PGSS Principles of Mathematics 11

Unit 3: Quadratic Functions

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PGSS
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Chapter 3 Introduction (Investigating Math)

Learning Outcomes

- ✓ Graphically perform and algebraically identify horizontal and vertical translations, reflections, and dilatations on absolute value functions
- ✓ Describe the patterns of these transformations in terms of the changes that occur in the coordinates of the graph and coefficients of the equations
- ✓ Identify axes of symmetry, vertices, and directions of opening of absolute value functions

Homework Correction

(none)

Assessment

Homework Quiz

Warm-Up

1. Evaluate
   a. $|-5|$
   b. $1+|-3-5|$
   c. $2|-2|$
   d. $3|5-2|-20$
2. Evaluate each expression for $x=-10$.
   a. $|x|$
   b. $3|2x+5|$
   c. $|5-x|$
   d. $-|-3x|$

Activities

Introduction

Function (of numbers): a rule that assigns a number in one set to exactly one (and only one) number in another set. The first set is called the domain of the function and the second set is the range of the function.

Domain: the set of all of the possible numbers a function can be applied to

Range: the set of all of the numbers that a function attains

On the overhead graphing calculator have the graph of $y=4x-3$

How you could move the line over to the left or to the right?

Would the line have the same slope, or a different slope?

Find a way to translate (move) the graph of $y=4x-3$ *exactly 5 points to the right.*

Have the students try to write an equation for the line: $y=4(x-5)-3=4x-23$

The translated line that is 5 points to the right is described by $y=4x-23$

Now, simplify: $y=4(x-5)-3$

Say to the students: this is the same line, but written in a different way. Conclusion: if we want to translate a line to the right 5 points, we replace x by $x-5$. What about translations of any function?

Terminology

Axis of symmetry: the equation of the line that divides the graph into two symmetrical pieces.

Vertex: (visual)

Absolute value function:

The graph of $y = |x|$.

Translations (or, movin' points around)

(Graphing Calc) Describe what happens to the function $y = |x|$ if we replace x by $x + 3$.

So, $y = |x + 3|$ is the graph of $y = |x|$ translated to the left by 3 points.

Predict what would happen to the function $y = |x|$ if we replace y by $y + 3$.

How could you graph this function on your calculators?

Conclusion:

To move the function $\|x\|$:	
c points to the left	Replace x by $x + c$
c points to the right	Replace x by $x - c$
c points up	Replace y by $y - c$
c points down	Replace y by $y + c$

Dilatations (or, stretching points apart)

A dilatation

Describe what happens to the function $y = 3|x|$

Describe what happens to the function $y = \frac{1}{3}|x|$

Reflection

Describe the graph of $y = -|x|$.

Multiple Transformations

Describe the graph of $y = -3|x|$

Describe the graph of $y = -3|x + 2|$

Describe the graph of $y = -3|x + 2| + 1$

Assignment

Pg.102, 1: #6, 2: #5 (c,d) 3: #4 (c,d), 4: #7(c,d), 5:#4, 6:#6,8, 7: (a,g,m,s)

3.1 Graphing $y = x^2 + q,\ y = ax^2, y = ax^2 + q$

Learning Outcomes

- ✓ Graph equations of the form $y = x^2 + q, y = ax^2$, and $y = ax^2 + q$
- ✓ Describe the vertex, axis of symmetry, domain, range, maximum value, minimum value, and intercepts of equations of the form $y = x^2 + q, y = ax^2$, and $y = ax^2 + q$
- ✓ Write the equations of a parabola given its vertex and a point on its graph
- ✓ Solve problems involving equations of the form $y = x^2 + q, y = ax^2$, and $y = ax^2 + q$

Homework Correction

(none)

Homework Quiz

(none)

Warm-up

For each relation

a. Construct a table of values
b. Write the tables of values as a set of coordinate points
c. Graph the points in (b)
d. Name the intercepts of each relation
e. Find the value of y for $x = 1.5$
f. Find the value of x for $y = -2$

1. $y = 2x + 1$
2. $x + 2y - 3 = 0$

Activities

Assignment

p.109 #6,9,17,19,22,29,39,45,58,63,73(a)

core:{58,63, 73(a)}

3.5 Graphing $y = ax^2 + bx + c$ by completing the square $(a = 1)$

Learning Outcomes

- ✓ Rewrite quadratic equations in general form as quadratic equations in standard form
- ✓ Find the maximum or minimum values of quadratic functions by rewriting quadratic equations in general form as quadratic equations in standard form
- ✓ Find the vertices of quadratic functions by rewriting quadratic equations in general form as quadratic equations in standard form
- ✓ Solve problems involving quadratic functions given in general form by rewriting them as quadratic equations in standard form

Homework Correction

p.119 #7,10,14,19,23,25,28,36,59,65,68,70,79

core:{59,65,68}

Homework Quiz

One of: p.109 {58,63, 73(a)} and one of p.119 {59,65,68}

Warm-up

1. Expand the following expressions.
   a. $(x + 3)^2$
   b. $(2x - 5)^2$
2. Factor the following expressions.
   a. $x^2 + 2x - 3$
   b. $x^2 - 3x - 10$
   c. $4x^2 - 7x - 2$
3. The expression $x^2 - 4x + 4$ is a perfect square because $(x - 2)^2 = x^2 - 4x + 4$. Rewrite each expression as a perfect square.
   a. $x^2 - 2x + 1$
   b. $x^2 + 6x + 9$
   c. $x^2 - 10x + 25$

Comment [M1]: (x-1)(x+3)

Comment [M2]: (x+2)(x-5)

Comment [M3]: (4x+1)(x-2)

Activities

The parabola $y = (x - 4)^2 + 3$ is the parabola $y = x^2$ shifted to the right 4 and up 3. What about the parabola $y = x^2 - 4x + 3$? What can we say about this quadratic? Has it moved to the left or right? Up or down?

The general form of a parabola is $y = ax^2 + bx + c$. In this form, we are not able to tell what the position or shape is. We must rewrite it in the standard form $y = a(x - p)^2 + q$. Today, we will talk about the special case when $a = 1$ so that we will rewrite $y = x^2 + bx + c$ quadratics into the $y = (x - p)^2 + q$ form.

The term $(x-p)^2$ is a perfect square; we would like to rewrite $y = x^2 + bx + c$ so that it, too, has a perfect square.

Why do we want the parabola in standard form?

Example

Assignment

p.131 #1,7,13,19,23,25,39,53,70(a,b) core: {25,39,53}

3.5 (Continued) Graphing $y = ax^2 + bx + c$ by completing the square

Learning Outcomes

- ✓ Rewrite quadratic equations in general form as quadratic equations in standard form
- ✓ Find the maximum or minimum values of quadratic functions by rewriting quadratic equations in general form as quadratic equations in standard form
- ✓ Find the vertices of quadratic functions by rewriting quadratic equations in general form as quadratic equations in standard form
- ✓ Solve problems involving quadratic functions given in general form by rewriting them as quadratic equations in standard form

Homework Correction

p.131 #1,7,13,19,23,25,39,53,70(a,b) core: {25,39,53}

Homework Quiz

p.131 {25,39,53}

Warm-up

1. Factor out the common term.
   a. $4x + 4y$
   b. $2ab^2 - 6ab$
   c. $8xy^2 + 2xy$
   d. $5xyz^2 + 10xyz$

Activities

We discussed completing the square of trinomials such as $-x^2 + 4x - 4$. There, we needed to factor out the -1 in order to complete the square. Suppose we have the parabola

$$y = 5x^2 - 10x + 7$$

Examples:

$$m = 2n^2 - 12n + 18$$

$$y = 3x^2 + 30x - 30$$

Example:

$$y = -2x^2 + 8x - 8$$

Example:

$$y = -4x^2 + 9x + 14$$

Assignment

p.131 #4, 10, 16, 22, 30, 34, 40, 42, 48, 58, 68, 70(e,f)

core: {58,68,70(e)}