ST. JEAN DE BREBEUF MATHEMATICS

CHAPTER 8

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

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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 positive →Parabola **opens up**	Parabola **opens up** →Minimum value of **0**
$y = x^2 - 16$	a = 1	*a* is positive →Parabola **opens up**	Parabola **opens up** →Minimum value of **– 16**
$y = -3x^2 + 27$	a = – 3	*a* is negative →Parabola **opens down**	Parabola **opens down** →Maximum value of **27**

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) $y = x^2 - 25$

$0 = x^2 - 25$

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

$\sqrt{x^2} =$ x

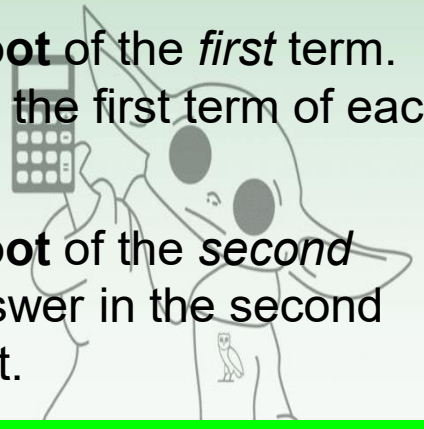
$\sqrt{25} =$ 5

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.

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



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$0 = x^2 - 25$

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

1st zero

$0 = x + 5$

$-5 = x$

2nd zero

$0 = x - 5$

$5 = x$

Factor by **difference of squares**
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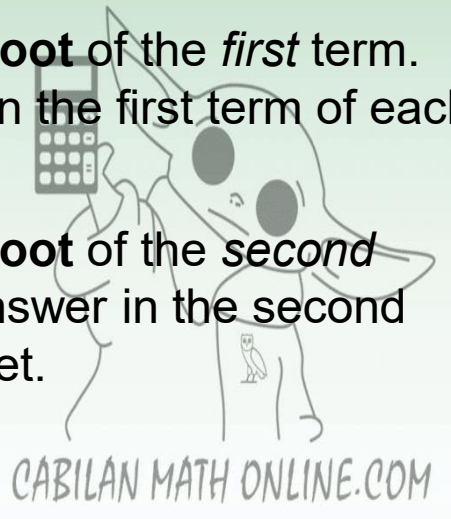

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EXAMPLE 2 *Finding the Zeros of a Quadratic Relation*

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) $y = x^2 - 16$

$0 = x^2 - 16$

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

$\sqrt{x^2} =$ x

$\sqrt{16} =$ 4

Factor by **difference of squares**
*Write down two sets of brackets

* Place a "**+**" in the first bracket and " **–** " in the second bracket.

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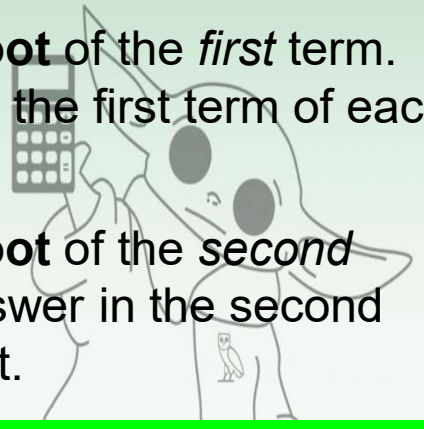

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$0 = x^2 - 16$

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

1st zero

$0 = x + 4$

$-4 = x$

2nd zero

$0 = x - 4$

$4 = x$

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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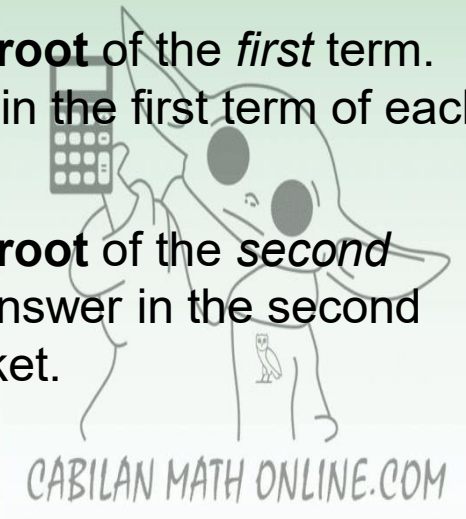


CHAPTER 8.3 THE QUADRATIC RELATION $y = ax^2 + c$

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) $y = 25x^2 - 225$

$0 = 25x^2 - 225$

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

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

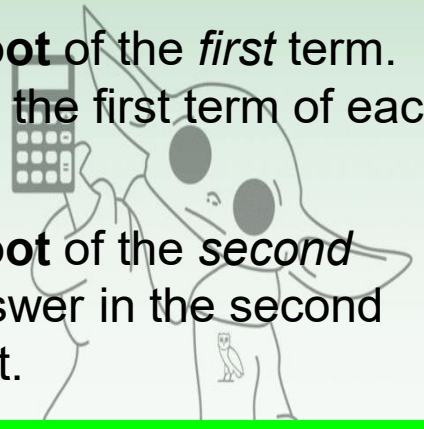
$\sqrt{225} = 15$

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.

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



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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

$0 = 5x + 15$

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

$-3 = x$

2nd zero

$0 = 5x - 15$

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

$3 = x$

Factor by **difference of squares**
*Write down two sets of brackets

* Place a "**+**" in the first bracket and " **–** " in the second bracket.

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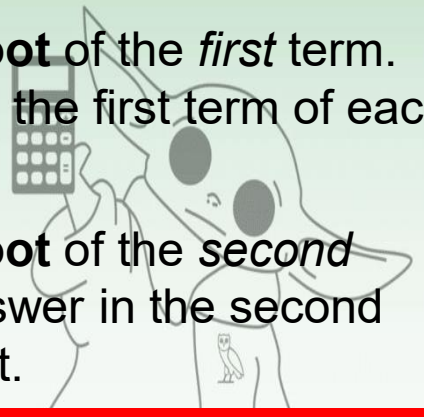


END OF DAY 1

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.

x y

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

$$y = ax^2 + 5$$

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

$$21 = 4a + 5$$

$$21 - 5 = 4a$$

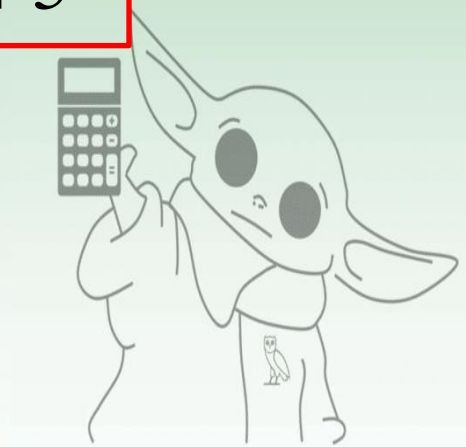
$$\frac{16}{4} = \frac{4a}{4}$$

$$4 = a$$

For the equation
→Substitute **a = 4** into the relation

$$y = ax^2 + 5$$

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



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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**)

→**h = 245**

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

Method 2:

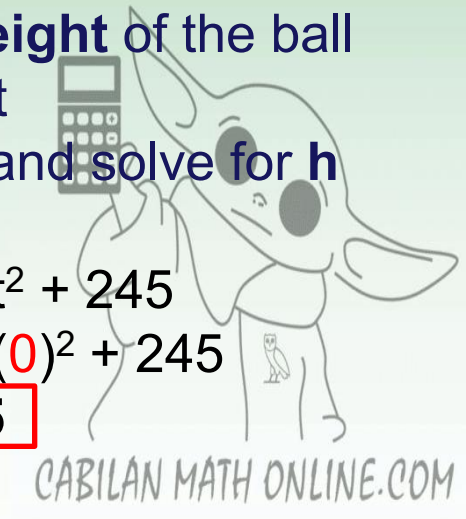
Solve for the **height** of the ball before it was hit

→Let **t =** **0** and solve for **h**

$h = -5t^2 + 245$

$= -5(0)^2 + 245$

$= 245$



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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 = 0

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

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

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

$$49 = t^2$$

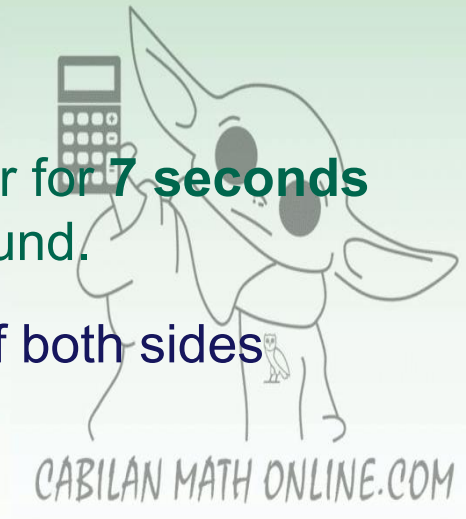
$$\sqrt{49} = \sqrt{t^2}$$

$$7 = t$$

Solve for **t**

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

Take the **square root** of both sides



ST. JEAN DE BREBEUF MATHEMATICS

CHAPTER 8.4

SOLVE PROBLEMS INVOLVING QUADRATIC RELATIONS

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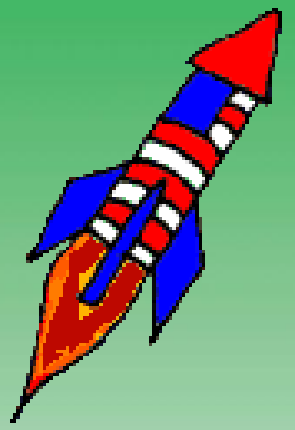
EXAMPLE *The Trajectory of a Model Rocket*



A model rocket is launched from a platform. The trajectory of the rocket can be modelled by the relation **$h = -5t^2 + 100t + 1$**, where ***h* is the height** of the model rocket in *metres* and ***t* is the time** in *seconds*.

(a) What is the **height** if the platform?

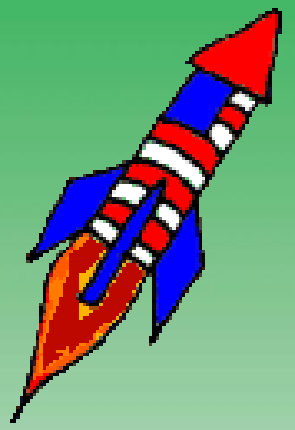
To solve for the height, we let t = 0 and solve for *h*

$$h = -5t^2 + 100t + 1$$
$$= -5(0)^2 + 100(0) + 1$$
$$= \mathbf{1\ metre}$$

The height of the platform is **1 metre**

CHAPTER 8.4 SOLVE PROBLEMS INVOLVING QUADRATIC RELATIONS

EXAMPLE *The Trajectory of a Model Rocket*



A model rocket is launched from a platform. The trajectory of the rocket can be modelled by the relation $\mathbf{h = -5t^2 + 100t + 1}$, where ***h* is the height** of the model rocket in *metres* and ***t* is the time** in *seconds*.

(b) What is the height of the rocket after **5 seconds**?

Substitute **t = 5** and solve for **h**

$h = -5t^2 + 100t + 1$

$= -5(5)^2 + 100(5) + 1$

$=$ **376 metres**

The rocket is **376 metres** in the air after 5 seconds.

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

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

FACTORING FLOW CHART

FIND **GREATEST COMMON FACTOR (GCF)** (if necessary)

- number, variable or combination of the two that divides evenly into each term

EXAMPLE

$2x^2 + 10x + 12$ GCF = 2

$= 2(x^2 + 5x + 6)$

TWO TERMS

DIFFERENCE OF SQUARES

$x^2 - c^2$

$(x + c)(x - c)$

EXAMPLE

$x^2 - 25$

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

THREE TERMS

USE "PRODUCT and SUM"

$x^2 + bx + c$

"c" is the **product**

"b" is the **sum**

*** Need to find two numbers that <u>multiply</u> to give you the **product**; *same* two numbers when <u>added</u> give you the **sum**

EXAMPLE

$x^2 + 5x + 6$ P = +6 S = +5

$= (x + 3)(x + 2)$

PREVIOUS

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