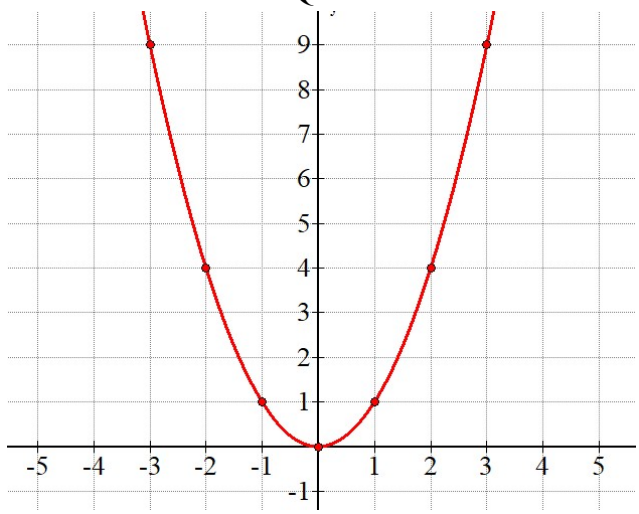
MODULE 7 LESSON 2 NOTES

GRAPHING QUADRATIC FUNCTIONS

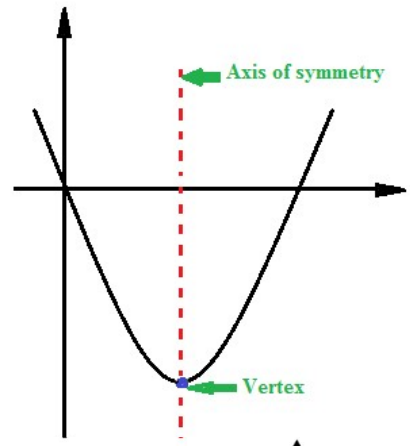
The mother function: $g(x) = x^2$

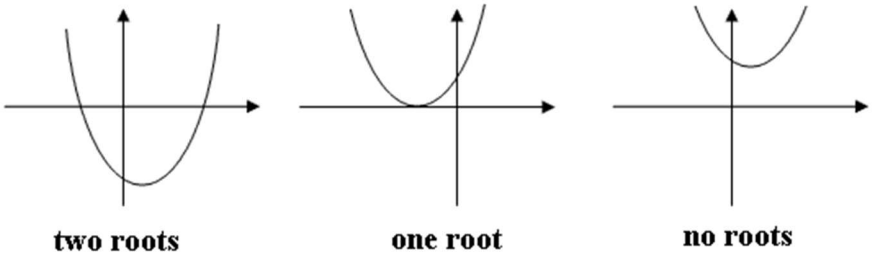
x	y
-3	9
-2	4
-1	1
0	0
1	1
2	4
3	9

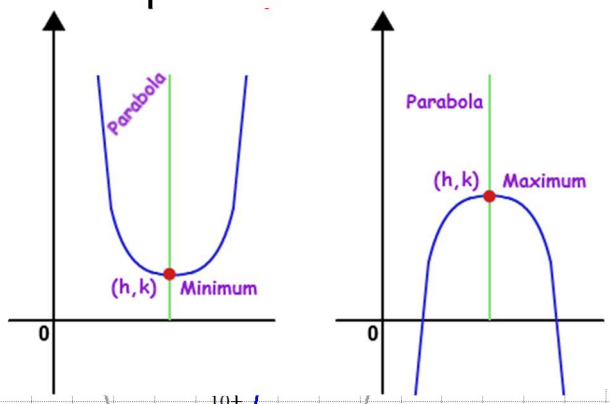


$f(x) = a(x-h)^2 + k$

1) The vertex is the point where the graph turns around and heads back the direction it came from. This should be the point (h, k).
2) The vertex is a minimum if the parabola opens up ($a > 0$). The vertex is a maximum if the parabola opens down ($a < 0$).
3) The axis of symmetry is the vertical line through the vertex, $x = h$.
4) The roots are where the parabola crosses the x-axis.







1) $f(x) = x^2 + 6x + 7$

$f(x) = (x^2 + 6x \qquad) + 7$

$\left(\frac{6}{2}\right)^2 = (3)^2 = 9$

$f(x) = (x^2 + 6x + 9) + 7 - 9$

$f(x) = (x+3)^2 - 2$

Vertex Form: $f(x) = (x+3)^2 - 2$

Vertex: $(-3, -2)$

Minimum or Maximum?

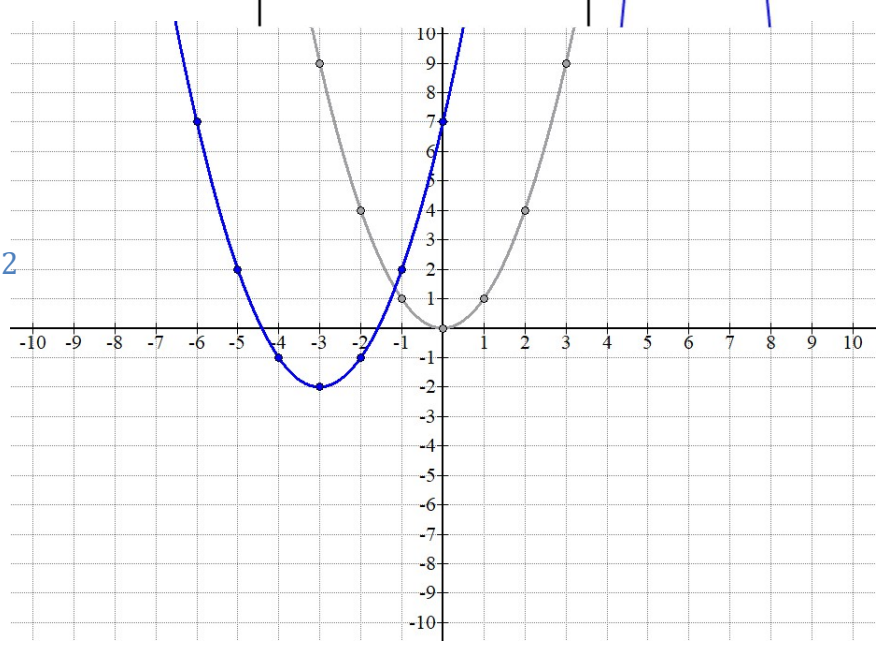
Axis of Symmetry: $x = -3$

Roots: Between -5 and -4

Between -2 and -1

Domain: $(-\infty, \infty)$

Range: $[-2, \infty)$



2) $f(x) = x^2 + 4x + 4$

$f(x) = (x^2 + 4x \qquad) + 4$

$\left(\frac{4}{2}\right)^2 = (2)^2 = 4$

$f(x) = (x^2 + 4x + 4) + 4 - 4$

$f(x) = (x + 2)^2$

Vertex Form: $f(x) = (x + 2)^2$

Vertex: $(-2, 0)$

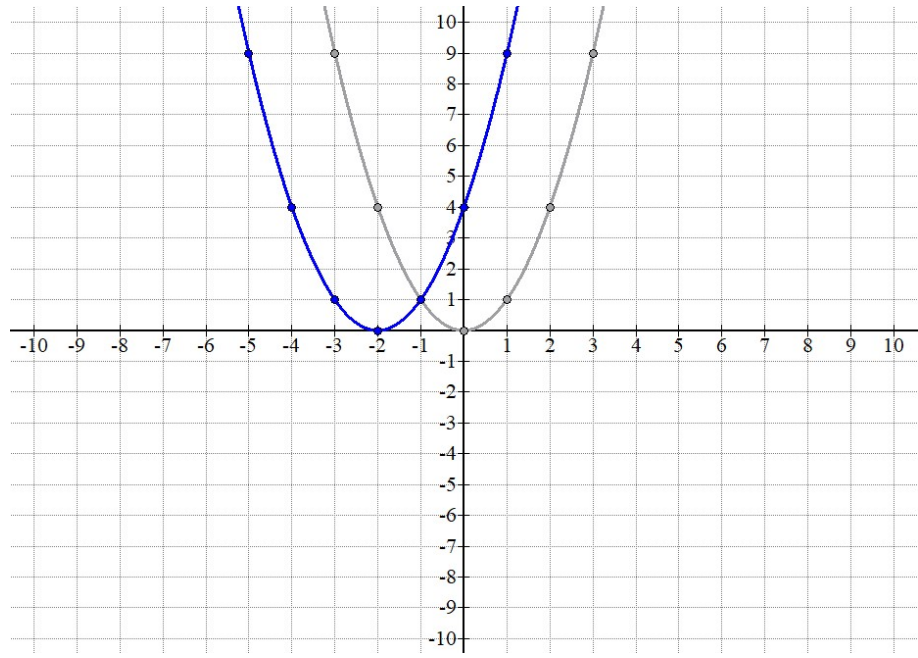
Minimum or Maximum?

Axis of Symmetry: $x = -2$

Roots: At -2

Domain: $(-\infty, \infty)$

Range: $[0, \infty)$



3) $f(x) = x^2 - 4$

Vertex Form: $f(x) = x^2 - 4$

Vertex: $(0, -4)$

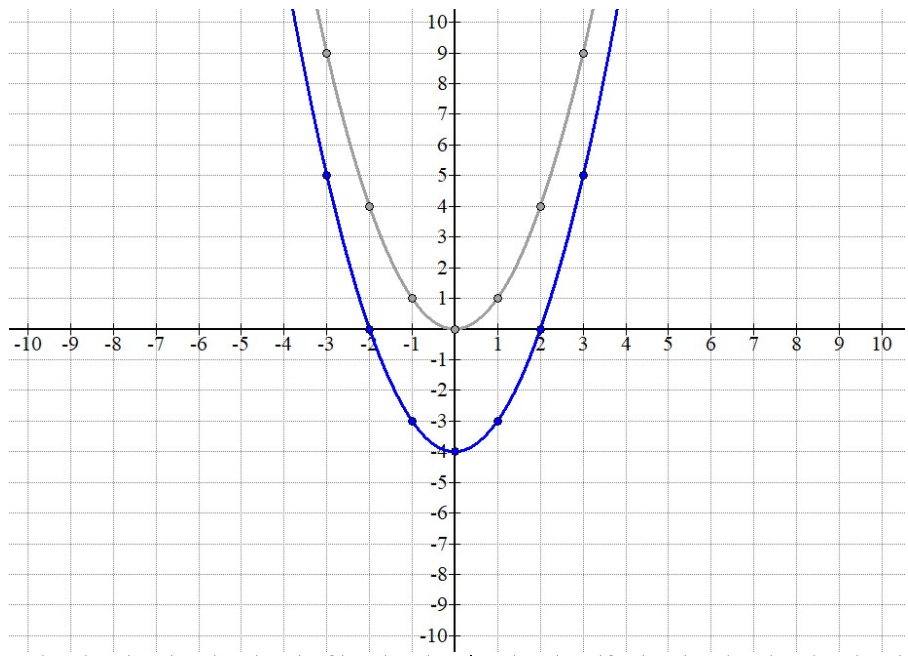
Minimum or Maximum?

Axis of Symmetry: $x = 0$

Roots: At -2 and 2

Domain: $(-\infty, \infty)$

Range: $[-4, \infty)$



4) $f(x) = -x^2 - 4x - 5$

$f(x) = -(x^2 + 4x \qquad) - 5$

$\left(\frac{4}{2}\right)^2 = (2)^2 = 4$

$f(x) = -(x^2 + 4x + 4) - 5 + 4$

$f(x) = -(x + 2)^2 - 1$

Vertex Form: $f(x) = -(x + 2)^2 - 1$

Vertex: $(-2, -1)$

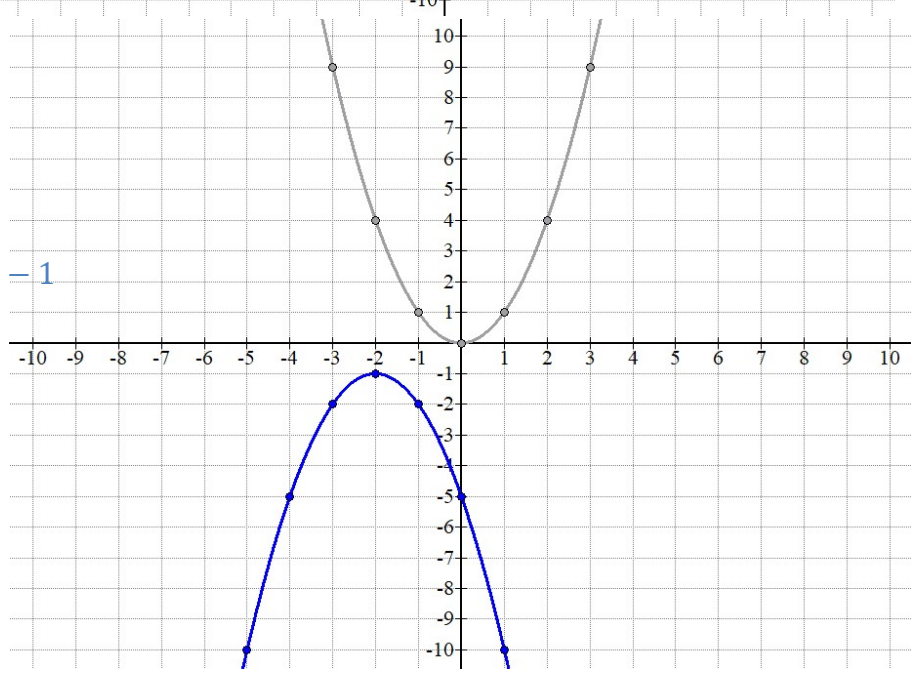
Minimum or Maximum?

Axis of Symmetry: $x = -2$

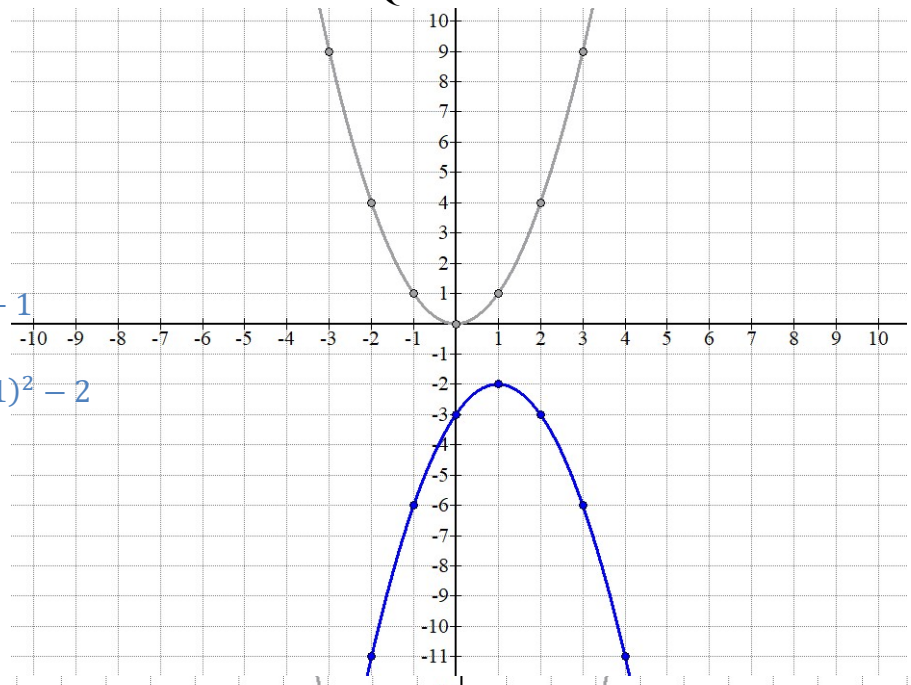
Roots: None

Domain: $(-\infty, \infty)$

Range: $(-\infty, -1]$



5) $f(x) = -x^2 + 2x - 3$



$f(x) = -(x^2 - 2x \qquad) - 3$

$\left(\frac{-2}{2}\right)^2 = (-1)^2 = 1$

$f(x) = -(x^2 - 2x + 1) - 3 + 1$

$f(x) = -(x - 1)^2 - 2$

Vertex Form: $f(x) = -(x - 1)^2 - 2$

Vertex: $(1, -2)$

Minimum or Maximum?

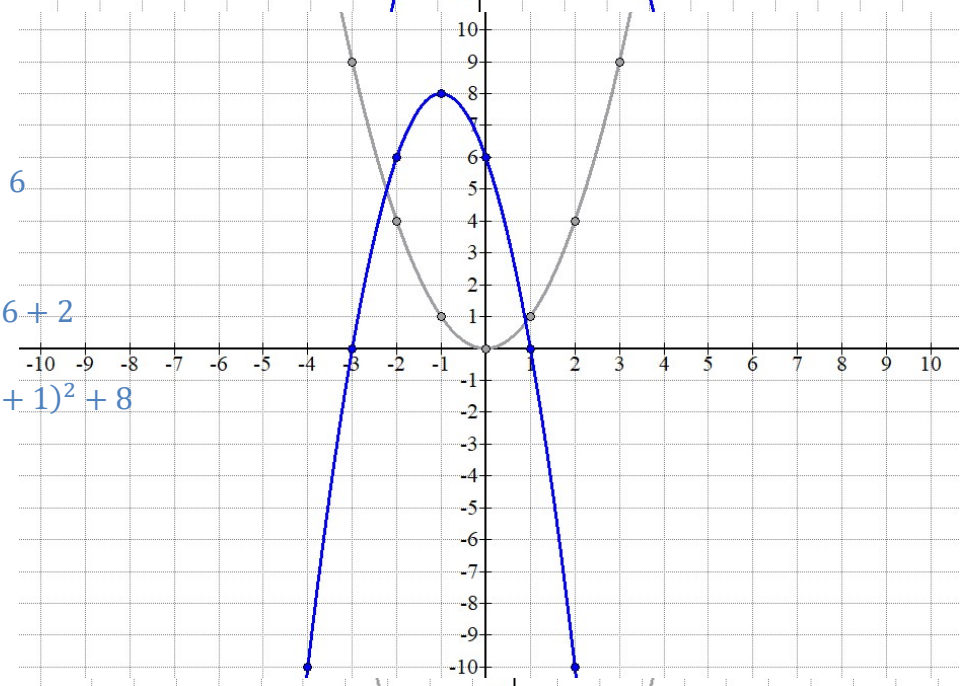
Axis of Symmetry: $x = 1$

Roots: None

Domain: $(-\infty, \infty)$

Range: $(-\infty, -2]$

6) $f(x) = -2x^2 - 4x + 6$



$f(x) = -2(x^2 + 2x \qquad) + 6$

$\left(\frac{2}{2}\right)^2 = (1)^2 = 1$

$f(x) = -2(x^2 + 2x + 1) + 6 + 2$

$f(x) = -2(x + 1)^2 + 8$

Vertex Form: $f(x) = -2(x + 1)^2 + 8$

Vertex: $(-1, 8)$

Minimum or Maximum?

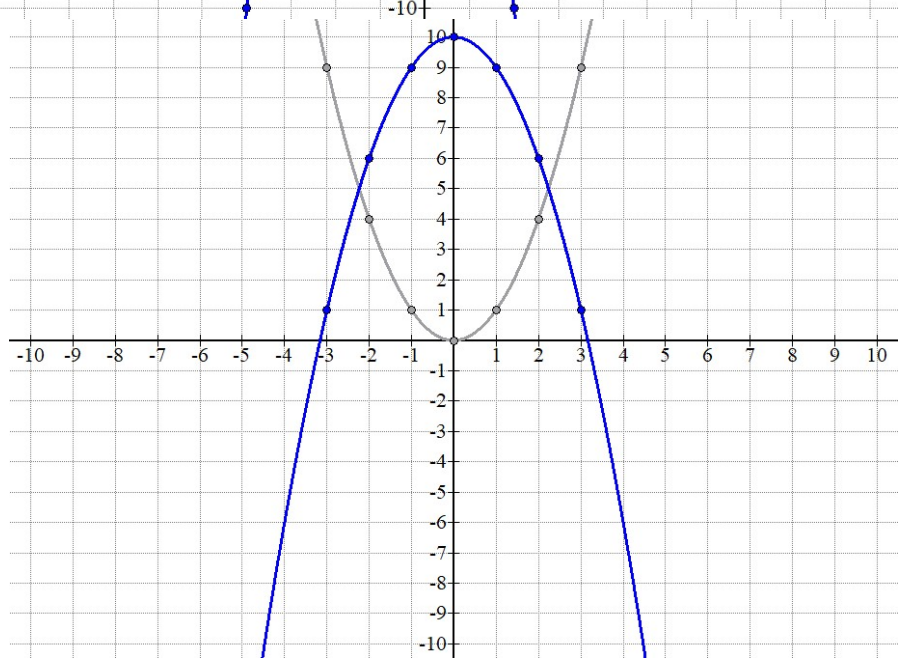
Axis of Symmetry: $x = -1$

Roots: At -3 and 1

Domain: $(-\infty, \infty)$

Range: $(-\infty, 8]$

7) $f(x) = -x^2 + 10$



Vertex Form: $f(x) = -x^2 + 10$

Vertex: $(0, 10)$

Minimum or Maximum?

Axis of Symmetry: $x = 0$

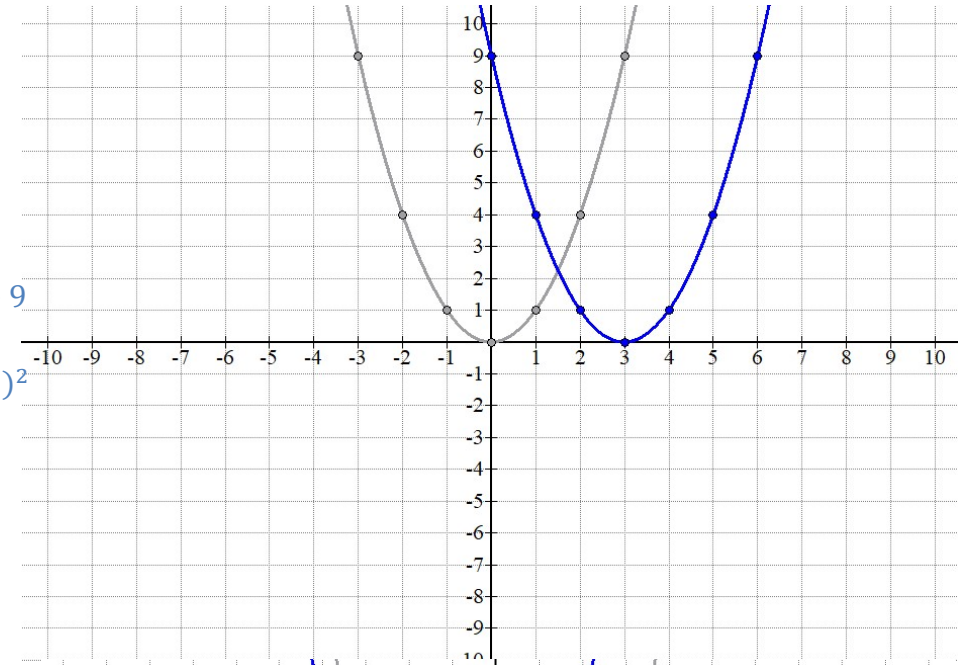
Roots: Between -4 and -3

Between 3 and 4

Domain: $(-\infty, \infty)$

Range: $(-\infty, 10]$

8) $f(x) = x^2 - 6x + 9$



$f(x) = (x^2 - 6x \qquad) + 9$

$\left(\frac{-6}{2}\right)^2 = (-3)^2 = 9$

$f(x) = (x^2 - 6x + 9) + 9 - 9$

$f(x) = (x - 3)^2$

Vertex Form: $f(x) = (x - 3)^2$

Vertex: $(3, 0)$

Minimum or Maximum?

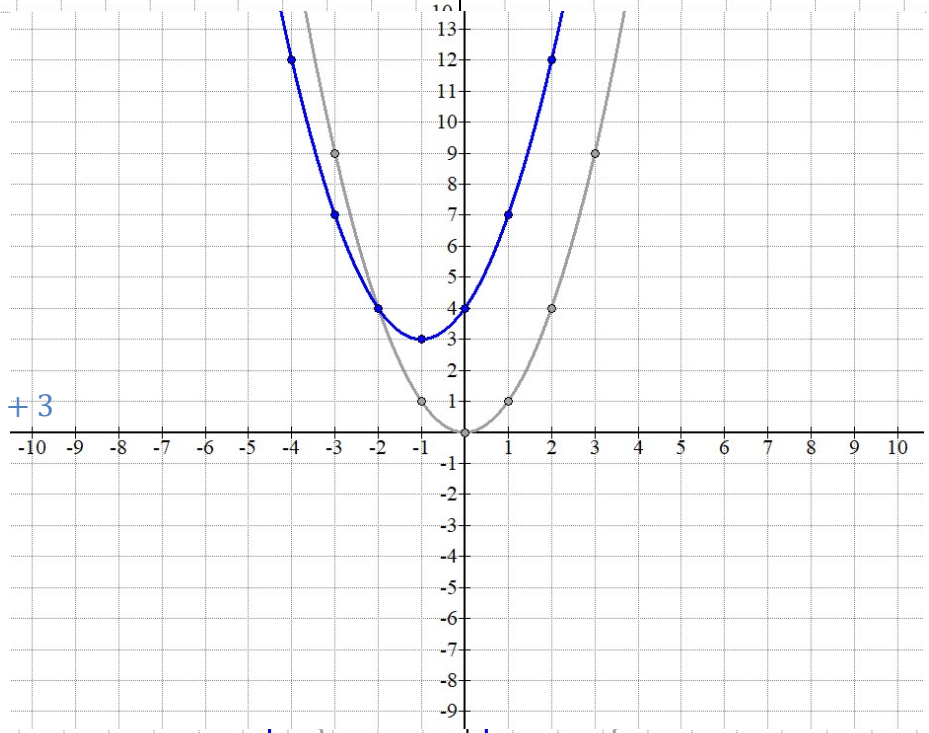
Axis of Symmetry: $x = 3$

Roots: At 3

Domain: $(-\infty, \infty)$

Range: $[0, \infty)$

9) $f(x) = x^2 + 2x + 4$



$f(x) = (x^2 + 2x \qquad) + 4$

$\left(\frac{2}{2}\right)^2 = (1)^2 = 1$

$f(x) = (x^2 + 2x + 1) + 4 - 1$

$f(x) = (x + 1)^2 + 3$

Vertex Form: $f(x) = (x + 1)^2 + 3$

Vertex: $(-1, 3)$

Minimum or Maximum?

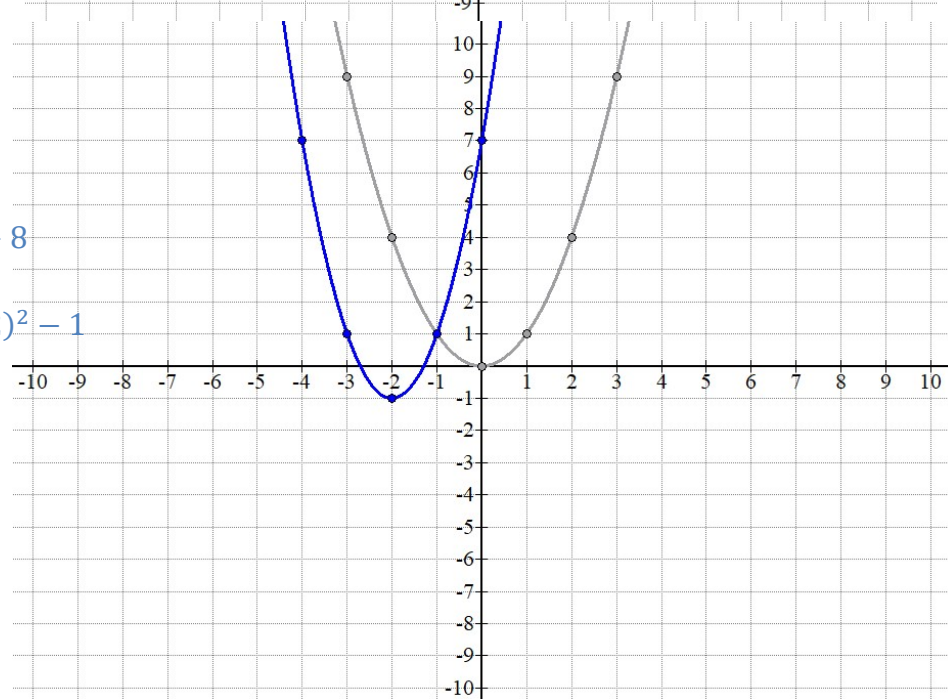
Axis of Symmetry: $x = -1$

Roots: None

Domain: $(-\infty, \infty)$

Range: $[3, \infty)$

10) $f(x) = 2x^2 + 8x + 7$



$f(x) = 2(x^2 + 4x \qquad) + 7$

$\left(\frac{4}{2}\right)^2 = (2)^2 = 4$

$f(x) = 2(x^2 + 4x + 4) + 7 - 8$

$f(x) = 2(x + 2)^2 - 1$

Vertex Form: $f(x) = 2(x + 2)^2 - 1$

Vertex: $(-2, -1)$

Minimum or Maximum?

Axis of Symmetry: $x = -2$

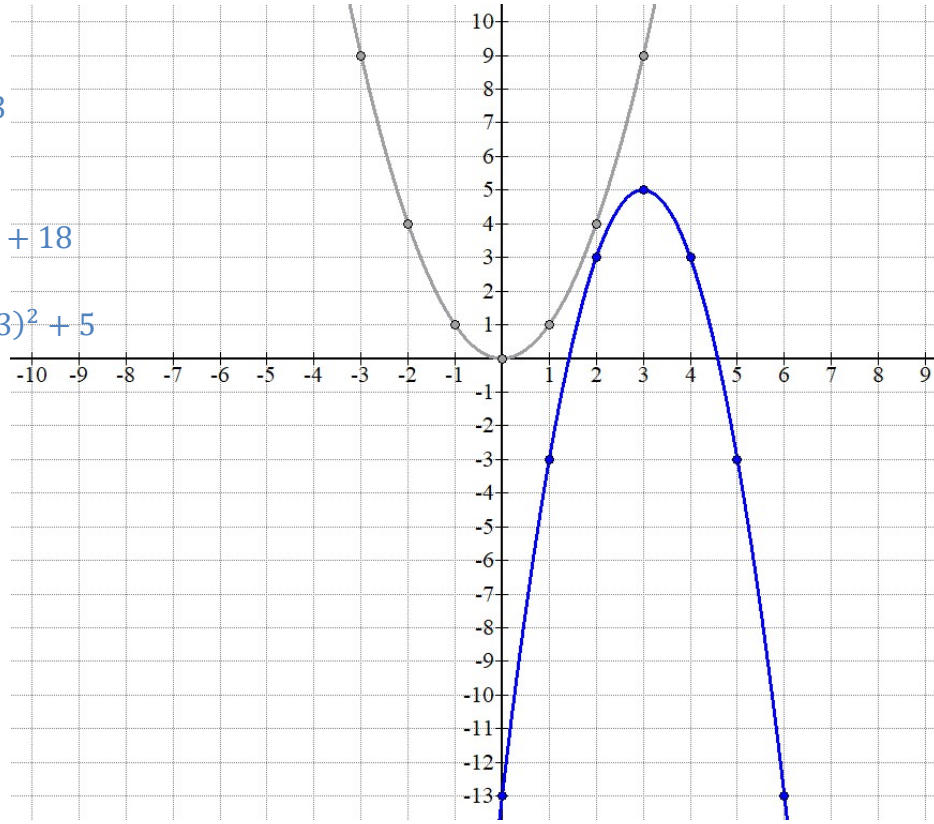
Roots: Between -3 and -2

Between -2 and -1

Domain: $(-\infty, \infty)$

Range: $[-1, \infty)$

11) $f(x) = -2x^2 + 12x - 13$



$f(x) = -2(x^2 - 6x \qquad) - 13$

$\left(\frac{-6}{2}\right)^2 = (-3)^2 = 9$

$f(x) = -2(x^2 - 6x + 9) - 13 + 18$

$f(x) = -2(x - 3)^2 + 5$

Vertex Form: $f(x) = -2(x - 3)^2 + 5$

Vertex: $(3, 5)$

Minimum or Maximum?

Axis of Symmetry: $x = 3$

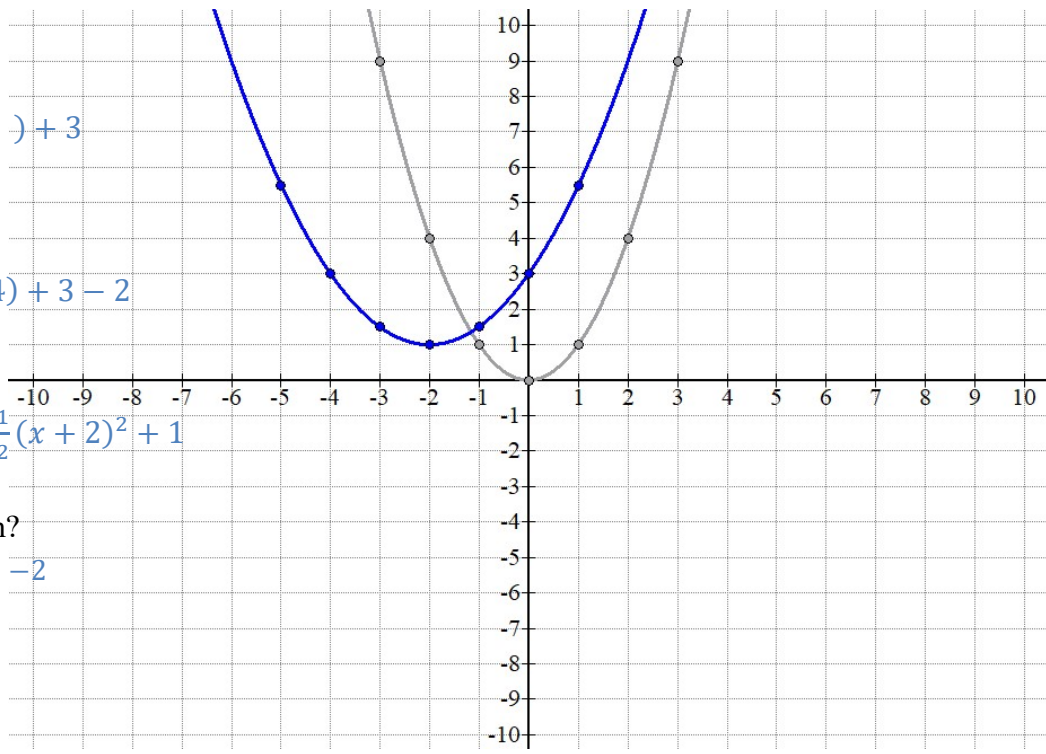
Roots: Between 1 and 2

Between 4 and 5

Domain: $(-\infty, \infty)$

Range: $(-\infty, 5]$

12) $f(x) = \frac{1}{2}x^2 + 2x + 3$



$f(x) = \frac{1}{2}(x^2 + 4x \qquad) + 3$

$\left(\frac{4}{2}\right)^2 = (2)^2 = 4$

$f(x) = \frac{1}{2}(x^2 + 4x + 4) + 3 - 2$

$f(x) = \frac{1}{2}(x + 2)^2 + 1$

Vertex Form: $f(x) = \frac{1}{2}(x + 2)^2 + 1$

Vertex: $(-2, 1)$

Minimum or Maximum?

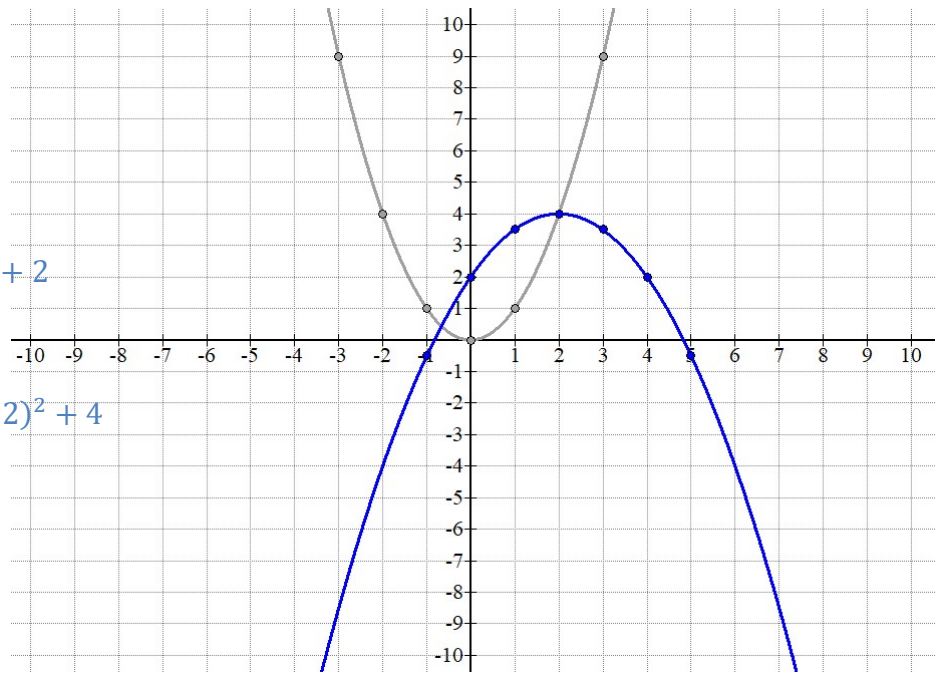
Axis of Symmetry: $x = -2$

Roots: None

Domain: $(-\infty, \infty)$

Range: $[1, \infty)$

13) $f(x) = -\frac{1}{2}x^2 + 2x + 2$



$f(x) = -\frac{1}{2}(x^2 - 4x \qquad) + 2$

$\left(\frac{-4}{2}\right)^2 = (-2)^2 = 4$

$f(x) = -\frac{1}{2}(x^2 - 4x + 4) + 2 + 2$

$f(x) = -\frac{1}{2}(x - 2)^2 + 4$

Vertex Form: $f(x) = -\frac{1}{2}(x - 2)^2 + 4$

Vertex: $(2, 4)$

Minimum or Maximum?

Axis of Symmetry: $x = 2$

Roots: Between -1 and 0

Between 4 and 5

Domain: $(-\infty, \infty)$

Range: $(-\infty, 4]$