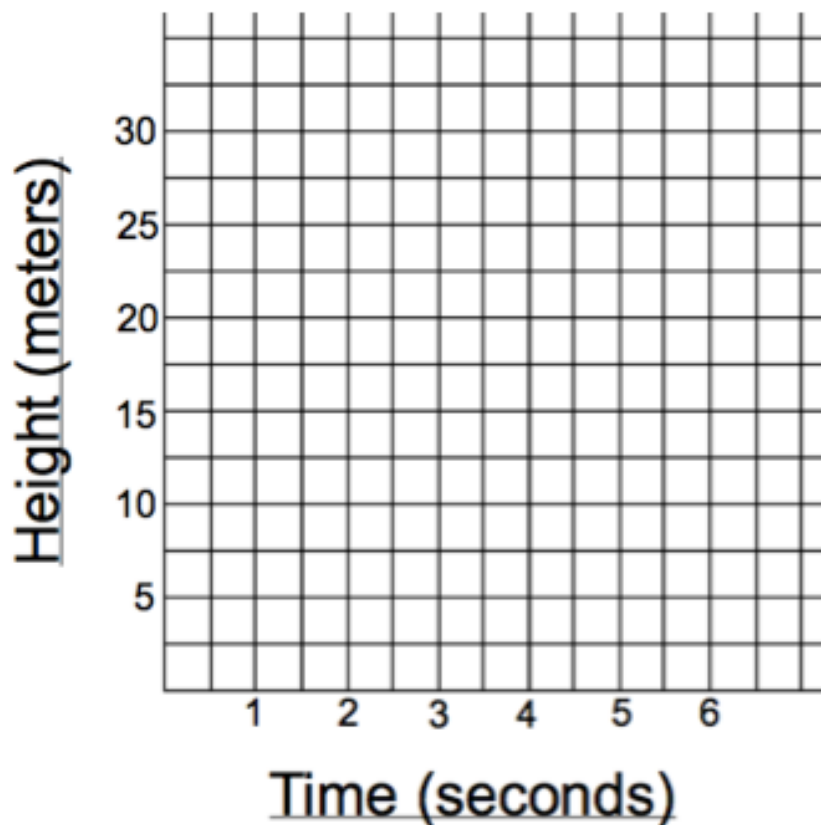## DO IT NOW

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.

Part 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**.

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

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 <u>constant</u>, the relation is _____

If the first differences of a relation are <u>not constant</u>, the relation is _____

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

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

x	y
0	0
1	3
2	6
3	9
4	12

First Differences

3-0 = 3

6-3 = 3

9-6 = 3

12-9 = 3

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
0	
1	
2	
3	
4	

First Differences

Conclusion:
the first differences are

_____

therefore the relationship is

_____

Example 2:

$y = x^2$

x	y
0	
1	
2	
3	
4	

First Differences

Conclusion:
the first differences are

_____

therefore the relationship is

_____

Example 3:

$y = 2^x$

x	y
0	
1	
2	
3	
4	

First Differences

Conclusion:
the first differences are

_____

therefore the relationship is

_____

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	First Differences
0	7	
1	3	
2	-1	
3	-5	
4	-9	

Type of relation:_____

Example 5:

x	y	First Differences
2	-5	
3	10	
4	25	
5	40	
6	55	

Type of relation:_____

Example 6:

x	y	First Differences
-2	-10	
-1	-2	
0	0	
1	2	
2	10	

Type of relation:_____