

## 3.1 Quadratic Functions

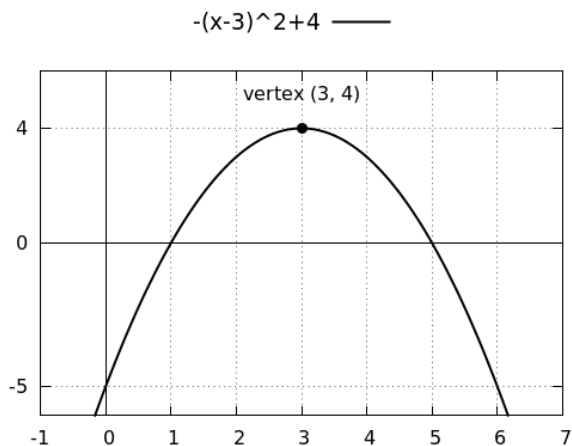
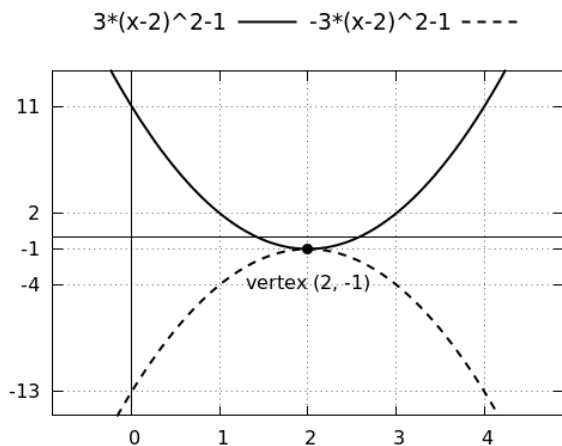
### Supplementary Notes

$$f(x) = \underbrace{ax^2 + bx + c}_{\text{expanded form}} = \underbrace{a(x - h)^2 + k}_{\text{vertex form}} \quad (a \neq 0)$$

The graph of  $f$  is a *parabola* with the following properties

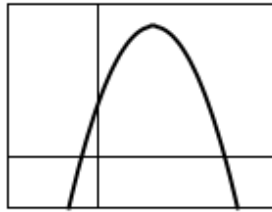
- opens  $\begin{cases} \text{up} & \text{if } a > 0 \\ \text{down} & \text{if } a < 0 \end{cases}$
- vertex  $(h, k) = \left(-\frac{b}{2a}, f\left(-\frac{b}{2a}\right)\right) = \left(-\frac{b}{2a}, c - \frac{b^2}{4a}\right)$
- $\begin{cases} 0 \\ 1 \\ 2 \end{cases}$   $x$ -intercepts if  $b^2 - 4ac$  is  $\begin{cases} < 0 \\ = 0 \\ > 0 \end{cases}$
- $y$ -intercept  $f(0) = c = ah^2 + k$
- vertical axis of symmetry  $x = h$
- minimum value of  $k$

Below are the graphs of  $f(x) = \pm 3(x - 2)^2 - 1$  and  $f(x) = -(x - 3)^2 + 4$ .



### Exercises

1. Find the vertex of the graph of  $f(x) = x^2 - 6x + 10$ .
2. Find the minimum or maximum value of  $f(x) = x^2 - 2x + 4$ .
3. Write (with lowercase  $x$  and  $y$ ) the equation of the parabola with vertical axis and with vertex  $(-1, 2)$  and  $y$ -intercept  $-4$ .



4. Select the equation of the following graph ( $c$  is a constant)

- A.  $4x^2 + 5x + c$
- B.  $4x^2 - 5x + c$
- C.  $-4x^2 + 5x + c$
- D.  $-4x^2 - 5x + c$