

$$y = x^2 + k$$

$$\boxed{y = ax^2 + k}$$

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Investigation 1: $y = x^2 + k$, when k is positive**(a) Graph $y = x^2$ and $y = x^2 + 1$ on the same axes.**

Compare the two parabolas,

(i) how are they similar?

- same shape
- same opening direction
- same axis of symmetry

(ii) how are they different?

- different vertices
- different minimum values.

(b) Graph $y = x^2$ and $y = x^2 + 3$ on the same axes.

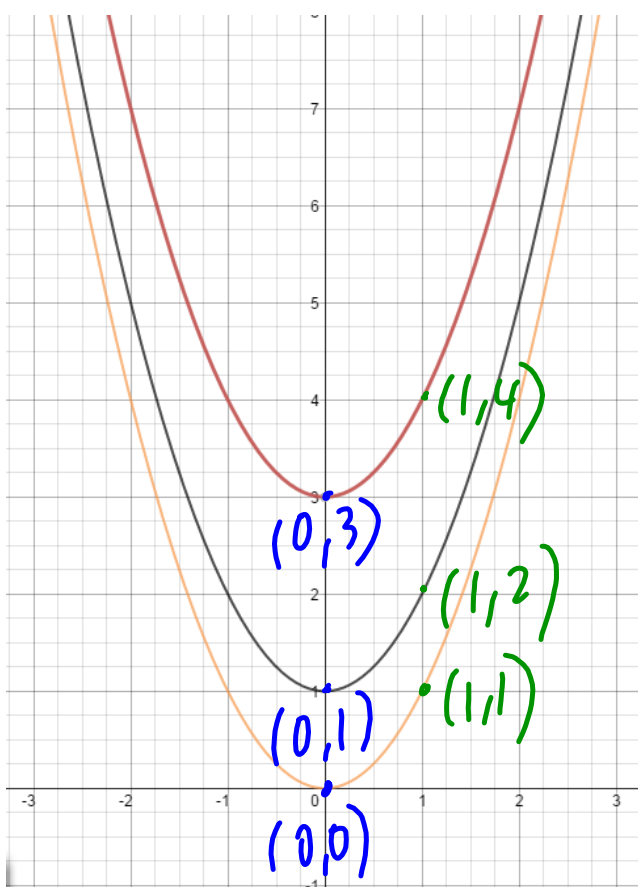
Compare the two parabolas,

(i) how are they similar?

- same shape
- same opening direction
- same axis of symmetry

(ii) how are they different?

- different vertices
- different minimum values.



$$y = x^2 + 3$$

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y (0, 0+3)

$$y = x^2 + 1$$

(0, 0+1)

$$y = x^2 + 5$$

(0, 5)
(1, 6)

Investigation 2: $y = x^2 + k$, when k is negative**(a) Graph $y = x^2$ and $y = x^2 - 2$ on the same axes.**

Compare the two parabolas,

(i) how are they similar?(ii) how are they different?

- same shape
- same opening direction
- same axis of symmetry

- different vertices
- different minimum values.

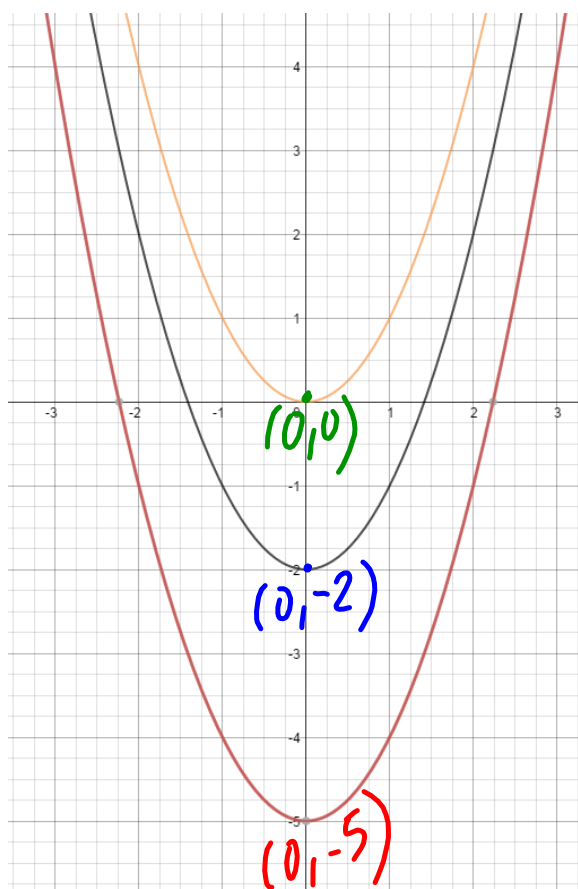
(b) Graph $y = x^2$ and $y = x^2 - 5$ on the same axes.

Compare the two parabolas,

(i) how are they similar?(ii) how are they different?

- same shape
- same opening direction
- same axis of symmetry

- different vertices
- different minimum values.

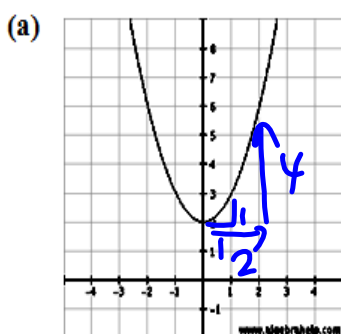


When k is negative, the graph of the quadratic relation $y = x^2 + k$ can be obtained from the graph of $y = x^2$ by a vertical translation of k units downward, below the x -axis.

(i.e. when $k < 0$, the graph of $y = x^2$ is shifted downward by k units, below the x -axis.)

The vertex of $y = x^2 + k$ is at $(0, k)$ and its y -intercept is k .

1. For each of the following parabolas, state the vertex, y -intercept, axis of symmetry and equation for the quadratic relation.



x	x^2
0	0
1	1
2	4

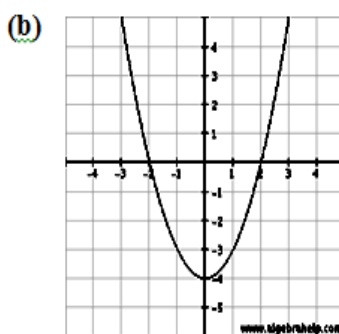
vertex = $(0, 2)$

y -intercept = 2

axis of symmetry:

$x = 0$

$y = x^2 + 2$



vertex = $(0, -4)$

y -intercept = -4

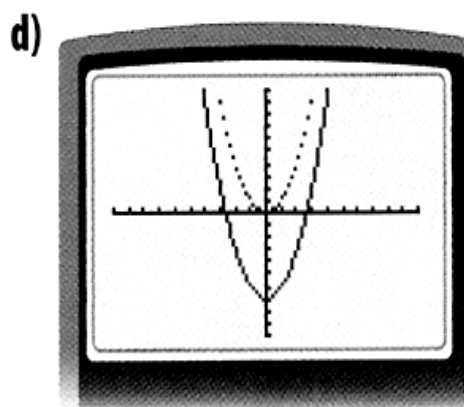
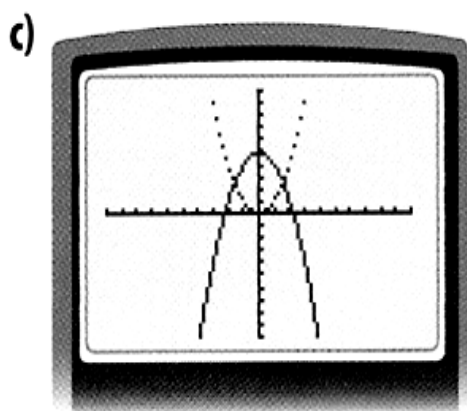
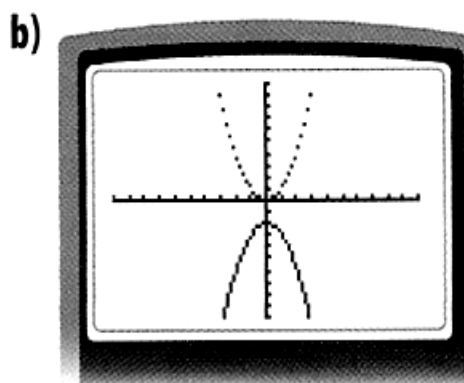
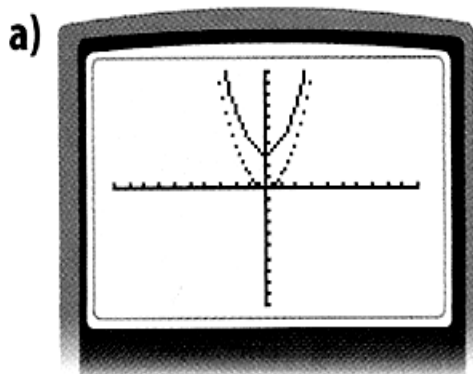
axis of symmetry

$x = 0$

$y = x^2 - 4$

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2. In each standard viewing window, the graph of $y = x^2$ is shown as a dotted parabola and the graph of a relation of the form $y = ax^2 + k$ is shown as a solid parabola. For each solid parabola, is k positive or negative? Explain.



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5. In each standard viewing window, the graph of $y = x^2$ is shown as a dotted parabola. Describe the shape and position of each solid parabola relative to the graph of $y = x^2$ in terms of a and k .

