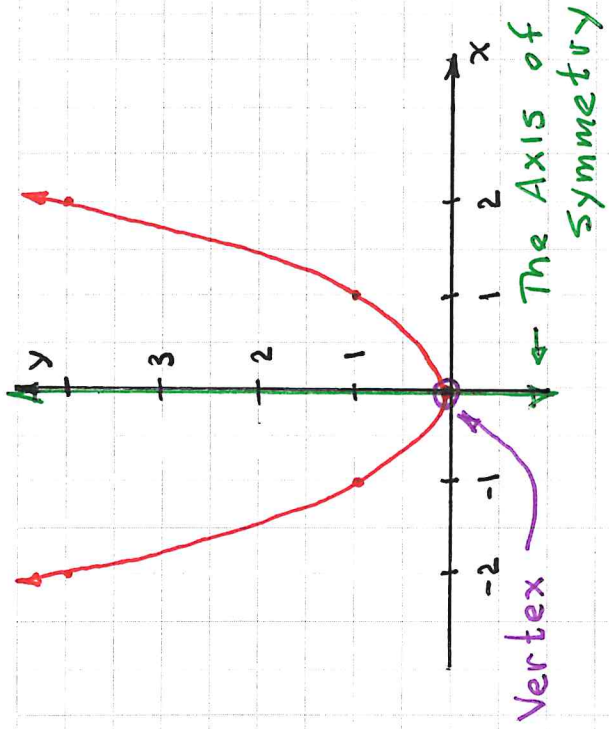


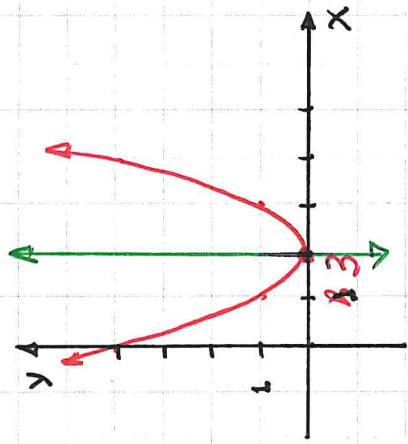
2.1 Quadratic Functions

Recall that $f(x) = x^2$ is one of the parent functions. Its graph is a parabola. The y-axis is its axis of symmetry and its vertex is located at $(0,0)$.



Ex. ① Sketch the graphs of the following functions.

a) $g(x) = (x-3)^2$

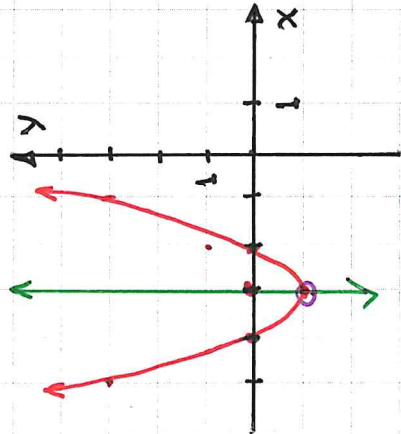


Vertex: $(3,0)$

Axis: $x = 3$

x-intercepts: $x = 3$

b) $h(x) = (x+3)^2 - 1$

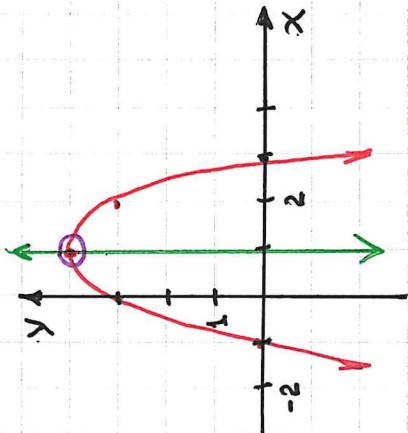


Vertex: $(-3,-1)$

Axis: $x = -3$

x-intercepts: $x = -2, -4$

c) $m(x) = -(x-1)^2 + 4$



Vertex: $(1,4)$

Axis: $x = 1$

x-intercepts: $x = -1, 3$

The Quadratic Function $f(x) = a(x-h)^2 + k$ is in Standard Form.

The graph is a parabola with vertex (h, k) and axis of symmetry $x=h$. When $a > 0$ the graph opens upward. When $a < 0$ the graph opens downward.

Expand and
Ex. ② Simplify: $h(x) = (x+3)^2 - 1$

Solution: $h(x) = x^2 + 6x + 9 - 1 = x^2 + 6x + 8$

The Quadratic Function $f(x) = ax^2 + bx + c$ is in General Form.

Ex. ③ For the function $f(x) = x^2 - 2x - 3$, find:

a) The coordinates of the vertex.

For $f(x) = ax^2 + bx + c$, the vertex has

x-coordinate $-\frac{b}{2a}$ and y-coordinate $f\left(-\frac{b}{2a}\right)$

So, $x = \frac{-(-2)}{2(1)} = 1$ and $y = f(1) = 1^2 - 2(1) - 3 = -4$

Vertex: $(1, -4)$

b) The axis of symmetry: $x=1$

c) The x-intercepts: $y=f(x)=0$

Solve: $x^2 - 2x - 3 = 0$

$$(x+1)(x-3) = 0$$

$$\boxed{x = -1, x = 3}$$

Ex. ④ Write the equation of the parabola $f(x) = -2x^2 - 4x + 5$

in Standard Form.

Find the vertex: $x = -\frac{b}{2a} = \frac{4}{-4} = -1, y = f(-1) = 7$

$$\boxed{f(x) = -2(x+1)^2 + 7}$$

Ex. ⑤ Write an equation of the parabola with vertex $(3, -2)$ and whose graph passes through the point $(0, 4)$.

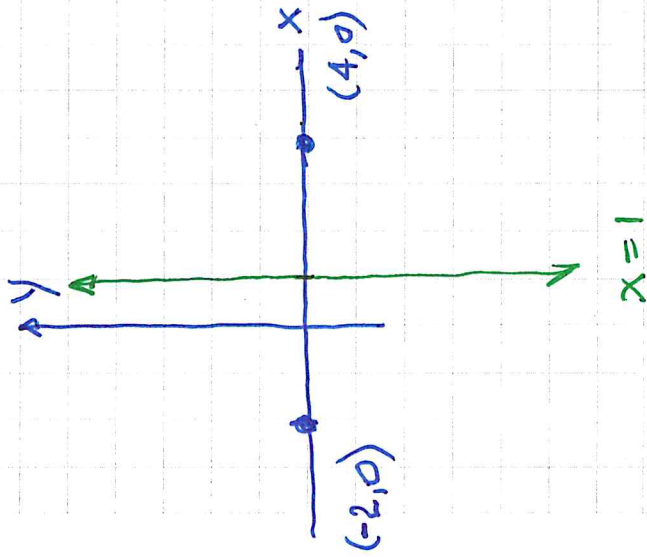
Since the vertex is $(3, -2)$ then $h=3$ and $k=-2$

So $f(x) = a(x-3)^2 - 2 \Rightarrow 4 = a(0-3)^2 - 2$

$\Rightarrow 4 = 9a - 2 \Rightarrow a = \frac{6}{9} = \frac{2}{3}$

$$\boxed{f(x) = \frac{2}{3}(x-3)^2 - 2}$$

Ex. ⑥ Write a quadratic function whose graph has x-intercepts at $(4,0)$ and $(-2,0)$.



We know that $f(x) = (x-4)(x+2)$

$$\text{So, } f(x) = x^2 - 2x - 8$$