What's Going On?

Checking In

Minds on Two Liners

Action! Differences Finale

Consolidation Bits and Pieces

Learning Goal - I will begin to put the pieces from this unit together.

Minds on

Two Liners

Using Your Two-Line Calculator

As I have mentioned, having a two-line calculator can help make your life as mathematician quite a bit easier.

For example. If you were asked to find the value of y for each value of x given:

$y = -2(x - 4)^2 + 7$, when x = -9, -5, -2, 0, 1, 4, 7

that could take quite a while!

Minds on

But with a two-line calculator it's as easy as [-, 2, (, -, 9, -, 4,), ^{2}, +, 7, =] and then [← , -, 5] repeat!

minus

Find the value of y for each value of x given:

$y = -2(x - 4)^2 + 7$, when x = -9, -5, -2, 0, 1, 4, 7

	x = -9	x = -5	x = -2	x = 0
y =				

	x = 1	x = 4	x = 7	
y =				

Minds on

Two Liners

Find the value of y for each value of x given:

$$y = -3.5(x + 7)^2 - 11.5,$$

when x = -11, -7, -3, 0, 1, 9, 13, 101

	x = -11	x = -7	x = -3	x = 0
y =	-67.5	-11.5		-183

	x = 1	x = 9	x = 13	x = 101
y =			-1411.5	

Action!

Finite Differences

How could we use Finite Differences to determine the equation of a:

a) Line

b) Parabola

x	y	First Differences	Second Differences
-2	-22		
		+10	
-1	-12		-4
		+6	
0	-6		-4
		+2	
1	-4		-4
		-2	
2	-6		-4
		-6	
3	-12		

Action!

Finite Differences

How could we use Finite Differences to determine the equation of a:

b) Parabola

Let's try to get it in the form

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

x	y	First Differences	Second Differences
-2	-22		
		+10	
-1	-12		-4
		+6	
0	-6		-4
		+2	
1	-4		-4
		-2	
2	-6		-4
		-6	
3	-12		

Remember that the second differences are twice the a-value...

$a = -4 \div 2 = -2$

Does this parabola have a maximum or a minimum?

a-value is **negative**... **maximum**!

Action!

Finite Differences

How could we use Finite Differences to determine the equation of a:

b) Parabola

Let's try to get it in the form

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

x	y	First Differences	Second Differences
-2	-22		
		+10	
-1	-12		-4
		+6	
0	-6		-4
		+2	
1	-4		-4
		-2	
2	-6		-4
		-6	
3	-12		

The maximum value of y for this parabola will be our k-value!

The maximum value of y in our table is -4.

How do we know if that is the maximum value?

Because the y-values are symmetrical on either side!

Action!

Finite Differences

How could we use Finite Differences to determine the equation of a:

b) Parabola

Let's try to get it in the form

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

x	y	First Differences	Second Differences
-2	-22		
		+10	
-1	-12		-4
		+6	
0	-6		-4
		+2	
1	-4		-4
		-2	
2	-6		-4
		-6	
3	-12		

We have **a = -2** and **k = -4**...

How do we get h?

We know that k is the y-value of the vertex...

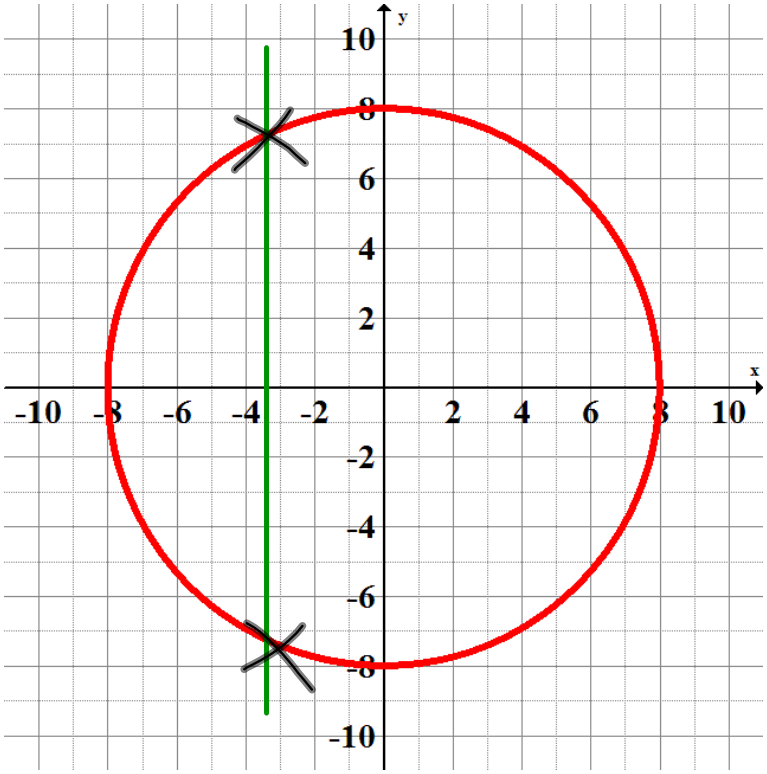
h is just the x-value of the vertex!

a = -2, k = -4 and h = 1

$$y = -2(x - 1)^2 - 4$$

Consolidation

Bits and Pieces



Domain

The domain of a relation is all possible values of X.

$-8 \leq x \leq 8$

Range

The range of a relation is all possible values of y.

$-8 \leq y \leq +8$

Function?

No. It does not pass the vertical line test.

Consolidation

Bits and Pieces

Transformations

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

Vertical Stretch - Happens when a is greater than 1 (a = -2, -3, +2, +3).
- "Stretches" the step pattern

Vertical Compression - Happens when a is less than 1 (fraction) (a = -0.5, -0.25, 0.25, 0.5)

Vertical Shift - Based on value of k.
If k ⊕ ⇒ curve shifts up.
If k ⊖ ⇒ curve shifts down.

Horizontal Shift - Based on value of 'h'
If h ⊕ ⇒ curve shifts right
If h ⊖ ⇒ curve shifts left

Reflected in the x-axis Happens when a is negative, the curve is flipped upside down.

Consolidation

Bits and Pieces

Transformations

Vertical Stretch

Happens when the 'value' of ***a*** regardless of the sign is greater than 1.
Example: When a is -3, -2, +2 or +3...

Vertical Compression

Happens when the 'value' of ***a*** regardless of the sign is less than 1. Basically, when ***a*** is a fraction / decimal.
Example: When a is -0.25, -0.5, +0.5, +0.25...

Vertical Shift

The ***k*** value controls vertical shift.
If ***k*** is positive, the curve is shifted up.
If ***k*** is negative, the curve is shifted down.

Horizontal Shift

The ***h*** value controls vertical shift.
If ***h*** is positive, the curve is shifted right.
If ***h*** is negative, the curve is shifted left.

Reflected in the x-axis

The curve is reflected in the x-axis when ***a*** is negative.

Consolidation

Bits and Pieces

$$y = -0.25(x - 5)^2 + 9$$

Vertical Stretch?

NO

Vertical Compression?

Yes

by 0.25

Vertical Shift?

Yes

up by 9 units

Horizontal Shift?

Yes

to the right 5 units

Reflected in the x-axis?

Yes

'a' is negative

Consolidation

Bits and Pieces

Vertical Stretch
Vertical Compression
~~Vertical Shift~~
~~Horizontal Shift~~

$y = -0.25(x - 5)^2 + 9$

To get this curve, we start with $y=x^2$.
Then we reflect our curve in the x-axis, shift it vertically up 9 units and horizontally right 5 units. Finally we compress the curve by a factor of 0.25.

Consolidation

Bits and Pieces

Verifying Intercepts

a) Verify that the x-intercepts of $y = -3x^2 - 6x + 45$ are 3 and -5.

Plug in 3 for x.

If y=0 ✓ If y≠0 ✗

$y=-3(3)^2-6(3)+45$

$y=0$ ✓

Plug in -5 for x.

If y=0 ✓ If y≠0 ✗

$y=-3(-5)^2-6(-5)+45$

$y=0$ ✓

b) Verify that the x-intercepts of $y = -3(x + 2)^2 + 3$ are -1 and -3.

Plug in -1 for x.

If y=0 ✓ If y≠0 ✗

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

$y=0$ ✓

Plug in -3 for x.

If y=0 ✓ If y≠0 ✗

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

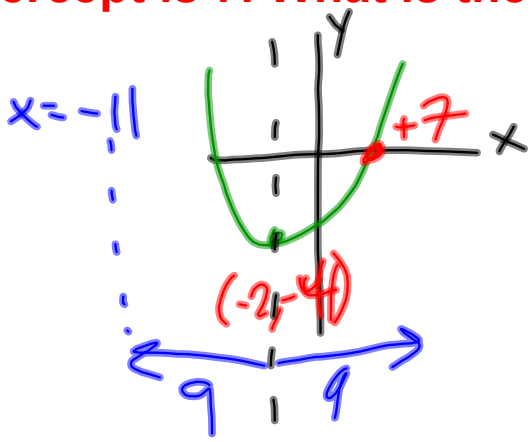
$y=0$ ✓

Consolidation

Bits and Pieces

Playing with x-Intercepts

The vertex of a parabola is (-2, -4).
One x-intercept is 7. What is the other x-intercept?



The other x-intercept is -11.

Consolidation

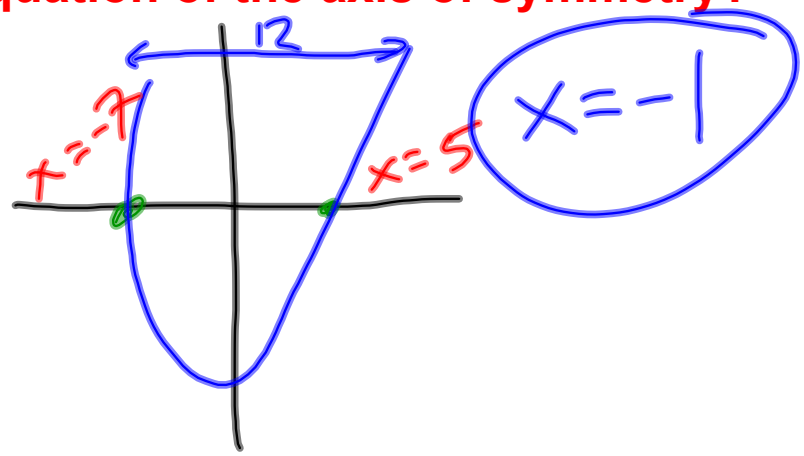
Bits and Pieces

Playing with x-Intercepts

The x-intercepts of a parabola are 5 and -7.
What is the equation of the axis of symmetry?

Find the average of -7 and +5...

$\frac{(-7)+(5)}{2} = -1$



Consolidation

Bits and Pieces

Playing with x-Intercepts

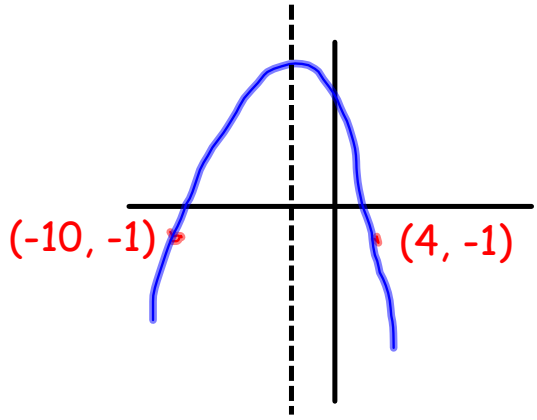
Two points on a parabola are (4, -1) and (-10, -1). What is the equation of the axis of symmetry?

Because the y-values of points are the same, we know that the point halfway between them is on the axis of symmetry.

We just need to find the average of the x-values:

$$\frac{(4)+(-10)}{2} = -3$$

The equation of the axis of symmetry is x = -3



Homework

Practice Test

Pg 258-259