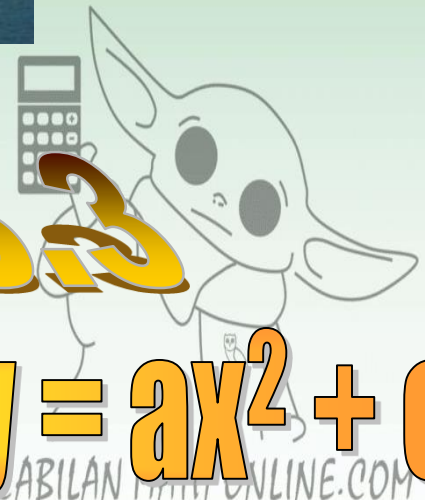


ST. JEAN DE BREBEUF MATHEMATICS



CHAPTER 8

THE QUADRATIC RELATION $y = ax^2 + c$



CHAPTER 8.3 THE QUADRATIC RELATION $y = ax^2 + c$

KEY CONCEPTS

For a quadratic relation of the form $y = ax^2 + c$, the *maximum* or *minimum* value occurs at c , which is the **y-intercept**.

When a is positive, the parabola **opens up** and has a **minimum**

When a is negative, the parabola **opens down** and has a **maximum**



CHAPTER 8.3 THE QUADRATIC RELATION $y = ax^2 + c$

EXAMPLE 1 Finding the Maximum or Minimum

For each relation, identify the following:

- The **a** value
- The **direction** of the opening of the parabola
- **Maximum** or **minimum** and its **value**

RELATION	VALUE OF "a"	DIRECTION OF OPENING	MAXIMUM OR MINIMUM? VALUE
$y = 5x^2$	$a = 5$	a is <u>positive</u> → Parabola <u>opens up</u>	Parabola <u>opens up</u> → <u>Minimum</u> value of 0
$y = x^2 - 16$	$a = 1$	a is <u>positive</u> → Parabola <u>opens up</u>	Parabola <u>opens up</u> → <u>Minimum</u> value of -16
$y = -3x^2 + 27$	$a = -3$	a is <u>negative</u> → Parabola <u>opens down</u>	Parabola <u>opens down</u> → <u>Maximum</u> value

CHAPTER 8.3 THE QUADRATIC RELATION $y = ax^2 + c$

EXAMPLE 2 Finding the Zeros of a Quadratic Relation

Without graphing, find the **zeros** of the following relations. Be sure to **factor** first!!!

Recall: When finding zeros, let $y = 0$ and solve for x

(a) $y = x^2 - 25$

$$0 = x^2 - 25$$

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

$$\sqrt{x^2} = \underline{x}$$

$$\sqrt{25} = \underline{5}$$

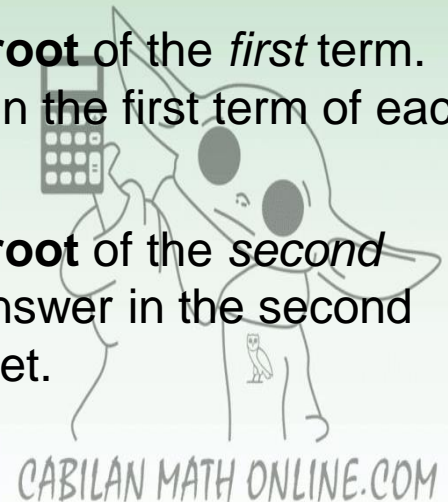
Factor by **difference of squares**

*Write down two sets of brackets

* Place a “+” in the first bracket and “-” in the second bracket.

*Take the **square root** of the *first* term. Place this answer in the first term of each bracket.

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$$0 = x^2 - 25$$

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

1st zero

2nd zero

$$\begin{aligned} 0 &= x + 5 \\ -5 &= x \end{aligned}$$

$$\begin{aligned} 0 &= x - 5 \\ 5 &= x \end{aligned}$$

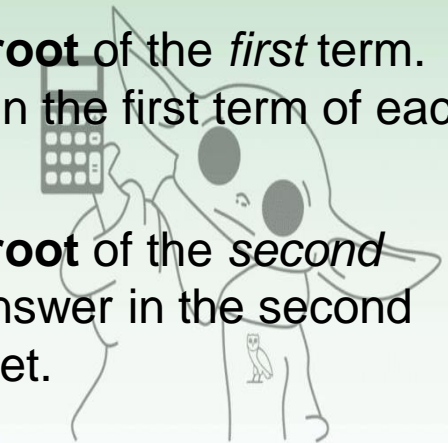
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CHAPTER 8.3 THE QUADRATIC RELATION $y = ax^2 + c$

EXAMPLE 2 Finding the Zeros of a Quadratic Relation

Without graphing, find the **zeros** of the following relations. Be sure to **factor** first!!!

Recall: When finding zeros, let $y = 0$ and solve for x

(b) $y = x^2 - 16$

$0 = x^2 - 16$

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

$\sqrt{x^2} = \underline{\quad x \quad}$

$\sqrt{16} = \underline{\quad 4 \quad}$

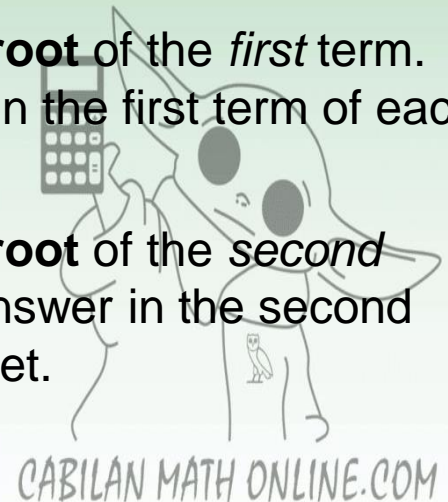
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CHAPTER 8.3 THE QUADRATIC RELATION $y = ax^2 + c$

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Recall: When finding zeros, let $y = 0$ and solve for x

(b) $y = x^2 - 16$

$$0 = x^2 - 16$$

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

1st zero

2nd zero

$$\begin{aligned} 0 &= x + 4 \\ -4 &= x \end{aligned}$$

$$\begin{aligned} 0 &= x - 4 \\ 4 &= x \end{aligned}$$

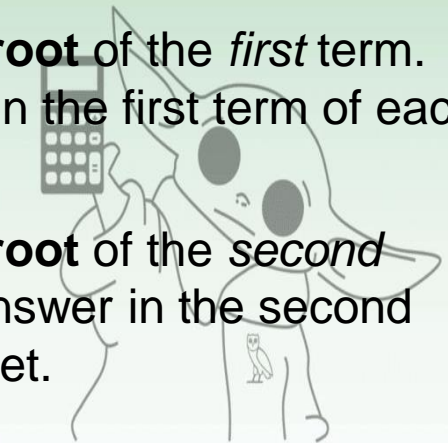
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CHAPTER 8.3 THE QUADRATIC RELATION $y = ax^2 + c$

EXAMPLE 2 Finding the Zeros of a Quadratic Relation

Without graphing, find the **zeros** of the following relations. Be sure to **factor** first!!!

Recall: When finding zeros, let $y = 0$ and solve for x

(c) $y = 25x^2 - 225$

$0 = 25x^2 - 225$

$0 = (5x + 15)(5x - 15)$

$\sqrt{25x^2} = \underline{5x}$

$\sqrt{225} = \underline{15}$

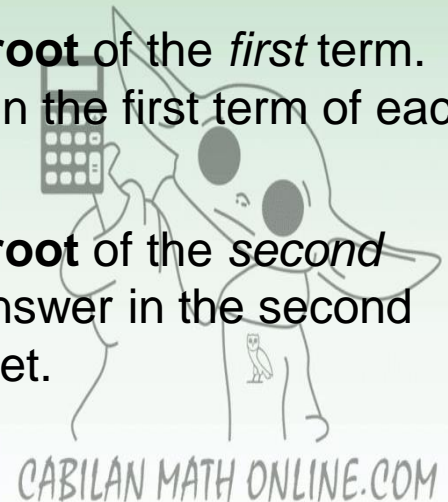
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CHAPTER 8.3 THE QUADRATIC RELATION $y = ax^2 + c$

EXAMPLE 2 Finding the Zeros of a Quadratic Relation

Without graphing, find the **zeros** of the following relations. Be sure to **factor** first!!!

Recall: When finding zeros, let $y = 0$ and solve for x

(c) $y = 25x^2 - 225$

$$0 = 25x^2 - 225$$

$$0 = (5x + 15)(5x - 15)$$

1st zero

$$0 = 5x + 15$$

$$\frac{-15}{5} = \frac{5x}{5}$$

$$\boxed{-3 = x}$$

2nd zero

$$0 = 5x - 15$$

$$\frac{15}{5} = \frac{5x}{5}$$

$$\boxed{3 = x}$$

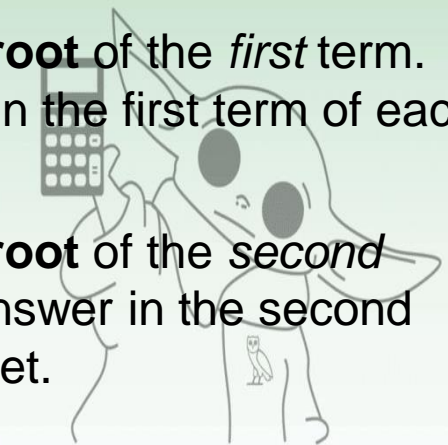
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CHAPTER 8.3 THE QUADRATIC RELATION $y = ax^2 + c$

EXAMPLE 3 Finding the Equation of a Quadratic Relation

The graph of the quadratic relation $y = ax^2 + 5$ passes through the point (2, 21). Find the value of a and the **equation** for this quadratic relation.

Substitute the point (2, 21) into the relation for x and y

$$y = ax^2 + 5$$

$$21 = a(2)^2 + 5$$

$$21 = 4a + 5$$

$$21 - 5 = 4a$$

$$\frac{16}{4} = \frac{4a}{4}$$

For the equation

→ Substitute $a = 4$ into the relation

$$y = ax^2 + 5$$

$$y = 4x^2 + 5$$

$$4 = a$$



END OF DAY 1

CHAPTER 8.3 THE QUADRATIC RELATION $y = ax^2 + c$

EXAMPLE 4 Application: Hitting a Golf Ball



Cheetah hits a golf ball from the top of a mountain. The path of the ball can be represented by the relation $h = -5t^2 + 245$ where h represents the **height** of the ball in *metres* and t represents the **time**, in *seconds*.

(a) From **what height** was the ball hit from?

Method 1:

Look at the **y-intercept** (or in this case, the **h-intercept**)

$$\rightarrow h = 245$$

The ball was hit from **245 metres** above the ground.

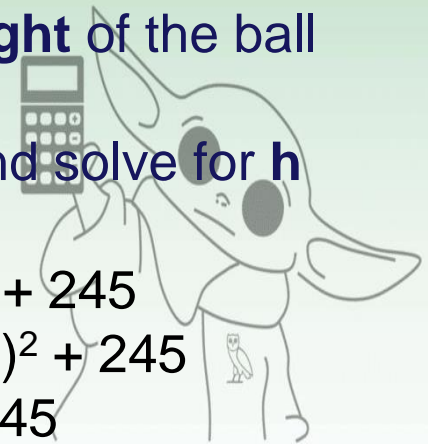
Method 2:

Solve for the **height** of the ball before it was hit

\rightarrow Let $t = \underline{0}$ and solve for h

$$\begin{aligned} h &= -5t^2 + 245 \\ &= -5(0)^2 + 245 \\ &= 0 + 245 \end{aligned}$$

$$= \boxed{245}$$



CHAPTER 8.3 THE QUADRATIC RELATION $y = ax^2 + c$

EXAMPLE 4 Application: Hitting a Golf Ball



Cheetah hits a golf ball from the top of a mountain. The path of the ball can be represented by the relation $h = -5t^2 + 245$, where h represents the **height** of the ball in *metres* and t represents the **time**, in *seconds*.

(b) **How many seconds** was the ball in the air before hitting the *ground*?

When the ball hits the ground, $h = \underline{\quad 0 \quad}$

$$h = -5t^2 + 245$$

$$0 = -5t^2 + 245$$

$$\frac{-245}{-5} = \frac{-5t^2}{-5}$$

$$49 = t^2$$

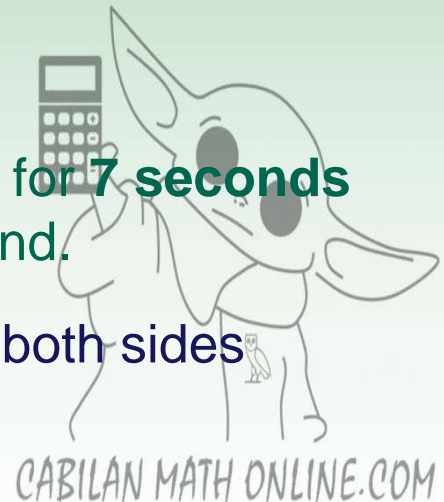
$$\sqrt{49} = \sqrt{t^2}$$

$$7 = t$$

Solve for t

The ball was in the air for **7 seconds** before hitting the ground.

Take the **square root** of both sides



CHAPTER 8.3 THE QUADRATIC RELATION $y = ax^2 + c$

Homework:

Page 341 – 343

(Day 1) #2a – d,
3a – d, 10

(Day 2) #4, 5, 7

