Name: ________________________________ Per: _____

Linear vs. Quadratic
& Writing Equations from Tables

Determining if a function is linear or quadratic from a table:
If the first differences are the same, then it is linear. If the second differences are the same, then it's quadratic.

Linear

Determine if the function is linear or quadratic.

x	*y*	1st
1	7	
2	4	-3
3	1	-3
4	-2	-3
5	-5	-3

Fill in the blanks:

The function is **linear** because it has a **1st difference** that is **constant**.

Quadratic

Determine if the function is linear or quadratic.

x	*y*	1st	2nd
1	9		
2	3	-6	
3	1	-2	+4
4	3	+2	+4
5	9	+6	+4

Fill in the blanks:

The function is **quadratic** because it has a **2nd difference** that is **constant**.

Determine if the function is Linear or Quadratic. Use the word bank to fill in the blanks.

The function is __________ because it has a ______________ that is __________.

Possible responses are:	Linear or Quadratic	1st difference or 2nd difference	constant

EXAMPLE

x	*y*	1st	2nd
1	-15		
2	-8	+7	
3	-1	+7	
4	6	+7	
5	13	+7	

1st diff. is +7
..because
-15+7=-8
-8+7=-1
-1+7=6
6+7=13

The function is **linear** because it has a **1st difference** that is **constant**.

EXAMPLE

x	*y*	1st	2nd
1	2		
2	16	+14	
3	24	+8	-6
4	26	+2	-6
5	22	-4	-6

The function is **quadratic** because it has a **2nd difference** that is **constant**.

1.

x	*y*
1	10
2	3
3	4
4	13
5	30

The function is __________ because it has a ______________ that is __________.

2.

x	*y*
1	-1
2	2
3	5
4	8
5	11

The function is __________ because it has a ______________ that is __________.

3.

x	*y*
1	15
2	9
3	3
4	-3
5	-9

The function is __________ because it has a ______________ that is __________.

4.

x	*y*
1	-8
2	-3
3	0
4	1
5	0

The function is __________ because it has a ______________ that is __________.

5.

x	*y*
1	-18
2	-16
3	-14
4	-12
5	-10

The function is __________ because it has a ______________ that is __________.

6.

x	*y*
1	-1
2	11
3	17
4	17
5	11

The function is __________ because it has a ______________ that is __________.

7.

x	*y*
1	-14
2	-5
3	-6
4	-17
5	-38

The function is __________ because it has a ______________ that is __________.

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Writing the Equation from a Table

A linear equation uses the formula $f(x) = mx + b$, so you need to find m & b.

A quadratic equation uses the formula $f(x) = ax^2 + bx + c$, so you need to find a, b, & c.

<table>
<tr><th>Steps for writing the Linear equation…</th><th>Linear Example</th></tr>
<tr><td>Step 1: Find the 1st differences.</td><td>
<table>
<tr><th>x</th><th>y</th></tr>
<tr><td>1</td><td>7</td></tr>
<tr><td>2</td><td>4</td></tr>
<tr><td>3</td><td>1</td></tr>
<tr><td>4</td><td>-2</td></tr>
<tr><td>5</td><td>-5</td></tr>
</table>
← <i>That gives us this</i> →
<table>
<tr><th>x</th><th>y</th><th>1st</th></tr>
<tr><td>1</td><td>7</td><td></td></tr>
<tr><td>2</td><td>4</td><td>-3</td></tr>
<tr><td>3</td><td>1</td><td>-3</td></tr>
<tr><td>4</td><td>-2</td><td>-3</td></tr>
<tr><td>5</td><td>-5</td><td>-3</td></tr>
</table>
</td></tr>
<tr><td>Step 2:
Find the leading coefficient (the first number in the equation), <i>m</i>.

<u>Here's how</u>
When it's $\boxed{linear}$, $\boxed{f(x) = mx + b}$, the leading coefficient is: $\boxed{m = \frac{1st\ difference}{1}}$</td><td>When it's linear, use:
$f(x) = mx + b$

$m = \frac{first\ difference}{1}$

$m = \frac{-3}{1}$
$m = -3$

My equation so far:
$f(x) = mx + b$
$f(x) = -3x + b$</td></tr>
<tr><td>Step 3:
Find the constant (the last number in the equation-the one that doesn't have an <i>x</i>), <i>b</i>.

<u>Here's how</u>
The constant (<i>b</i>) is where <i>x</i> is 0.

So, use the differences to find what <i>y</i> would be if <i>x</i> were 0.</td><td>$b =$ y when $x = 0$
(use the 1st difference to get 0)

<i>I know that the y-value at $x = 0$ is b, and that it will go down 3 units to become 7 (the y-value at $x = 1$). So…</i>
<table>
<tr><th>x</th><th>y</th><th>1st</th></tr>
<tr><td>0</td><td>b</td><td></td></tr>
<tr><td>1</td><td>7</td><td>-3</td></tr>
</table>
$b - 3 = 7$
$b = 10$

My equation so far:
$f(x) = -3x + b$
$f(x) = -3x + 10$
I'm done! The equation of this line is: $\boxed{f(x) = -3x + 10}$.</td></tr>
</table>

8.

x	y
1	-1
2	2
3	5
4	8
5	11

9.

x	y
1	15
2	9
3	3
4	-3
5	-9

10.

x	y
1	-18
2	-16
3	-14
4	-12
5	-10

11.

x	y
1	-3
2	2
3	7
4	12
5	17

12.

x	y
1	24
2	17
3	10
4	3
5	-4

13.

x	y
1	-17
2	-6
3	5
4	16
5	27

Name: _______________________________ Per: _____

Steps for writing the Quadratic equation…	Quadratic Example

Step 1: Find the 1st differences and the 2nd differences.

x	y
1	9
2	3
3	1
4	3
5	9

← That gives us this →

x	y	1st	2nd
1	9		
		-6	
2	3		+4
		-2	
3	1		+4
		+2	
4	3		+4
		+6	
5	9		

Step 2:
Find the leading coefficient (the first number in the equation), a.

Here's how
When it's $\boxed{quadratic}$, $\boxed{f(x) = ax^2 + bx + c}$, the leading coefficient is:

$$\boxed{a = \frac{2nd\ difference}{2}}$$

When it's quadratic, use:

$$f(x) = ax^2 + bx + c$$

$$a = \frac{second\ difference}{2}$$

$$a = \frac{+4}{2}$$

$$a = 2$$

My equation so far:

$$f(x) = ax^2 + bx + c$$

$$f(x) = 2x^2 + bx + c$$

Step 3:
Find the constant (the last number in the equation-the one that doesn't have an x), c.

Here's how
The constant (b) is where x is 0.

First, use the second differences to figure out what the first difference is

$c =\ y$ when $x = 0$
(Start by using the 2nd difference to find the 1st)

		1st	2nd
0	*c*		
		?	
1	9		+4
		-6	
2	3		+4

So, focusing on the 1st difference that I need…

1st	2nd
?	
	+4
-6	

$$1st\ + 4 = -6$$

$$1st\ = -10$$

Now, use the 1st differences to find what y would be if x were 0.

		1st
0	*c*	
		-10
1	9	

$$c - 10 = 9$$

$$c = 19$$

My equation so far:

$$f(x) = 2x^2 + bx + c$$

$$f(x) = 2x^2 + bx + 19$$

Finally, use the point (1, 9) to solve for b. (Plug them in)

$(1, 9) \rightarrow f(x) = 2x^2 + bx + 19$

$9 = 2(1)^2 + b(1) + 19$

$9 = 2 + 1b + 19$

$9 = b + 21$

$-12 = b$

So, my equation is:

$$f(x) = 2x^2 - 12x + 19$$

14.

x	y
1	10
2	3
3	4
4	13
5	30

15.

x	y
1	-8
2	-3
3	0
4	1
5	0

16.

x	y
1	-1
2	11
3	17
4	17
5	11

17.

x	y
1	-14
2	-5
3	-6
4	-17
5	-38

18.

x	y
1	7
2	11
3	17
4	25
5	35

19.

x	y
1	3
2	13
3	19
4	21
5	19

Name: ______________________________ Per: _____

When you're done solving the problems on this handout, make sure you check your answers against the **correct answers below**.

1. The function is **quadratic** because it has a **2nd difference** that is **constant**.	2. The function is **linear** because it has a **1st difference** that is **constant**.
3. The function is **linear** because it has a **1st difference** that is **constant**.	4. The function is **quadratic** because it has a **2nd difference** that is **constant**.
5. The function is **linear** because it has a **1st difference** that is **constant**.	6. The function is **quadratic** because it has a **2nd difference** that is **constant**.
7. The function is **quadratic** because it has a **2nd difference** that is **constant**.	8. $f(x) = 3x - 4$
9. $f(x) = -6x + 21$	10. $f(x) = 2x - 20$
11. $f(x) = 5x - 8$	12. $f(x) = -7x + 31$
13. $f(x) = 11x - 28$	14. $f(x) = 4x^2 - 19x + 25$
15. $f(x) = -x^2 + 8x - 15$	16. $f(x) = -3x^2 + 21x - 19$
17. $f(x) = -5x^2 + 24x - 33$	18. $f(x) = x^2 + x + 5$
19. $f(x) = -2x^2 + 16x - 11$	