit the ground.

# CHAPTER 4.4 (PART 2) THE QUADRATIC RELATION $y = a(x - h)^2 + k$

## Homework

Page 213 – 216

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