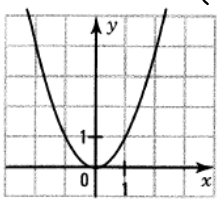
QUADRATIC FUNCTIONS

The basic quadratic function: $f(x) = x^2$

$y = ax^2$

The graph is a parabola with vertex (o, o)



Domain:
Range:
y-intercept:
Zero:
Increasing:
Decreasing:
Positive:
Negative:
Minimum:

Axis of symetry: x=o

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TRANSFORMED QUADRATIC FUNCTION

$f(x) = ax^2$

Parameter a: the sign of parameter a determines if the parabola opens upwards or downwards

+ *a > o : the parabola opens upwards*
− *a< o : the parabola opens downwards*

Furthermore the absolute value of "a" determines the opening of the parabola

***Note: absolute value means the positive value*

a > 1 : the parabola's opening gets narrower
a < 1 : the parabola's opening gets wider

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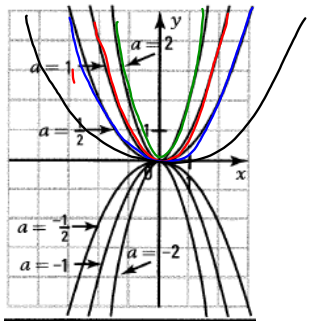

https://www.mathsisfun.com/algebra/quadratic-equation-graph.html

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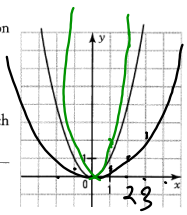
Consider the basic quadratic function $y = x^2$ and the function $f(x) = ax^2$ $(a > 0)$.

1. Represent function f when
   1) $a = \frac{1}{4}$. 2) $a = \frac{1}{2}$. 3) $a = 2$.
2. As parameter a increases, do you observe a vertical stretch or reduction of the parabola?



$y = 2(2)^2$

$y = \frac{1}{4}(2)^2$

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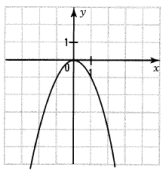
b) Consider the quadratic function $y = -x^2$ and the function $f(x) = ax^2$ $(a < 0)$.

1. Represent function f when
   1) $a = -\frac{1}{4}$. 2) $a = -\frac{1}{2}$. 3) $a = -2$.
2. As the absolute value of parameter a increases, do you observe a vertical stretch or reduction?



c) Consider the parabola with equation $y = ax^2$.
Is the parabola open upward or downward when

1. $a > 0$? _____ 2. $a < 0$? _____

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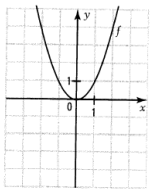
The graph of the function $f(x) = x^2$ is drawn on the right. Deduce the graph of

a) $g(x) = \frac{1}{4}x^2$. b) $h(x) = \frac{3}{2}x^2$.
c) $i(x) = -x^2$. d) $j(x) = -2x^2$.



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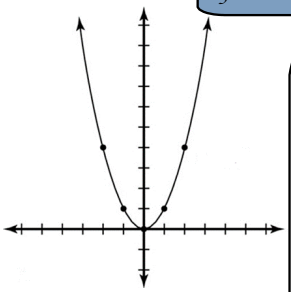
FINDING THE RULE FOR A QUADRATIC

$f(x) = ax^2$



Steps:

1. Start with the base equation $f(x) = ax^2$
2. Plug in an x and y value
3. Solve for a
4. Use rule to answer question

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1. A parabola is defined by the equation $y = ax^2$ and passes through the point A(-4, 8). Point B on this parabola has an x-coordinate of 6.

What is the y-coordinate of point B?

$y = ax^2$

$8 = a(-4)^2$

$\frac{8}{16} = \frac{16a}{16}$

$0.5 = a$

$y = 0.5 \times 2$

$y = 0.5(6)^2$

$y = 18$

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2. A table of values for the quadratic function g(x) is given.

What is the rule of function g(x)? _____

x	g(x)
0	0
5	37.5
8	96

$f(x) = ax^2$

$37.5 = a(5)^2$

$\frac{37.5}{25} = \frac{25a}{25}$

$a = 1.5$

$f(x) = 1.5x^2$

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3. A pebble is dropped into a well.

The table of values illustrates the quadratic function, which gives the distance travelled by the pebble (in m) as a function of the drop time (in seconds).

Drop time (sec)	Distance travelled (m)
0	0
1	5
2	20

Determine the drop time if the well has a depth of 180 m.

$y = ax^2$

$5 = a(1)^2$

$5 = a$

$a = 5$

$20 = a(2)^2$

$\frac{20}{4} = \frac{4a}{4}$

$a = 5$

$\frac{180}{5} = \frac{5x^2}{5}$

$\sqrt{36} = \sqrt{x^2}$

$6 = x$

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4. Aiden is celebrating his birthday by setting off a rocket. The height of the rocket he launches varies with time according to a quadratic function. Some of the values of this function are shown in the table below.

x	Time (seconds)	2	4	6	10
y	Height (metres)	16	64	144	400

The rocket is designed to explode when it reaches a height of 1600 metres.

How many seconds after launch will the rocket explode?

$y = ax^2$

$16 = a(2)^2$

$\frac{16}{4} = \frac{4a}{4}$

$4 = a$

$y = 4x^2$

$\frac{1600}{4} = \frac{4x^2}{4}$

$\sqrt{400} = \sqrt{x^2}$

$20 = x$

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