# Thread 2, Quiz 1 – Quadratic Relations /K 4 /T 4 /C 4 /A 4

**Version 1 – 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 | 1 | | |
| | | 1 | |
| 1 | 2 | | 4 |
| | | 5 | |
| 2 | 7 | | 4 |
| | | 9 | |
| 3 | 16 | | 4 |
| | | 13 | |
| 4 | 29 | | |

The relation is quadratic .

Review: *Quadratic Relations and Finite Differences*

**b)**

| $x$ | $y$ | First diff. | Second diff. |
|---|---|---|---|
| 1 | 3 | | |
| | | 3 | |
| 2 | 6 | | 3 |
| | | 6 | |
| 3 | 12 | | 6 |
| | | 12 | |
| 4 | 24 | | 12 |
| | | 24 | |
| 5 | 48 | | |

The relation is neither .

**K 2** 2. Use the step pattern to sketch $y = \frac{1}{2}x^2 - 4$ on the grid. Do not make a table of values. Then fill in the blanks.

Opens: up

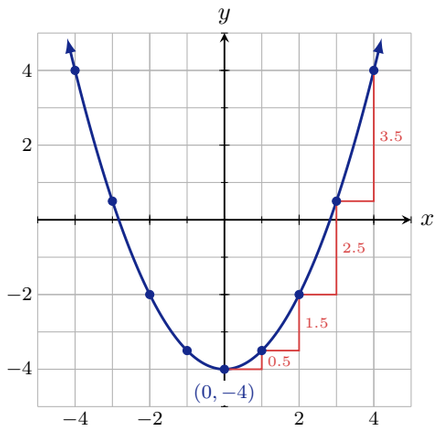
Vertex: $(0,\ -4)$

Axis of symmetry: $x = 0$

Max. or min. value: minimum, $-4$

$y$-intercept: $-4$

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 $(0,\ 5)$, so $k = 5$.

$y = ax^2 + 5$

$-1 = a(2)^2 + 5$ substitute $(2,\ -1)$

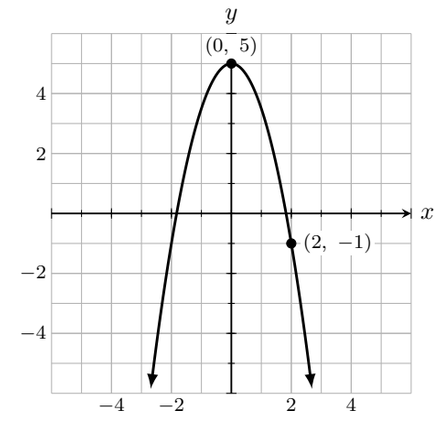
$-1 = 4a + 5$ subtract 5

$-6 = 4a$ divide by 4

$a = -1.5$

The equation is $y = -1.5x^2 + 5$.

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 | |
| | | 2 |
| 1 | 2 | |
| | | 6 |
| 2 | 8 | |
| | | 10 |
| 3 | 18 | |

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 $a = 2$. Put another way, for $y = x^2$, $a = 1$, and the step pattern is 1, 3, 5. Since the step pattern here is doubled: 2, 6, 10, then $a = 2$.
The equation is $y = 2x^2$.

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

$y = 18$. The axis of symmetry is $x = 0$, so $y$ is the same at $x = -3$ and at $x = 3$.

**Marks**

**C 2** 5. Maya made this table of finite differences. The second differences are not constant. So Maya decided the relation is not quadratic.

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

| $x$ | $y$ | First diff. | Second diff. |
|---|---|---|---|
| $-2$ | 5 | | |
| | | $-3$ | |
| $-1$ | 2 | | 2 |
| | | $-1$ | |
| 0 | 1 | | 5 |
| | | 4 | |
| 2 | 5 | | 1 |
| | | 5 | |
| 3 | 10 | | 11 |
| | | 16 | |
| 5 | 26 | | |

The $x$-values in Maya's table are not evenly spaced. Some go up by 1, and some go up by 2 (from 0 to 2, and from 3 to 5).

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

Review: *Quadratic Relations and Finite Differences*

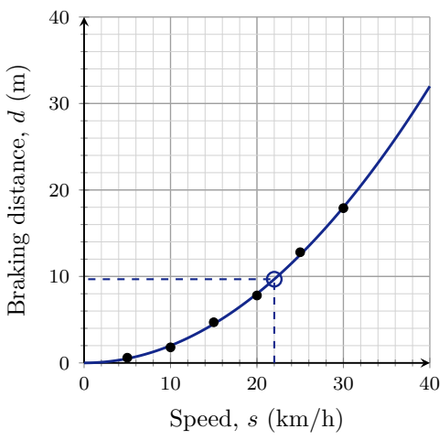
**C 2** 6. Compare the graphs of $y = 3x^2 - 2$ and $y = -3x^2 - 2$. Explain how the two graphs are alike. Explain how the two graphs are different. Use the words *vertex*, *axis of symmetry*, and *maximum* or *minimum* in your answer.

Alike: Both graphs have the same vertex, $(0, -2)$, and the same axis of symmetry, $x = 0$. Both graphs are the same width.

Different: In $y = 3x^2 - 2$, $a = 3$ is positive, so the graph opens up, and $-2$ is its minimum value. In $y = -3x^2 - 2$, $a = -3$ is negative, so the graph opens down, and $-2$ is its maximum value.

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

**A 4** 7. Leo rides his bicycle on a wet road. He brakes at different speeds. Each time, he measures how far the bicycle travels after he brakes. The scatter plot shows his data.




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

Speed is the independent variable. Leo chooses the speed, and the braking distance depends on it.

**b)** Draw a curve of best fit. Use the curve to estimate the braking distance at 22 km/h. Is this estimate interpolation or extrapolation?

The braking distance is about 10 m. This is an interpolation, because 22 km/h is inside the data.

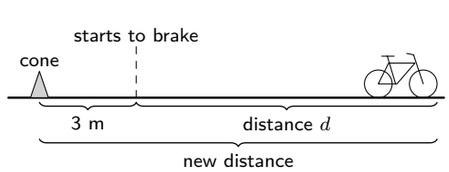
**c)** The model $d = 0.02s^2$ fits the data. Use the model to predict the braking distance at 40 km/h. Is this prediction as reliable as your answer to b)? Explain why.

$d = 0.02(40)^2$
$= 0.02(1600)$
$= 32$

The braking distance is 32 m.

This prediction is less reliable. It is an extrapolation, because 40 km/h is beyond the data. The pattern may not continue.

**d)** Now Leo measures each distance from a cone. The cone is 3 m before the spot where he starts to brake. Write the new model. Which part of the equation changed?




The new model is $d = 0.02s^2 + 3$. Only $k$ changed, from 0 to 3, because every distance is 3 m longer. The value of $a$ is still 0.02.

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