Thread 2, Quiz 1 – Quadratic Relations

/K 4 /T 4 /C 4 /A 4

Version 3 – Full Solutions

Marks *Show your work for every question. Write your steps clearly. Do not write only a final answer.*

K 2 1. Find the finite differences. Is each relation linear, quadratic, or neither?

a)

x	y	First diff.	Second diff.
0	0		
		1	
1	1		6
		7	
2	8		12
		19	
3	27		18
		37	
4	64		

The relation is neither .

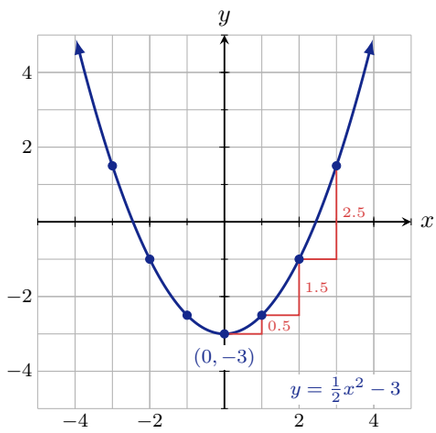
b)

x	y	First diff.	Second diff.
1	2		
		5	
2	7		6
		11	
3	18		6
		17	
4	35		6
		23	
5	58		

The relation is quadratic .

Review: *Quadratic Relations and Finite Differences*

K 2 2. Compress $y = x^2$ vertically by a factor of $\frac{1}{2}$. Then translate the graph 3 units down. Use the step pattern to sketch the new graph on the grid. Do not make a table of values. Then fill in the blanks.



Opens: up

Vertex: $(0, -3)$

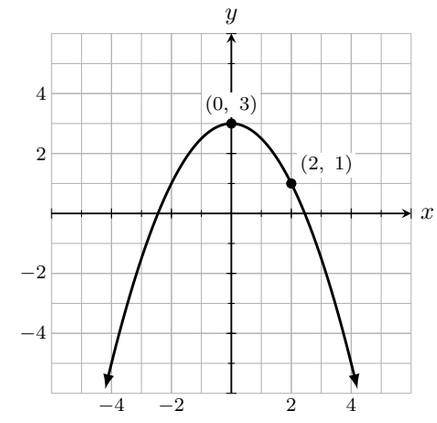
Axis of symmetry: $x = 0$

Max. or min. value: minimum, -3

y-intercept: -3

Review: *Stretches, Compressions, and Reflections*

T 2 3. The graph shows a parabola. The relation has the form $y = ax^2 + k$. The vertex and one other point are marked.



Write the equation of the parabola.
Explain how you found a.

The vertex is $(0, 3)$, so $k = 3$.

$y = ax^2 + 3$

$1 = a(2)^2 + 3$ substitute $(2, 1)$

$1 = 4a + 3$ subtract 3

$-2 = 4a$ divide by 4

$a = -0.5$

The equation is $y = -0.5x^2 + 3$.

Review: *Stretches, Compressions, and Reflections*

T 2 4. The table shows some points on a parabola. The relation has the form $y = ax^2$.

x	y	First diff.
0	0	
		4
1	4	
		12
2	16	
		20
3	36	

Review: *Stretches, Compressions, and Reflections*

a) Write the equation of the relation. Explain how you found a.

The first difference from the vertex is a, so $a = 4$. Put another way, for $y = x^2$, $a = 1$, and the step pattern is 1, 3, 5. Since the step pattern here is multiplied by 4: 4, 12, 20, then $a = 4$.
The equation is $y = 4x^2$.

b) Write the value of y when $x = -3$. Do not calculate. Explain how you know.

$y = 36$. The axis of symmetry is $x = 0$, so y is the same at $x = -3$ and at $x = 3$.

Marks

C 2 5. Ana made this table of finite differences. Ana wrote: "The second differences are not constant. So the relation is not quadratic."

What mistake did Ana make? What should Ana do instead?

x	y	First diff.	Second diff.
0	2		
		1	
1	3		2
		3	
2	6		9
		12	
4	18		−3
		9	
5	27		15
		24	
7	51		

The x-values in Ana's table are not evenly spaced. Some go up by 1, and some go up by 2 (from 2 to 4, and from 5 to 7).

Ana should use evenly spaced x-values. Then Ana should find the first and second differences again.

Review: *Quadratic Relations and Finite Differences*

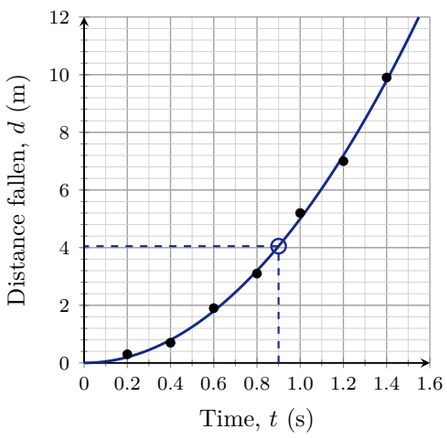
C 2 6. Compare the graphs of $y = -2x^2 + 3$ and $y = -2x^2 - 1$. Explain how the two graphs are alike. Explain how the two graphs are different. Use the words *vertex*, *axis of symmetry*, and *maximum* or *minimum* in your answer.

Alike: In both equations, $a = -2$ is negative, so both graphs open down, and each has a maximum value. Both graphs have the same axis of symmetry, $x = 0$, and the same width.

Different: The vertex of $y = -2x^2 + 3$ is $(0,\ 3)$, so its maximum value is 3. The vertex of $y = -2x^2 - 1$ is $(0,\ -1)$, so its maximum value is -1. The second graph is the first graph translated 4 units down.

Review: *Stretches, Compressions, and Reflections* and *The Parent Parabola and Vertical Translations*

A 4 7. Jordan drops a ball from a balcony and takes a video of the ball. From the video, Jordan reads how far the ball has fallen every 0.2 seconds. The scatter plot shows Jordan's data.



a) Which variable is the independent variable? Use Jordan's situation to explain why.

Time is the independent variable. Jordan chooses the times to read from the video, and the distance fallen depends on the time.

b) Draw a curve of best fit. Use the curve to estimate the distance fallen at 0.9 s. Is this estimate interpolation or extrapolation?

The distance fallen is about 4 m. This is an interpolation, because 0.9 s is inside the data.

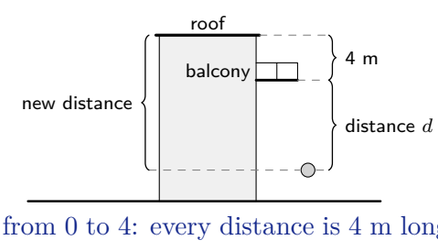
c) The model $d = 5t^2$ fits the data. Use the model to predict the distance fallen at 2 s. Is this prediction as reliable as your answer to b)? Explain why.

$d = 5(2)^2$
$= 5(4)$
$= 20$

The distance fallen is 20 m.

This prediction is less reliable. It is an extrapolation, because 2 s is beyond the data. The pattern may not continue.

d) Now Jordan measures each distance from the roof. The roof is 4 m above the balcony. Write the new model. Which part of the equation changed?



The new model is $d = 5t^2 + 4$. Only k changed, from 0 to 4: every distance is 4 m longer.

Review for parts a), b), and c) of this question: *Relations and Models*.
Review for part d): *The Parent Parabola and Vertical Translations*.