

Unit 5: Quadratic Relations

Day 3: Key Features of Quadratic Relations

Today we will...

1. Learn how to identify each of the key points on a parabola.

Investigation 1

In Desmos, graph the following four equations on the same grid.

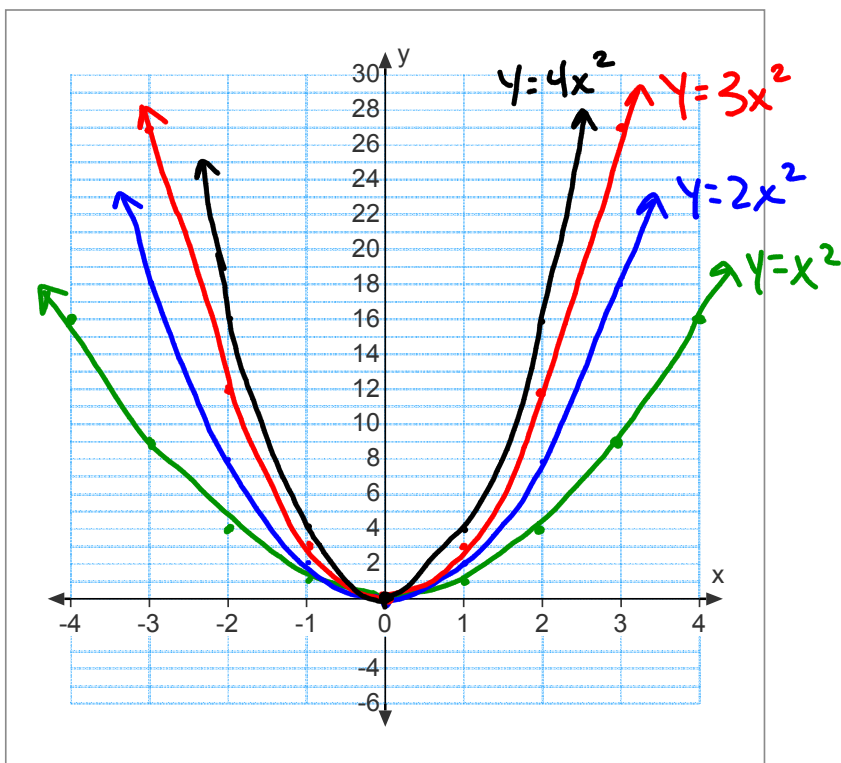
1. $y = x^2$
2. $y = 2x^2$
3. $y = 3x^2$
4. $y = 4x^2$

Answer the following questions:

- (a) How did each parabola compare to the previous parabola?

→ the higher the coefficient of x^2 , the taller and skinnier the parabola

- (b) Sketch the four parabolas on the grid below. Label each parabola with its equation.



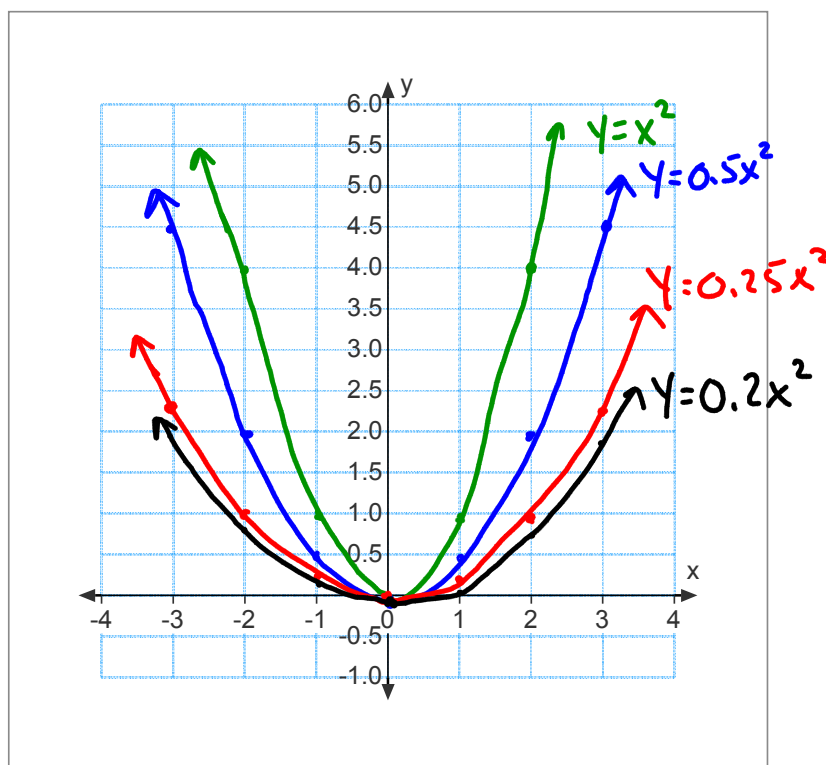
Investigation 2

Clear your previous equations and graph the following four equations on the same grid.

1. $y = x^2$
2. $y = 0.5x^2$
3. $y = 0.25x^2$
4. $y = 0.2x^2$

Answer the following questions:

- (a) How did each parabola compare to the previous parabola?
→ the smaller the decimal, the flatter and wider the parabola
- (b) Sketch the four parabolas on the grid below. Label each parabola with its equation.



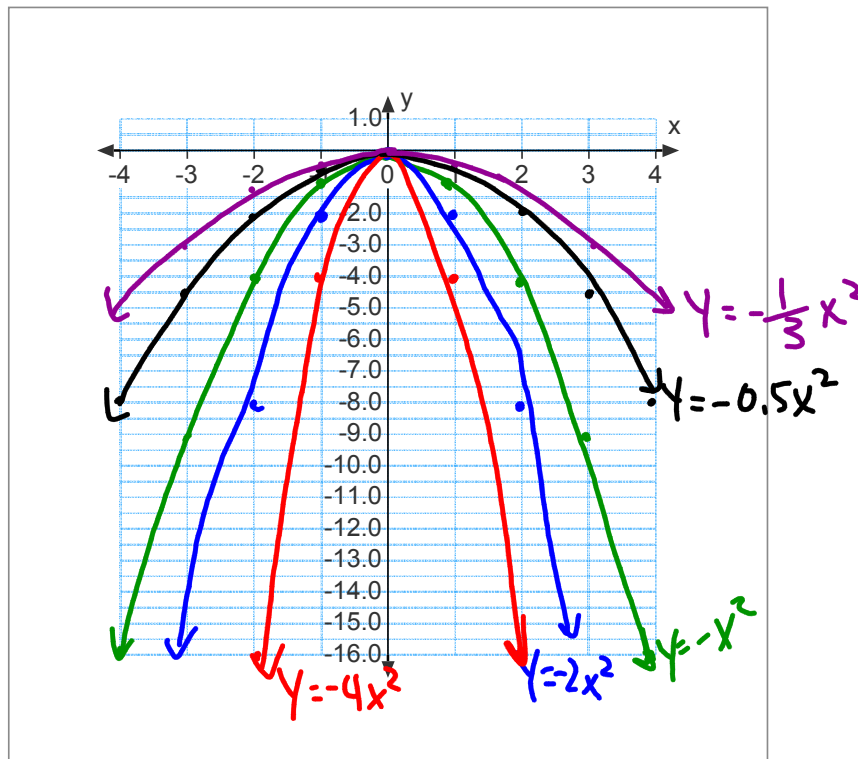
Investigation 3

Clear your equations. In Desmos, graph the following four equations on the same grid.


1. $y = -x^2$
2. $y = -2x^2$
3. $y = -4x^2$
4. $y = -(0.5)x^2$
5. $y = -(1/3)x^2$

Answer the following questions:

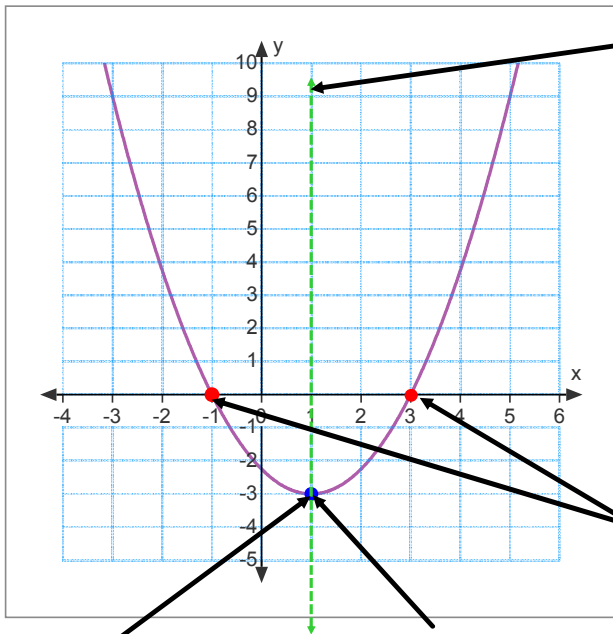
- (a) How did each parabola compare to the previous parabola?
 - negative sign makes the parabola open down
 - numbers larger than 1 stretch the parabola (taller, skinnier)
 - fractions less than 1, compress the parabola (wider, flatter)
- (b) Sketch the five parabolas on the grid below. Label each parabola with its equation.



Reflect: Given a quadratic equation of the form $y = ax^2$, describe the effect of a on the graph of $y = x^2$.

- if a is negative, the graph.... *opens down* 
- if a is between 0 and 1 (ie. decimal or fraction), the graph... *is compressed (wider, flatter)*
- if a is greater than 1, the graph... *is stretched (taller, skinnier)*

The Key Features of a Parabola



Axis of Symmetry

- the vertical line that passes through the vertex
- the line of symmetry (mirror)
- the equation of the axis of symmetry is $x = h$ where h is the x-coordinate of the vertex

x-intercepts (zeros)

- the x-coordinate(s) of the point(s) at which the parabola crosses the x-axis

Vertex

- the point at which the parabola changes direction

Maximum/Minimum

- the greatest/least y-value on the graph
- the y-value at the vertex

Example 1

Identify the following for the quadratic relation shown:

- (a) the coordinates of the vertex

$$(x, y) = (-1, -4)$$

- (b) the equation of the axis of symmetry

$$x = -1$$

- (c) the y-intercept

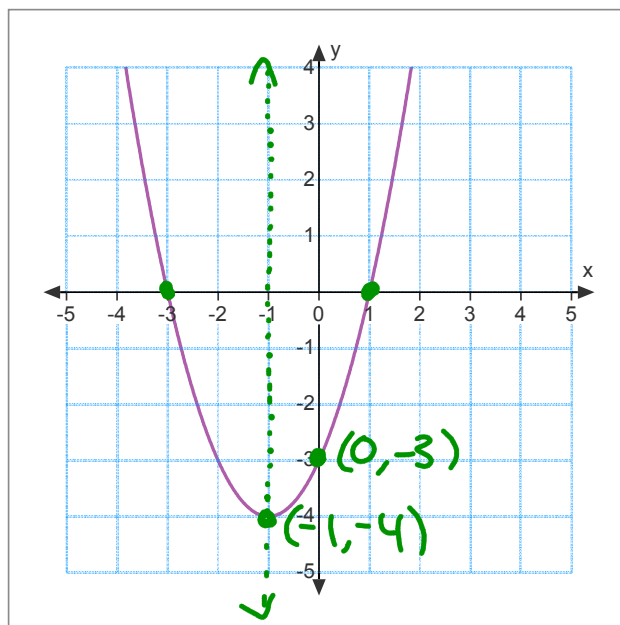
$$(0, -3)$$

- (d) the maximum or minimum value

Minimum of -4

- (e) the x-intercepts

-3 and 1



Example 2

A quadratic relation is given by the equation $y = 2x^2 - 4x + 6$.

- (a) Use Desmos to graph the equation.
- (b) Identify the maximum or minimum value and the coordinates of the vertex.

minimum of 4
vertex: (1, 4)

- (c) Write the equation of the axis of symmetry.

$$x = 1$$

- (d) Identify the y-intercept.

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- (e) Identify the x-intercepts.

there are none

Homework:
Section 6.3 Handout

Note: When the homework says "use a graphing calculator", you are to use DESMOS