

## Section 5.5 – First Differences

MPM1D

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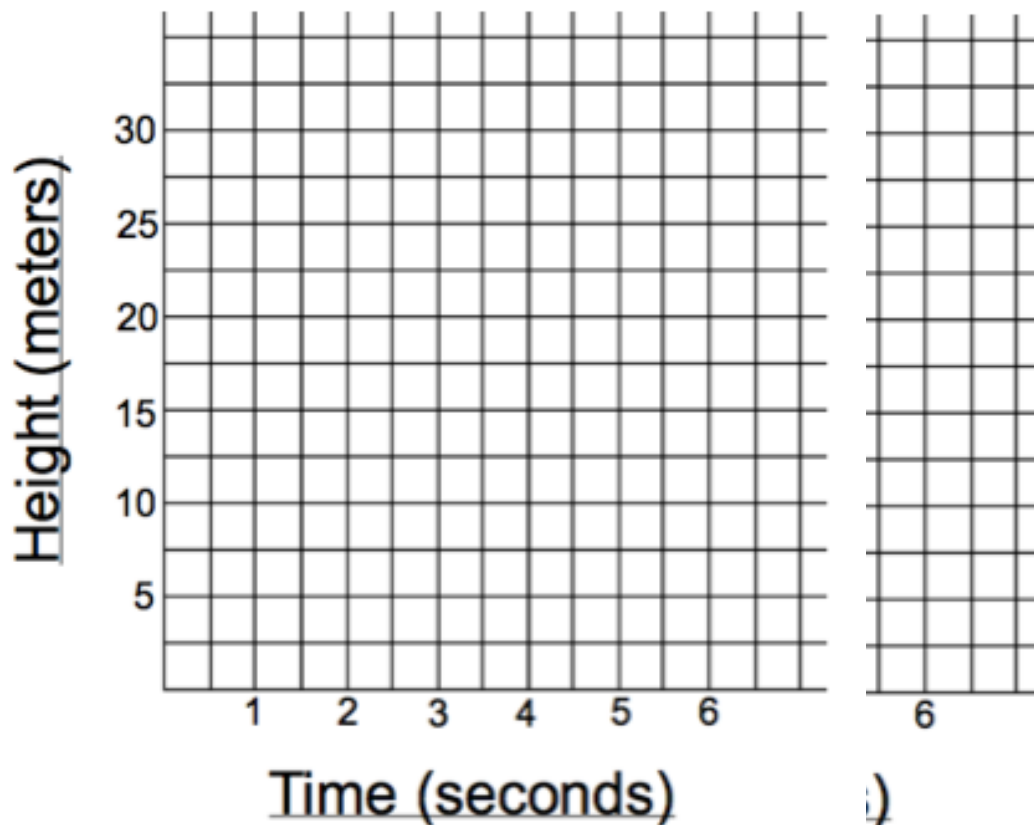
### DO IT NOW

If a tennis ball falls out of the third story window of a building will its motion be linear?

The height of the ball over time is recorded in the following table.

Time (seconds)	Height (meters)
0	30
1	29
2	26
3	21
4	14
5	5
6	0

Graph the relation and determine if it represents linear motion.



## 1:Recall

We know from graphing lines that **if the slope (rise and the run) is constant** then the relation will **form a straight line**.

$$\text{slope} = m = \frac{\text{rise}}{\text{run}} = \frac{\Delta x}{\Delta y}$$

Therefore, we need to determine if the changes in x and y are constant in a table to determine if a relation is linear.

## Part 2: What are First differences

**First differences** are the differences between consecutive y-values in tables of values with evenly spaced x-values.

If the first differences of a relation are constant, the relation is \_\_\_\_\_

If the first differences of a relation are not constant, the relation is \_\_\_\_\_

Notice that the x-values change by a constant amount. This is a requirement to work with first differences!

<b>x</b>	<b>y</b>	
0	0	
1	3	
2	6	
3	9	
4	12	

**First Differences**

$3-0 = 3$
$6-3 = 3$
$9-6 = 3$
$12-9 = 3$

Notice that the differences between consecutive y-values are constant! This means it is a linear relation

### Part 3: Calculating First Differences

Complete a table of values for each equation given. Then determine if the first differences are constant and state whether the relation is linear or non linear.

#### Example 1:

$$y = -2x + 7$$

$x$	$y$	<b>First Differences</b>
0		
1		
2		
3		
4		

**Conclusion:**

the first differences are

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therefore the relationship is

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#### Example 2:

$$y = x^2$$

$x$	$y$	<b>First Differences</b>
0		
1		
2		
3		
4		

**Conclusion:**

the first differences are

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therefore the relationship is

---

#### Example 3:

$$y = 2^x$$

$x$	$y$	<b>First Differences</b>
0		
1		
2		
3		
4		

**Conclusion:**

the first differences are

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therefore the relationship is

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### Part 4: Check Your Understanding

Use first differences to determine which of these relations are linear and which are non linear.

#### Example 4:

$x$	$y$	
0	7	<b>First Differences</b> _____ _____ _____ _____
1	3	
2	-1	
3	-5	
4	-9	

Type of relation: \_\_\_\_\_

#### Example 5:

$x$	$y$	
2	-5	<b>First Differences</b> _____ _____ _____ _____
3	10	
4	25	
5	40	
6	55	

Type of relation: \_\_\_\_\_

#### Example 6:

$x$	$y$	
-2	-10	<b>First Differences</b> _____ _____ _____ _____
-1	-2	
0	0	
1	2	
2	10	

Type of relation: \_\_\_\_\_