Introduction to Quadratic Relations

Complete the handout as we work through these slides together.

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Introduction to Quadratic Relations

In grade 9 you studied Linear Relations and now you will study Quadratic Relations. From the work that we have already done with quadratics, compare and contrast the two relationships.

Linear Relations	Quadratic Relations
Equation: $y = mx + b$	Equation: $y = ax^2 + bx + c$
Ex: $y = 2x + 3$, $y = -\frac{2}{3}x - 7$	Ex: $y = a(x-s)(x-t)$, $y = 6x^2 + 3x + 5$, $y = 6(x-2)(3x-4)$
Properties:	Properties:
- Straight line - maximum of 1 y-int and 1 x-int - highest exponent of x is 1. (degree 1) - two coefficients → slope, y-int	- parabola - highest exponent of x is 2 (degree 2) - 3 coefficients

Note: The highest exponent in a one-variable algebraic expression is called the degree.

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What is the easiest way to graph something? Make a table of values (TOV)

Recall - To create a table of values (or TOV):

1. Pick a value for *x*.
2. Substitute the *x*-value into the equation.
3. Solve for *y*.
4. Repeat for several other values of *x*.
5. Plot each point (*x*, *y*) on the x-y plane.

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Ex.: Create a TOV for $y = 2x + 1$

'Δ' (delta) means "change in" or "difference".
Δy is the change in y, or the first difference.

x	y	$\Delta y = y_2 - y_1$
-2	-3	2
-1	-1	2
0	1	2
1	3	2
2	5	

$(-1) - (-3) = -1 + 3 = 2$

$1 - (-1) = 1 + 1 = 2$

In a linear relationship, the first differences are equal and represent the slope.

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Ex.: Create a TOV for $y = x^2$

$\Delta^2 y$ is the change in Δy, or change in 1st differences.

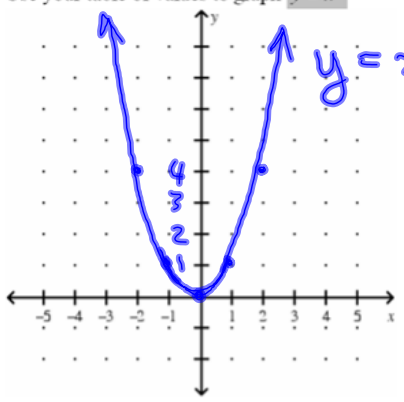
$\Delta^2 y$ is the second difference.

x	y	$\Delta y = y_2 - y_1$	$\Delta^2 y = \Delta y_2 - \Delta y_1$
-2	4	-3	2
-1	1	-1	2
0	0	1	2
1	1	3	
2	4		

In a quadratic relationship, first differences are not equal

and second differences are equal.

Use your table of values to graph $y = x^2$



$y = x^2$

$y = ax^2 + bx + c$

$a = 1$, $b = 0$, $c = 0$

This shape is called a parabola.

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$y = -(-2)^2 + 2(-2) + 3$

$= -4 - 4 + 3$

$= -5$

Ex.: Create a TOV for $y = -x^2 + 2x + 3$

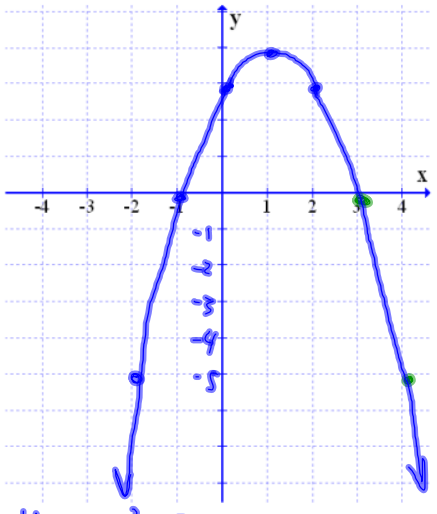
x	y	$\Delta y = y_2 - y_1$	$\Delta^2 y = \Delta y_2 - \Delta y_1$
-2	-5	5	-2
-1	0	3	-2
0	3	1	-2
1	4	-1	
2	3		

In a quadratic relationship,

first differences are different

and second differences are the same.

Use your table of values to graph $y = -x^2 + 2x + 3$



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

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Sub $x=-2$: $y = 2((-2)-1)((-2)+1)$
$= 2(-3)(-1)$
$= 6$

Ex.: Create a TOV for $y = 2(x-1)(x+1)$

$y = 2x^2 - 2$

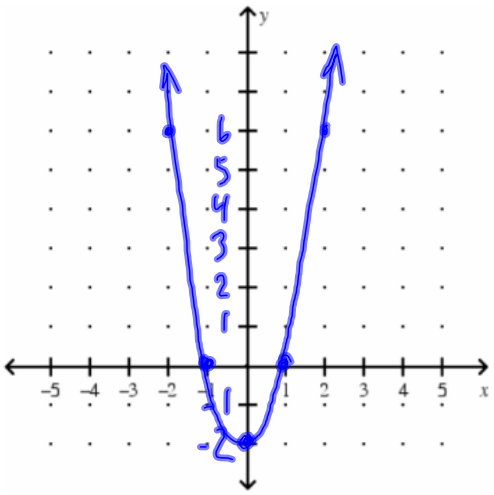
x	y	$\Delta y = y_2 - y_1$	$\Delta^2 y = \Delta y_2 - \Delta y_1$
-2	6	-6	4
-1	0	-2	4
0	-2	2	4
1	0	6	
2	6		

In a quadratic relationship,

first differences are different

and second differences are the same.

Use your table of values to graph $y = 2(x-1)(x+1)$



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Ex.: Create a TOV for $y = -0.4(x-3)(x+2)$

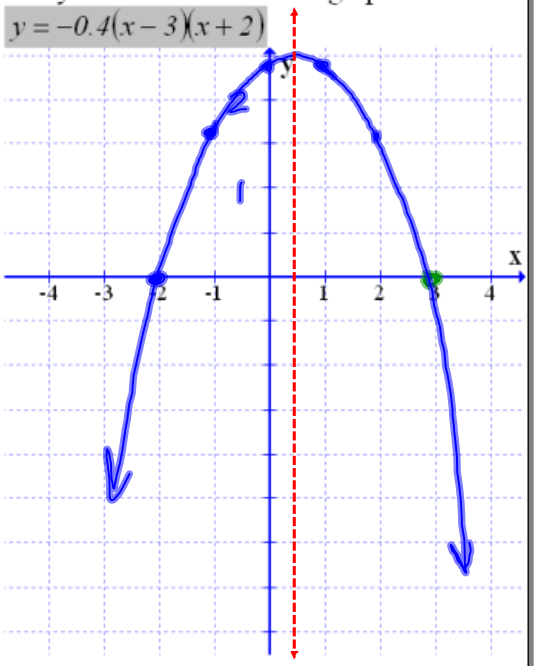
x	y	$\Delta y = y_2 - y_1$	$\Delta^2 y = \Delta y_2 - \Delta y_1$
-2	0	1.6	-0.8
-1	1.6	0.8	-0.8
0	2.4	0	-0.8
1	2.4	-0.8	
2	1.6		

In a quadratic relationship,

first differences are different

and second differences are the same.

Use your table of values to graph $y = -0.4(x-3)(x+2)$



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Can you predict from the equation that the parabola is opening up? yes

If yes, how?

The value of the coefficient in front of the x^2-term is positive (a is positive)

or 2nd differences positive

Can you predict from the equation that the parabola is opening down? yes

If yes, how?

The coefficient of the x^2-term is negative (a is negative)

or 2nd differences negative

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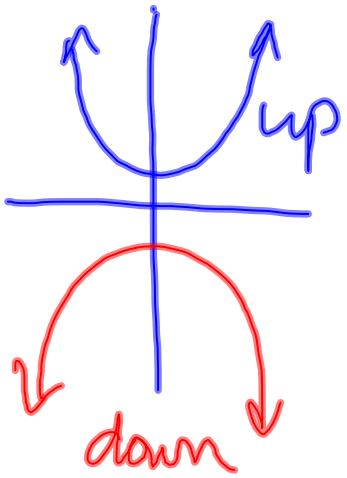
up $y = 3x^2 - 5x - 6$

up $y = 2x^2 + 5x + 6$

down $y = -5x^2 + 3x + 2$

down $y = -5x^2 - 3x - 2$



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Can you predict from the equation the value of the second differences? yes

If yes, how?

The 2nd differences equal 2a, double the coefficient of the x^2-term.

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Assigned Work:

p. 137 # 1, 2, 3, 4, 5ab, 6, 7

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7. $y = ax^2 + bx + c$, $a \neq 0$

set $a = 0$

$y = (0)x^2 + bx + c$

$= bx + c \longrightarrow$ linear relation!

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